Overview of “The Secret Life of Chemicals” the By Prof Alfred Poulos

Chapter titles are as follows. 1. Introduction. 2. Pesticides in food. 3. The plastics revolution. 4. Toxic metals. 5. The indestructibles. 6. Air pollutants. 7. Chemicals from paper manufacture and use. 8. Chemical exposure in the workplace. 9. Fluorocarbons. 10. Radiation pollutants. 11. How do our bodies deal with chemicals? 12. Genetic variability and the risk of disease or the advantages and disadvantages of being different. 13. Environmental chemicals and genes. 14. Environmental chemicals and mitochondria. 15. Environmental chemicals and the immune system. 16. Just because the amounts are small does it mean they are safe?. 17. What can we do?

Chapter 1 Global warming is one example of the potential and devastating effects of industrial waste products on the environment. But while some attention is now focused on carbon dioxide and global warming, little attention has been given to the other consequences of industrial activity. Planet Earth is finite and we are not adequately dealing with the waste products of industrial activities that the hackers have already caused harm to communities throughout the world. Unless drastic measures are taken to limit the use or, if this is not practical for stringent controls are put in place to reduce their release into the environment, they will continue to do so. You just need a. Analysis of urine shows that we are exposed to a complex mixture of chemical pollutants. Some are harmful to animals. We also know that there are many diseases for which there are no known causes. And the possibility is that chemical pollutants to contribute to some of these diseases.The author hopes that while it is difficult to completely eliminate our exposure to many of these environmental contaminants ,that the information contained in the book will help people to be in a better position to develop strategies to avoid or eliminate exposure.

Chapter 2 Pesticides in Food. Several million tonnes of a variety of pesticides are used annually around the world. There are hundreds of different types and the number and complexity of them goes on increasing. The modern monoculture system has increased the susceptibility of crops to insects and diseases and resulted in our reliance on pesticides. Some of them are broken down very slowly and some of them interfere with the natural predators of other insects and pests. These substances include insecticides, herbicides and fungicides. Many of the organophosphate insecticides are highly toxic to humans and some also to bees. The toxic defects of pesticides are evaluated are all in laboratory animals where the acute toxicity measure is now as the LD50. Attempts have been made to assess chronic impact of long-term exposure in annals that the measurements are difficult to evaluate. There is always discussion of the national and international agencies and their attempts to monitor the impact of pesticides but there is little evidence that the systems are giving pertinent information especially with respect to contamination in food. What is clear however is that there is many years 219 separate pesticide have been detected in different foods. Indexed pesticides occur in most foods and residues from literally dozens of pesticides• were the in and were really was this the better detected in a great number of foods including meats, vegetables and fruit the author concludes that the average adult male could be consuming in excess of 150 µg of pesticides daily and that the labels for children are even more concerning. He concludes that there is a great variety of insecticides to the size and fungicides used at all stages in the ground and food which has contributed to the quality and choice of food available as well as the cost. There are environmental and ecological concerns is the indiscriminate use of pesticides and testing of the toxicity of pesticides involves administration of rodents and determination of the level required to produce effects and animals.On the issue of individual pesticides detected in foods random monitoring carried out by state governments and industry really approaches the maximum residual considered to pose no threat to human health. The level of individual pesticide permitted in food are thousands of less than the amounts producing a measurable effect in animals. He sums up the chapter by saying that the issue for us really is whether the often tiny amounts of is's these substances have had or will have any impact on our health and well-being. Despite the apparently rigorous standards laid down by government regulatory bodies before registration and subsequent

release of pesticides on the market, there is increasing evidence that they do contribute to ill-health in some sections of the community. This is particularly true for those who are exposed in an occupational setting such as farmers and pest exterminators. What we do not know is whether pesticide exposure through the diet is more or less likely to cause disease in humans than skin and lung contact. We do not know as yet, whether they contribute to degenerative diseases such as cancer in the normal population but there is sufficient suggestive evidence to raise some concerns about the impact on our health. Given our uncertainties it certainly makes good sense to reduce anxiety environmental exposure to these chemicals in whatever way we can. This was not a particularly satisfying discussion which ramble around the issues quite considerably..

