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THE EFFECTS OF ENVIRONMENTAL ASSAULTS ON HUMAN PHYSIOLOGY (1)

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It gives me great pleasure and joy to be invited as guest of honour to give this keynote address on this occasion of the 25th annual Scientific Conference and Silver Jubilee Celebration of the Physiological Society of Nigeria. The theme of this conference is “The effects of environmental assaults on human physiology”. This is very relevant now that we know the air, water (surface and underground) and land have been polluted as a result of human, manufacturing, oil / gas and related activities. You are aware that the Rivers State and indeed the Niger Delta is the most environmentally stressed.

The Federal Government of Nigeria and the Rivers State Government have put in place environmental laws, edicts, guidelines and standards; and regulations to check and improve environmental practice. These include amongst others :

FEPA Decree 58 of 1988

EIA Decree 86 of 1992

Environmental Guidelines and Standards for Control of Environmental Pollution (both Federal and State)

Rivers State Environmental Protection Edict No. 2 Of 1994

Rivers State Environmental Sanitation Edict of 1986.

S. 1.8 : National Environmental Protection (Effluent Limitation) Regulations 1991.

S. 1.9 : National Environmental Protection (Pollution Abatement in Industries and Facilities generating wastes) Regulations 1991

S. 1.15 : National Environmental Protection Management of solid and hazardous waste regulations 1991.

It is equally imperative to point out that environment is a global issue. The Agenda 21 is the International document on environment. The slogan used is “Think globally but act locally”. We are aware that environment is multi-disciplinary and multi-sectoral.

The theme consists of four concepts, viz.: effects, environmental, assaults and physiology. The

physiology of human being can be captured properly if we recall our concept of cell – the building block for all living organisms (plants and animals). You may recall that I have posited that the Rivers State is environmentally stressed and this exposes all of us to environmental assaults which have “effects” on “human physiology”. My assignment today will be to give a general overview of the theme and cite some examples of environmental assaults and their effects on human physiology in terms of diseases and death. Mine is a Keynote address, to be presented as one with an insight.

In the United States, for example, people born today, on the average have a life expectancy of about twice that of folks over a century ago. Most of these additional years have been gained by healthy environmental changes – indicating improved sanitation, purified water, cleaner air, the safer use of chemicals in our homes, gardens, factories and offices, and the restriction or elimination of unsafe practices. In other health-promoting steps, the United States and its states and cities, businesses and unions have worked together and removed lead from gasoline, and redesigned the gasoline pump to expose users to less benzene, which might increase the risk of cancer.

Removed from the market questionable products such as a laxative ingredient that tests showed could cause cancer. Restricted or removed from commerce many workplace chemicals, food dyes and pesticides because they pose a risk of sterility, cancer or other diseases

Recommended healthier food habits, e.g., advising pregnant women to avoid eating certain large ocean fish like shark and swordfish in which mercury accumulates.

In each case, these preventive measures did not just happen. They were put in place following studies by the National Institute of Environmental Health Services, National Toxicology Program and other similar laboratories of the United States. We therefore have a lot of work to do.

In Nigeria, all the above applies except that there is still the existence of gas flaring and some of the pesticides banned are still in the market – no wonder, life expectancy has dropped from the meagre 54 years in 2001 to 43 announced recently.

Persistent Organic Pollutants (POPs) are carbon containing chemical compounds that to a large degree, resist photochemical, biological and chemical degradation. POPs are halogenated and characterized by low water solubility and high lipid solubility, leading together with the persistence, to bioaccumulation in fatty tissues. They are also semi-volatile, a property which permits these compounds either to vaporize or to be adsorbed on atmospheric particles. They therefore undergo long range transport in air and water from warmer to colder regions of the world.

Although, many different chemicals, both natural and anthropogenic (i.e. produced by man), may be defined as POPs, 12 POPs, all chlorine-containing organic compounds have been chosen by the United Nations Environment Programme (UNEP) for their impact on human health and environment. The twelve POPs include: Adrin, Dieldrin, Endrin, Chlordane, DDT, Heptachlor, Mirex, Toxaphene, Hexachlorobenzene (HCB), PolyChlorinated Biphenyls (PCBs), Dioxins and furans. Out of the above listed nine are pesticides most of which, have been banned. Those who research into these readily get grants.

