6

HOW WESTERN AGRICULTURE IS FEEDING GLOBAL WARMING

To reiterate, global temperatures are determined by the optical characteristics of the atmosphere. We are massively modifying those optical characteristics by discharging huge quantities of carbon compounds into the air. The most significant of those compounds is carbon dioxide.

There are other less significant pollutants we add that contribute to Global Warming, however the majority of these compounds are chemicals produced in association with the production of CO_2. Almost without exception when the generation of CO_2 is stopped, in whatever circumstances, we automatically stop the generation of these associated chemicals.

In the past, volcanoes were the only major source of CO_2. The discharge rates and the sequestration rates of this CO_2 reached a general equilibrium many millions of years ago. That balance recently ceased. Mankind is generating excess carbon dioxide and destabilizing the environment of the planet.

The carbon to produce this excess carbon dioxide comes from two sources. One is from deeply buried ancient carbon deposits existing as coal, oil and natural gas. We burn this carbon for energy and so produce carbon dioxide. The other is derived from carbon held in topsoil in a variety of forms collectively described as organic matter. The inclusion of organic matter is the defining difference between fertile soil and weathered decomposed rock. Incorrect agricultural practices break down and destroy organic matter. This breakdown releases carbon into the atmosphere in the form of carbon dioxide.

It is probable that CO_2 production from soil fertility loss is slightly less than that generated from fossil fuel sources, but even this is debatable. It could be more.

Soil fertility loss increases global heating. There is no argument about this, yet soil fertility is being destroyed in every country where Western agricultural systems and practices have been adopted. In most Western agricultural countries, soil fertility has been in gradual decline for well over two centuries. This rate of decline has now been drastically accelerated with the widespread promotion, and in many cases enforced adoption, of quite dangerous crop and livestock production concepts.

Fortunately, soil fertility decline can be reversed. More fortunately, good soil can be created where before none existed. And most fortunately for us in our battle to halt Global

Warming, it can be done rapidly and dramatically. And for a double win, it's invariably profitable.

Fertile soil, cultivated correctly, is totally immune to damaging erosion. It does not wash away in huge quantities down into the nearest valley. Good soil resists erosion beautifully. Fertile soil ecological systems could not have evolved in any other way.

Within the soil environment some slight erosion is actually necessary to expose a replacement supply of minerals from the underlying geological formation and subsoil. Healthy soil always requires a gentle continuous supply of mineral rich subsoil. Very different is the much photographed erosion gutters seen in some farmland. These gutters are a symptom of degenerated soil fertility. Filling them with a bulldozer does not solve any soil erosion problem and is a waste of time and money. Soil fertility loss is the problem. Recreating soil fertility is the answer.

The five prime requirements in the creation of true soil and ultimately rich fertile soil where none existed before are: Water, Air, Subsoil, Sunlight and Grazing Animals. The processes and techniques for the creation of fertile soil are considered in the next chapter.

However, before we embark on a program of creating soil fertility we first have to know and appreciate how soil fertility is destroyed. Only then can we stop destroying it, and only then we can start creating it.

Soil fertility is being destroyed in three major ways.

THE FIRST process results from the ever increasing use of agricultural chemicals and so called "fertilizers". This process started in earnest just before World War II, and has been expanding and accelerating ever since.

THE SECOND method of soil deterioration results from the increasing practice of mono-cropping. This is the practice of continuously growing one type of crop, and one type only, on a particular land area, year after year. This practice started in earnest just after World War II.

THE THIRD way fertility has been lost results from the specific method by which soil is cultivated. The process of cultivating soil by turning it upside-down creates an extremely unsatisfactory biological environment for natural soil bacteria and fungi. The inversion of soil layers by incorrect cultivation is the agricultural process that has been going on for the longest time. It started during the Middle Ages in Europe.

Let's look at the first of these soil-destroying processes in more detail.

FIRST: CHEMICAL AGRICULTURE – A HORRIFIC MISTAKE

Let's consider the first process. The microbes, bacteria and fungi that all live deep within the soil, their cycle of life, their activity and death, is the only process by which crushed rock particles can be made to yield up in quantity, the myriad of elements required by the higher life forms.

The millions upon millions of tons of agricultural chemicals spread on, mixed with, or injected into the agricultural lands of this very Earth of ours, kill soil life. From the use of these chemicals, fertility and the nutrient levels in our soils have experienced a long inevitable decline. Along with the decline of fertility and nutrient levels we are experiencing a decline in the health and the production levels of our crops, our pastures and our animals.

As fertility levels drop, the carbon atoms in the soil organic matter inevitably end up as carbon dioxide in the air. If chemical agriculture had never occurred and world soil fertility had been maintained, not releasing its entrapped carbon into the atmosphere, the current disastrous consequences of Global Warming would still be at least another quarter century down the track. The rise in CO_2 levels would be half what they now are.

The increase in yields that were characteristic of the so-called "Green Revolution" in the 1950s and 1960s sprang from a whole range of new high yielding plant varieties. It's a piece of marketing gobbledygook to say that the Green Revolution had anything to do with agricultural chemicals. Nevertheless agricultural chemicals were

marketed and sold to farmers in ever increasing quantities to supposedly boost production levels. In fact they do, but only for a short period, like taking Benzedrine. Nowadays they are being sold simply to try to maintain production levels in our constantly sickening soils.

Where did this all pervading emphasis on chemical based agriculture originate?

The first serious use of nitrogen fertilizers, other than from farm waste, was the use of Peruvian guano. The mining of this guano commenced in the 1830s. This was soon followed by the mining in Chile of naturally formed sodium nitrate.