Chapter 3.The Plastics Revolution. There is increasing awareness of environmental contamination with plastic materials and particularly Micro plastics as a problem. Reports of contamination of marine animals by micro-plastics has certainly alerted governments to the potential dangers of plastic pollution. Unfortunately the emphasis has been on what can be seen because governments and the general public seem unaware that a great number of chemicals are released from plastics including micro plastics into the environment and these can all be taken up by walls and humans. Their exposure to chemicals from plastics is undeniable as is their ability to enter our bodies in different ways. The real issue is not whether some of the pesticides and other chemicals are potentially harmful because certainly animal studies have shown consistently that in larger amounts they are, and there is no real reason to believe that human tissues will respond all that differently from rodent tissues. After all when the safety of new chemicals are assessed they are often first tested in reference and later in other animals. While there are clear differences between humans and rodents there are also similarities in the structure and chemical composition of the major organs. What we do not know is whether the small amounts of various chemicals derived from plastics, in amounts much less than those shown to be harmful in animals represent a hazard. There are hints that even in these small amounts they may cause harm in humans, mainly by interfering with the actions of natural hormones. Unfortunately the jury is still out on theatre near yo will of or's all of you are and you you should should are you's's is you you world were a of are and is's are are is are is is the the youuthis and meanwhile we continue to be exposed to these substances.

Chapter 4. Toxic Metals. The toxicity of lead, arsenic and mercury has been known for a long time. It is therefore truly astounding and governments around the world permitted the use of lead in petrol when it was clear that, with an EVER- the increasi very good decision plastic boxes that there is a I are together though less income of the with you user you and is are will the young number of people driven motor vehicles on our roads, the levels of lead entering the atmosphere will also increase. Similarly, it is incomprehensible, at least with the knowledge we have today that mercury, another neurotoxic was incorporated into vaccines the children and amalgams users filling strategic and that arsenic, another toxic metal was used as a preservative for wood used in children's playgrounds. It is also not clear whether any thought was given to how the environment would cope with this and toxic burden. Unlike many other pollutants that are released into the environment, which can be degraded by microbes into simpler less toxic substances, toxic metals such as lead, mercury and arsenic our stable and remaining forms that retail level of toxicity. If governments really believe that toxic levels of mercury one has the amounts, why then do they advise pregnant women to limit their intake of the larger fish. Also, while the amounts we are exposed to a small there is ample proof that in the same way that the larger predator fish accumulated these sustances in their tissues through the food, humans also seem to be able to do the same thing. While the amounts of the toxic metals in the organs of humans are small, there is the possibility, rarely considered, that the levels may be sufficiently high in certain specialised parts and organs to affect the function of the whole organ. The fact is that these vehicles have already caused harm to communities around the world. Unless drastic measures are taken to limit the use

or, if this is not practical, more stringent controls are in place to reduce their release into the environment, and will continue to do so.

Chapter 5. The indestructibles. The amounts, number and variety of chemicals used by industry and the waste products derived from them is staggering. At least 80,000 different chemicals are registered in the USA and the number is growing by around 2000 each year. Many of them are very stable and break down very slowly. They include the polychlorinated biphenyls (on PCBs) the dioxins and the polybrominated biphenyls (PBDE's). These represent a classic illustration of how industrial chemicals can spread from the site of the usage into air and water finally ending up in our food and drinking water and then in our bodies. The assumption that the combination of heat, light, microorganisms, water and other environmental factors would quickly degrade these substances thereby limiting the buildup in the environment has clearly been shown to be just plain wrong. There are literally thousands of industrial chemicals like these and many are released into the environment. Not all have this level of environmental stability but it would be surprising if some do not show the same degree of environmental stability possible effects on our health as DDT and PCP and PBDE's. It is clear that much more stringent regulatory mechanisms are required for the scores of industrial chemicals and these need to take into account the likely environmental stability, whether they can enter our food chain and any likely impact on our health .