One of the results of the interest and the ensuing research is the banning of DDT, dioxin, PCB's and other harmful and persistent chemicals in the US and many countries including Nigeria. These and the rest of the "dirty dozen" chemicals linked to cancer, birth defects and impaired reproduction are being curtailed internationally under the Stockholm convention on Persistent Organic Pollutants (POPs) to which Nigeria is a participant.

Chemicals are the basis of our way of life and health today. There are about 15000 chemicals made and used in high volume worldwide. And there are many natural products herbal products, for example that have become widely marketed and used without testing.

Synthetic chemicals used on our farms, not only help feed us cheaply and well, they help feed much of the rest of the world. Chemical fibre clothes us. Chemicals cure us. They form key parts of our cars and our phones and computers, many building materials, rugs and other furnishings, you name it.

Just as fire can burn us as well as warm us, some chemicals, natural as well as made-made, can cause diseases. Most of us are familiar, at least in a

general way, with the evidence that tobacco smoking is a major cause of lung cancer, and other diseases.

Similar data in testing animals as well as population studies showed that asbestos causes mesothelioma (an unusual tumour of the linings of the chest and abdominal cavity) and lung cancer and increases in gastro-intestinal cancer. Another condition caused by asbestos is a chronic fibrous disease of the lung aptly called asbestosis. Nigeria still uses asbestos for roofing so on.

Scientists also discovered that a number of chemicals including the pesticides; kepone and dibromochloropropane were causing workers to become sterile. Some chemicals can also cause nerve damage. This resulted, in the case of kepone, in workers at a plant suffering nervous tremors, twitching and flickering eyes.

There has been a revolution in how we measure and study the impact of environmental agents on our health. Indeed, the chemists and water testers of yesterday would be surprised by the scenes at environmental health research centre today:

Cloned human genes are being set out in clusters on a glass slide to test suspected poisons. In the future, such technologies using clones of your genes may help predict how you, as an individual will react to a drug or other chemicals.

The blood and urine of groups of people representing the population, as a whole are being tested to see what chemicals these people have individually absorbed and

The genes of similar, representative groups are being studied to see what slight changes in their so-called "susceptibility" genes make them more or less susceptible to cigarette smoke, industrial chemical, pesticides and sunlight.

The environmental health sciences have taken up the advanced tools of genetic research and moved into a phase that intrigue many of our best scientists.

Epidemiology is the study of the occurrence of disease in large numbers of people. It attempts to link an exposure; some of the people have had to a subsequent disease. Sometimes, this can be straight forward: In 1775, Sir Percival Pott of England reported that chimney sweeps had a very high incidence of cancer of the scrotum, the pouch of skin containing the testes. His report of a disease related to an environment (chimneys full of soot) was an early example of an epidemiological study. Because it makes such good sense, epidemiology is easily understood and accepted by the public.

Most health regulations today are based on epidemiological studies. But they do have some limitations. Since people get exposed to all sorts of things, pinning down which exposure caused an illness, especially an illness that occurs 10 or 20 years after, can be very difficult. Usually, people do not know the chemicals they have been exposed to, and in what amounts. Newer epidemiological studies try to get around this problem by testing people for residues of chemicals that have collected in body fat. For example, test for DDE, a substance that DDT breaks down to, in the body, can indicate past exposure to the pesticide.

In terms of protecting people, the most significant problem is that epidemiology is entirely an after-the-fact science. It can link exposures to disease only after people have experienced the exposure and the illness and sometimes death.

Thus, we often turn to ways to screen substances before people are exposed. The foremost methods are animal studies.

Such studies have produced much of the evidence that has led to the listing of more than 200 drugs, pesticides, metals, chemicals and other substances in the report on carcinogens in USA.

Some of the advantages of a carefully planned animal study over a human being are obvious. The genetic make up of the laboratory mice and rats can be controlled and I don't know who will like to be used for such tests.

They are specifically bred for uniformity. The environment and exposures also can be carefully controlled, so that cause and effect can be demonstrated more easily. Generally, three or more different doses of a substance are used on different groups of rodents. If a resulting cancer or other disease occurs at highest rates, among the highest dosed rodents, and less at the lower dosages, that reinforces a cause-and-effect relationship. If a test rodent is known to handle a chemical in its body, the way a human does, that also is important evidence.

In some of the newest studies, these rodents are modified to carry human-like genes carrying increased susceptibility to diseases, such as cancer. Skeptics may argue "I am a man (or woman), not a mouse." "And they are right". But studies have demonstrated that there is less difference than we might think. And when these results are studied, almost always, compounds that have

proved to cause cancer in humans also have caused cancer in test animals.

While there are exceptions, and some animals may be more sensitive to a substance than a human is, a carefully done animal studies can often tell a lot. Vinyl Chloride was discovered to cause cancer in animal studies, before such effects were observed in factory workers. Allatoxin, which is a product of a fungus that can grow on peanuts, corn and other grains was first discovered to cause cancer in trout, then in laboratory animals and finally in epidemiological studies of human populations.

"Toxico-genomics" combines the word for the study of toxins or poisons with the word for genetic studies.

A "library" of the patterns of genes turned on or off by known toxins is being developed. Screening suspect chemicals to see if they produce the same patterns of turned off/turned on genes will follow this.

With this, there is hope, for there are thousands of potentially useful drugs and chemicals out there to be discovered, though a full animal study may take years and financial resources to accomplish.

There is varying susceptibility in humans.

You may be hurt by a chemical that does not bother most people.

Your co-worker may fall ill and you are fine. You may be more resistant than most people.

"Susceptibility" genes are different from some disease genes identified in sequencing them. When genetic variations are matched to a demonstrated increase or decrease on vulnerability we may learn about why persons A and B reacted so differently to the chemicals in tobacco smoke. Why person A is dead of lung cancer while person B keeps on trucking, with only a raspy voice and a little cough.

With such knowledge, we should be able to fine tune regulations so that they are not needlessly restrictive but do protect the most susceptible.

Like people, doing a jigsaw puzzle, scientists are fitting together all these new data from their exciting scientific tools. We are struggling to look at where genetics and the environment interact in the human cell, causing a molecule to change, that starts a kind of chain reaction, leading to a disease.

Scientists liken the cascade (a series) of cellular change to a chain reaction that may lead to cancer, arthritis, heart diseases or other diseases.

EXAMPLES OF ENVIRONMENT ASSAULTS

1.0 *Carbon monoxide poisoning:*

Carbon monoxide or CO is an odourless, colourless gas that causes sudden illness and death. Carbon monoxide is found in combustion firms such as those produced by cars and trucks, small gasoline engines, stoves, lanterns, burning charcoal and wood; and gas ranges and heating systems. Carbon monoxide from these sources can build up in enclosed or semi-enclosed spaces. People and animals in these spaces can be poisoned by breathing it. Carbon monoxide is one of the gases produced as a product of gas flares.

The most common symptoms of carbon monoxide poisoning are headache, dizziness, weakness, nausea, vomiting, chest and confusion. High levels of carbon monoxide poisoning can cause loss of consciousness and death. Unless suspected, carbon monoxide poisoning can be difficult to diagnose because the symptoms mimic other illnesses.

All people and animals are at risk of carbon monoxide poisoning. Certain groups – unborn babies, infants, and people with chronic health disease, anemia or respiratory problems are more susceptible to its effects. Carbon monoxide poisoning can however be prevented using appropriate safety and design procedures.

2.0 *Alteration of Pulmonary Immunity to Listeria Monocytogenes by Diesel Exhaust Particles (DEPs):*

Diesel Exhaust Particles (DEPs) generated by heavy duty diesel engines in various industries can absorb 450 different organic compounds including mutagenic and carcinogenic Polycyclic Aromatic Hydrocarbon (PAH). These particles can remain unburned for a long period of time and will be deposited in the lungs. Epidemiological studies have shown a constant association between elevated levels of particulate matter in ambient air and increased incidence of pulmonary infection or increased respiratory mortality. Because DEPs are a major component of particulate air pollution in most industrialized urban areas, their effects on pulmonary infections is of great environmental and occupational concern. Such effects in Nigeria can better be imagined.

3.0 *Environmental Assault on Immunity:*

Many immunotoxicologists say that exposures to certain chemicals can have a significant effect on immune functions. Studies have shown that chemical exposures can affect immunity in two major ways: by causing hypersensitivity reactions including allergy, which can be harmful to organs and tissues; and autoimmunity, in which immune cells attack self or by causing immunosuppression, a reduction in the responses and activities of the immune system.

4.0 *Perchlorate Debate Grows:*

The presence of a rocket fuel component called perchlorate in drinking water sources has drawn the attention of scientists and public health advocates whose research have shown that even small doses of the chemical can threaten people's health.