Chapter 6. Air pollutants. Air pollution is made up of volatile and particular matter. The gases include nitrogen dioxide formed from the combustion of fossil fuels and wood; ozone, formed from the interaction of oxygen in the air with nitrogen dioxide and hydrocarbons from fossil fuels, sulphur dioxide formed from the burning of fossil fuels and paper production, carbon monoxide methane formed from the decomposition of plant matter and produced by livestock and hydrocarbons. There are many others there are released as consequence of industrial activities. The particular matter is just as complex. People who live in urban areas are the most exposed although pollutants can travel many miles year end up even in rural areas when there is no industrial activity. There is no question that the various pollutants are taken up into our lungs where there may induce inflammation of the delicate tissue and increase the risk of asthmatic attacks. It is generally believed that air pollution can increase the risk of cardiovascular diseases and there are also indications that the risks of cancer such as bladder and lung cancer and leukaemia increased on continuing exposure to air pollution. There is also the view that air pollution is the price that we all have to pay if we want jobs and a better lifestyle. Unfortunately, if the latter view continues to prevail, some cataclysmic event will be required before governments are forced to confront the threat of air pollution.

Chapter 7. Chemicals from paper manufacture and use. Despite predictions of a paperless society, the volume of paper manufactured throughout the world has increased markedly over the last decade or so. There is a large increase in the use and subsequent environmental release of a great number of chemical substances many of which are not normally present in the environment. It has been assumed that whatever is released is not harmful either to animals or humans but in respect to paper manufacture we know that this is not the case. These chemicals I used for breaching and pulp manufacture resulting in harmful substances such as this and dioxins and we know very little about the long-term effects of release. As the evidence grows stronger there is gradual acceptance and there may be something in the preliminary reports leading to a gradual phasing out of the technology. Certainly the use of alternative bleaching processes for paper manufacture is a positive development. However it is not clear whether the chemicals generated from the other processes in the manufacture, use, recycling and disposal of paper are as harmless as we are led to believe. Unfortunately, only time will tell.

Chapter 8. Chemical exposure in the workplace. While most people know that physical injuries can result from what they do at work, more all is the failure of the do you the what there are the you are a well this is his alleged use many do not appreciate the risks of exposure to workplace

chemicals. Chemical exposure can take a decade or more to develop into disease and during this time there may be no indication of any disease. There is discussion although the story of this this this which can take up to 3 or four decades resulting disease. It is s exceedingly difficult to design animal experiments that can predict what is likely that happen after a decade or more from exposure. Epidemiological studies have some role sbut are difficult to undertake. There are examples of chemicals and dusts which have been shown unequivocally to increase the risk of cancer and lung disease .

Chapter 9. Fluorocarbons. These combinations of fluoride and carbon are present in a number of substances. They are produced by humans and now have a ubiquitous presence throughout the environment being found in the soil, air, rivers, oceans and wildlife literally everywhere . Their ubiquitous presence must lead to a questioning of the wisdom of releasing substances that are resistant to the normal degradation process the into the environment. They find their way into our food, water and most of our organs. They are found in the blood and tissue of almost all humans. Most people are exposed to only very small quantities of these pollutants much smaller than are required to cause harm in a variety of different animals. Where exposure limits are set there is little evidence that they are exceeded. But there are some grounds for concern, because these substances are not completely inert. There is evidence that the greater exposure of people to these substances can lead to an increase in the cholesterol and possibly a slightly greater risk of heart disease. There are also questions about the impact on the kidney thyroid and perhaps also reproductive processes such as sperm development and birth weight. The fluorocarbons taken up into our bodies are mixtures of related substances and we really know very little about what these mixtures do. So the jury is still out on whether these mixtures either by themselves or in combination with mixtures of other pollutants could be having an impact on our health.

Chapter 10 . Radiation pollutants. Radiation is a form of energy and ionising radiation strips one or more of the electrons surrounding the nucleus of atoms, resulting in the formation of atoms with a positive electric charge. The energy from radiation is released mostly as either electrical particles such as electrons and protons or electromagnetic waves. These particles or waves are able to travel through space and if they collide with matter such as human tissues they can strip electrons from atoms, causing damage. The cosmic rays that shower our planet every day come from outside our solar system and they are a form of ionising radiation. These particles interact with gases and can strip electrons from atoms, generating secondary cosmic rays though mostly subatomic particles such as mesons. While non-ionising radiation has less energy it is therefore mostly not able to strip electrons from atoms, it may induce temperature changes as it passes through material such as human tissues that can cause damage. The foods that we eat and the water we drink, the air we breathe all contain small amounts of radioactive substances, as do the fossil fuels that we use as sources of energy. We have been exposed to natural sources of non rising radiation by sunlight and electrical storms. The greatest concern relates to the potential effects of ionising radiation which has the capacity to damage tissues and their constituent proteins and DNA. This can increase the risk of cancers and there is evidence from survivors of the atomic bomb in Japan and accidents such as Chernobyl. According to one school of thought, any amount of radioactivity has the potential to harm us. The other view is that any risk to health only occurs when the amount we are exposed to is above a certain level. We are also being increasingly exposed to non-ionising radiation through the Internet, mobile phones and magnetic resonance imaging machines. And there is now some evidence that it may not be completely harmless. One possibility is that it could contribute to brain cancer and exposure to high-intensity radiation over long periods can caused vertigo and nausea in susceptible individuals. With the growing of such radiation, the likely impact on our health remains uncertain.

Chapter 11. How do our bodies deal with chemicals? Entry to the body can occur through food, water and the air we breathe. Entry through the nasal mucosa may enable direct access to the

brain bypassing the blood-brain barrier. Most chemicals enter the blood and are transported to the liver and then to the kidneys where they are mostly excreted in urine. Some are stored in body fat. Detoxification and excretion processes are controlled by different genes and there is increasing evidence that each of us inherit slight differences in our genrsd including those involved in detoxifying and excreting environmental chemicals. Mitochondria and genes are particularly susceptible, and chemicals are also known to affect the function of the immune system. These three elements are dealt with in subsequent chapters.

Chapter 12. Genetic variability and the risk of disease – or the advantages and disadvantages of being different. It has become increasingly apparent that disease mostly develops as an abnormal response of our genes to exposure to certain lifestyle or environmental triggers, many of which are known. Many of us have inherited certain polymorphisms of one or more of our genes that can predispose us to cancer, heart disease or one or more of the other degenerative diseases, but whether we get sick really depends on two other elements that we can control – environmental factors and lifestyle. It is likely as in the future we will have a better understanding of the relationship between our genetic polymorphisms and the disease process.

Chapter 13. Environmental chemicals and our genes. The maintenance of the chemical structure of DNA is absolutely essential for our survival as a species and we have all inherited complex mechanisms to preservve DNA structures during our lives. Damage to the DNA structure can lead to the death of the cell, disease and birth defects. For us, the potentially greatest source of concern is the burgeoning number of chemicals developed by humankind and released into the environment. Although we have mechanisms for repairing some of these changes, even if our repair mechanisms are working efficiently not all changes in DNA can be corrected. As more and more chemicals, many of which have not been properly evaluated are released into the environment, it is likely that many more will be identified in the future. In addition to the effects of pollutants on the chemical structure of a genes, there is increasing evidence that pollutants can also affect the expression of individual genes by changing the composition of the epigenetic tags which function as on/off switches and thereby regulate the expression of genes through the production of proteins. It is also worth stressing that we really have a limited knowledge of all of the chemicals released and this is because in some industries such as the paper industry there are potentially scores of unknown chemical by-products of the various industrial processes and it is unlikely that at least some of these do not cause damage to DNA.