The Department of Defense (DOD) and the National Aeronautical and Space Administration (NASA) of the United States of America have been adding perchlorate to rocket fuels and ammunitions since the 1940's and its use remained unregulated.

There is agreement amongst researchers that perchlorate interferes with the uptake of iodine into the thyroid gland as well as other tissues including the placenta and mammary glands. The real danger of perchlorate contaminated water is the threat it poses to pregnant women, infants and fetuses. Whereas, adults have the reserved capacity to withstand a month or more with limited iodine intake, a foetus or infant can be harmed much more rapidly due to the reliance of the developing brain on adequate thyroid hormone levels.

Meanwhile, the perchlorate issue took another turn when the Environmental Working Group, a research and advocacy organization, conducted a study confirming earlier reports of perchlorate in some California-grown lettuce. Further studies showed that the Colorado river which is polluted by perchlorate, irrigates 1.5 million acres in Arizona and Southern California and the food grown there is shipped all over the country. "The whole food uptake issue makes it a much more widespread problem than if it was just a drinking water problem". The drinking water problem is enormous but the food uptake issue makes it even bigger. Measurement at such levels require sensitive equipment which we all know are not easy to come by.

5.0 *Rangers Environmental Breaches to 1995:*

The Ranger (uranium mine) built at Kakadu in Australia with all the necessary control measures has since 1985 breached the control measures borne in mind at the point of inception. The mine started production in 1981 and as at date, the production lines have failed many times leading to discharge of radioactive contaminated water outside the Restricted Release Zone (RRZ) and there has been more than twenty four (24) occurrences of pollution which have caused regulatory concerns. You may recall that exposure to more than the threshold doses of uranium and its daughter nuclides: radon, polonium, bismuth and lead will cause gene mutation and cancer in humans and other organisms.

6.0 *Animal Venoms:*

Animal venoms cause problems as one does not have much control over their movement and where the animals live. Environmental assault on human physiology also includes the effects of animal toxins. Some snake venoms, we are aware, have specific actions on acetylcholine receptors especially the *Elapidae* family. The implication is obvious.

Spider stings also produce adverse effects on the physiology of humans. Cnidarian toxins have been identified as having effect on the neurons of humans. Some victims of cnidarian stings have compared the stings with an electric shock sensation. Muscular cramps, severe whealing, mental depression and a sensation of chest constriction have been reported. Some of such cnidarians are: *Andidendron plumosum*, *Anemonia sulcata*, *Anthopleura elegantissima*, *Anthopleura xanthogrammica*, *Bolocera tuediae*, *Condylactic gigantea*, etc. Some of these cnidarians are found in Nigerian marine environment. Indeed *Diadumene kameruniensis* found on Eagle Island, and *Bunodosoma cavernata* found around Bonny also effect on human physiology. They haemolyse human blood.

7.0 *PRODUCTS OF GAS FLARING:*

Gas flares are common in the Niger Delta. These flares produce poisonous gases which are harmful and distort the physiology of man. There have been cases of nausea, dizziness, heart perturbations, respiratory problems etc reported in areas where gas flares by oil companies exist.

Recommendations:

Academics should publicize effects of research findings in readable pamphlets or publications to allow the ordinary man access to the effects we are here to discuss, and also proffer solutions to the problems. I challenge you all to tackle these problems squarely for the good of humanity. This keynote has cited cases in the USA because the publications in Nigeria are not made available to the reading public.

Authentic statistics are required in the field. Data collection therefore should be pursued vigorously by the association for public enlightenment and planning. In other words, a data bank is imperative for planning.

Conclusion:

From the foregoing, it is obvious that many researches have been done and others are on-going in the area of preventing some of these diseases and; managing the environmental assaults occasioned by both natural and man-made activities.

Environmental Laws will not clean our environment but the right attitudes will.

There are many oil spills, and complains about environmental degradation in the State. The awareness is high and many of the Citizens know their rights. This has made the Ministry to spend a lot of time settling disputes.

I have enjoyed giving this keynote address and know that discussion of the theme is going to be an exciting experience in the conference. We are aware more than ever before, that our environment is no longer safe, and something has to be done about it.

I believe that all participants in the conference would make meaningful contributions to address the concerns and the issues raised.

I thank you for your patience and attention. God bless.

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