Chapter 14. Environmental chemicals and mitochondria. Certain genetic diseases are caused by an abnormality in specific mitochondrial components. Some substances such as cyanide can interfere with mitochondrial function and rapidly result in death. Their vulnerability is a by-product of their function to generate chemical energy from the food we eat. The movement of electrons from the food components to oxygen is a source of vulnerability, because leakage can occur during this process and, eventually can result in the generation of highly active free radicals that react with almost anything in the cell. These free radicals can damage components of the electron transport chain as well as mitochondrial DNA. If this damage is not corrected, then these abnormalities can lead to the loss of function of mitochondria and can in turn affect the function of the cell, in which these mitochondria are located. There are processes that can correct abnormalities as they develop through the deactivation of free radicals by certain proteins or antioxidants such as vitamins E or vitamins C or some proteins. These can destroy the antioxidants before they cause any damage. In addition, if the free radicals cause changes in mitochondrial DNA, then there are special proteins, which we all have, that can repair the damage. Despite this, mitochondrial abnormalities do develop over time and it is likely that environmental factors can contribute to this. Certain chemicals are known mitochondrial toxins including certain pesticides and it is likely that some of the many thousands of environmental chemicals, most of which have not been tested,

may also be mitochondrial toxins and therefore contribute to degenerative diseases such as cancer, diabetes and heart disease.

Chapter 15. Environmental chemicals and the immune system. Like any other part of our body the immune system can be compromised by exposure to some of the thousands of chemicals to which we are exposed. We know that some of the chemicals that can affect the immune system as a result of studies with animals. But what we do not know is how many of the diseases that affect us are related to the exposure given that environmental chemicals have been clearly shown to affect many different immune cell types and given also that there are literally thousands of chemicals released into the environment or added to our food, many of which are almost certainly not tested for potential immuno toxic effect it was the most unlikely that they are all totally a nerd and therefore without effect. So, we do not know the full extent of the problem and if we did, we may argue that it is not acceptable. The view that we are only exposed to very small amount and therefore that there is no problem has been explored repeatedly in this book. Unfortunately small does not necessarily mean safe.

Chapter 16. Just because the amounts are small does it mean they are safe ? Certainly not. We know that microgram amounts of some substances can kill us and very small amounts of certain food proteins can cause severe allergic reaction is and even death. There is increasing evidence that exposure to Tania mounts of the toxic chemical may have unexpected effect through the process of homelessness or through synergism or priming which depend on the combined actions of a pollutant with other substances that maybe present in our blood and tissues. Some of the pollutants we are exposed to have been demonstrated to produce effect by these processes in animals and even human tissues such as the brain and the immune system. There are literally thousands of chemical reaction is occurring in our bodies any time and it is likely that at least some of the reactions are rather inhibited or stimulated in the presence of small amounts of one or more of the many pollutants taken up into our bodies, possibly affecting the function of the organs in which the reactions are taking place.

Chapter 17. What can we do?The rush to industrialisation in the developing countries of the world is unstoppable and has consequences for all of us. While there has been discussion of carbon dioxide and its impact the corresponding release of many other pollutants has not attracted such attention. The idea that governments have put in regulatory systems is not reassuring, Especially because if something produces an effect that is not immediate but requires a constant exposure over many years it is exceedingly difficult to prove and without this proof, governments will not usually act. In view of the fact that there are thousands of environmental chemicals only a few of which have been discussed in this book, and given that we also know that some of the environmental chemicals have already been shown to be harmful and that there are literally thousands of others we know we are very little about what can we do? Are we completely powerless? The difficulty we face in getting governments to recognise the severity of the problem is clear from the recent Paris meeting. And because action taken by government can I have a major impact on some groups with a lot of jobs and profit governments usually find it difficult to respond quickly. There is no easy solution but to put a little pressure on individual governments. Yeah Sumption has been made that whatever waste we produce will eventually be degraded either by microorganisms in the environment or by normal non-biological processes. And even though the amounts to which we exposed maybe very small, they can build up to quite high levels. We can reduce our exposure by growing our own food and avoiding processed food. We would be best to do and if we chose fresh food where ever possible. It is also desirable to use paper or glass to store food particularly food that has a significant fat content. We should avoid plastic or single use plastic bags and plastic containers for our food. It is also worth avoiding potentially chlorinated drinking water which contains substantial organic matter. The collection of rainwater in tanks is another option although environmental contaminants can find their way onto the collection service. It is difficult to avoid air-pollution for people who live in cities especially where there is high density. There is some case for use of indoor air purifier is where Pollution is common. We are living in a time when the world population is five greater that attentio the origins of the food they eatnis ever been and we are half or more of the population is poised to greatly increase its standard of living. To do this will require the use of more of this resources than ever before. There is already clearance that literally no place on earth, even the most pristine environments That are far removed from industrialisation is free of environmental contamination. As both the diversity and quantity of pollutants increases in the future, in step with a burgeoning population and further technological developments, it will be surprisingly if there is no corresponding impact on our health and well-being. The author hopes that governments recognise that pollution is a problem with potentially catastrophic consequences for humankind and that action is taken before it is too late to re

“The Secret Life of Chemicals” By Prof Alfred Poulos

Overview by Em Prof Bob Douglas AO, Former Director, National Centre for Epidemiology and Population Health at The Australian National University

This is a very carefully researched book, which provides extensive information on the chemicals that inhabit our environment, our food, our water and our air and the impact that they may be having on human health. The author is a medical scientist, with training in the law.

In 17 chapters and 276 pages he documents current understanding about pesticides in food, the plastics revolution, toxic metals, air pollutants, chemical exposure in the workplace, radiation pollutants, how our bodies deal with chemicals, genetic variability and the risk of disease, the effect of chemicals on genes, mitochondria and the immune system and what we can do about it all.

The take-home message from the book is disturbing. Industrialisation has resulted in many thousands of chemicals, which are being continuously developed and often escaping from where they are used into our human environment, without us really knowing enough about them. In high dosages or with continuous small dosage, the evidence suggests, that many of them could interfere with human health and some of them are known to be doing so. But for the vast majority, we are left wondering whether some could be responsible for some diseases the causes of which are inadequately understood. Every chapter is thoroughly reinforced with several pages of references from the peer-reviewed literature or less commonly, from the Internet.

This reader is left with a clear view that we cannot continue to go on as we are, with a finite planet, a growing human population and very light touch government regulation of new chemicals as they are produced and released. The so-called greenhouse gases, which are accumulating in the upper atmosphere dramatically illustrate the magnitude of the threat to civilisation from chemical pollution . The poisoning of the planet and its living inhabitants is one of an interlinked series of ten massive threats to the survival of our species. The others that are being largely ignored by politicians everywhere, are the consequences of the changing climate, human population growth, food insecurity, ecosystem destruction, depletion of the resources on which our societies depend, the threat of nuclear war, uncontrolled technology, pandemic diseases and, above all, the mass self-delusion, that these things are too far in the future for us to worry about. Dealing with these threats is not rocket science but it requires unprecedented collaboration across nations, industrial sectors and across national and ethnic groups.. Without global collaboration in transformative change aimed at mitigating these, there is every reason to believe that Homo sapiens is a doomed species.

For now, the author makes it clear that individuals can reduce risk to themselves by paying close attention to the origins and packaging of the foods we eat; to the sources of our drinking water and to the environment in which we work. But we must surely demand of our governments, more convincing regulatory actions directed towards the registration and production and release of new chemicals.