The use of factory manufactured nitrogen fertilizers received its first real boost following the cessation of hostilities at the end of World War I when huge quantities of explosive stockpiles were released onto the agricultural market. In those days, these products were relatively simple compounds.

At the end of World War II, the chemical and explosive factories soon started running out of orders for their war-time newly, developed highly sophisticated products. Some major replanning was essential. Modified products with non-military uses had to be developed, and new markets had to be created. The government and the military were then the customers. They had to be replaced by the government and the farmers. As a result, explosives and biological weapons became fertilizers and farm chemicals. Oil-based nitrogen explosives were switched to oil-based nitrogenous fertilizers. Nerve gasses were modified to become pesticides, with fungicides and herbicides following. Organophosphates is the generic class of chemicals used in most pesticides. Organophosphates were chemicals originally developed for the production of nerve gasses. Sarin, the gas that terrorists sprayed in the Tokyo subway to murder people, is an organophosphate. The marketing of these modified chemicals must have been well planned. It most certainly has been ruthlessly effective.

The agricultural chemical industry and agricultural colleges advise state soil conservation services and state agricultural departments. The agricultural colleges receive constant financial support from the agrochemical companies. The services and the departments then advise farmers exactly how to use these agricultural chemicals. This constant dissemination of false and misleading information by these bodies institutionalizes a faith in chemical agriculture. Manipulated propaganda and public relations blurbs become accepted "wisdom". The inevitability of an agricultural future based on ever increasing chemical use then becomes an "acknowledged truth".

The drop in soil nutrient levels from widespread dependency on chemical fertilizers in turn enforces a massive drop in food nutrient levels, to the detriment of our own personal health. The lack of taste in these foods is your tongue telling you the stuff is hardly worth eating.

Unhealthy plants are attacked by all manner of pests and fungi. To them, unlike us, unhealthy plants taste better. They are not readily attracted to healthy plants. All manner of chemical pesticides and fungicides are developed, promoted and recommended to kill the pests and fungi feeding on these unhealthy plants. As this spiral tightens, chemical agriculture booms.

I must point out that there is a variety of fertilizers described as "mineral fertilizers". In simple terms mineral fertilizers are ground up crushed rock. As they are not readily soluble, they are safe. Mineral fertilizers are generally beneficial, and at worst harmless. They are discussed in the next chapter.

It is important to appreciate that of all the chemicals applied to soils, by far the worst destroyers of soil life are nitrogenous fertilizers. Plants need nitrogen to grow, and ultimately it becomes the nitrogen in all our proteins. Nitrogen is supplied to plants in the form of ammonia (NH_3) or nitrate (NO_3). These are available to plant roots from the natural decomposition of organic material and from the nitrogen-fixing bacteria on leguminous plant roots. In this normal structured manner it is delivered in millions of minute and safe doses in all healthy humus laden soils. More than ample quantities are produced in developed soil.

Nitrogen makes up about 5% of soil organic matter. So in an acre of soil with a few percent organic matter content in the top twelve inches (three hands, 300 mm), there could easily be 7,500 pounds of nitrogen per acre. (Conveniently, rates expressed in pounds per acre are almost identical to the same number in kilograms per hectare, so 7,500 kg/ha.) This provides an abundant source of nitrogen, which becomes available to plants by microbes breaking down and restructuring the organic matter.

Nitrogenous fertilizers in solid form are generally water-soluble nitrogen compounds such as ammonia sulphate and sodium nitrate. Almost all fertilizers are deliberately made water-soluble. The plant is then unable to individually select its own nutritional requirements and is effectively "force fed". Excess fertilizer has to be used to ensure good root contact. This enormous excess is washed away into the river systems or leaches down into the ground water. Next year's sales of agricultural chemicals are thus assured.

Soil life, bacteria, earthworms, etc. are perfectly adapted to their natural environment, but they haven't had millions of years to adapt to the new concentrations of nitrogenous fertilizers that rain down on them. These compounds are concentrated, water-soluble chemicals, and in the "fertilizing" process they kill the nitrogen-fixing bacteria and can kill all other micro-soil life.

Pure ammonia gas is used to force-feed ammonia direct onto plant roots. Driving through the American Midwest you see a never-ending series of what appears to be small silver-painted fuel depots. But they're not. They are pressurized steel containers full of pure ammonia gas. It is called anhydrous ammonia. (i.e. ammonia gas that is not diluted and is not dissolved in water).

Ammonia is a pungent and poisonous gas, and millions of cubic feet of this gas is injected into the cropland soils of the world, every year. The injecting nozzle cuts through the soil to a considerable depth to ensure that the gas is not "wasted" by leaking into the air. The nozzles are spaced rarely more than a few feet, maybe a metre apart, and generally much closer. Within twenty inches (half a metre) of the gas nozzles, every living creature, every worm, every bacterium, every ant, everything, will die immediately.

Carbon dioxide and methane are the most common breakdown products of all this death and destruction. These gasses inevitably rise and enter the atmosphere, contributing massively to Global Warming.

The fact that all is not well with the use of nitrogenous fertilizers is demonstrated by the results of soil tests which can show bizarre results in cropping areas. For example, from chemical analysis it can be shown that an acre of crop might use a total of one hundred pounds of nitrogen in the growing process. Now if fertilizer containing one hundred pounds of nitrogen is applied to the crop and the crop uses one hundred pounds to grow, then things should end up square.

But they don't. After the harvest, you find that total soil nitrogen levels are actually reduced, often by as much as fifty pounds per acre, and sometimes considerably more. It is still somewhat uncertain if the crop gets its nitrogen from the fertilizer induced breakdown of the biological produced nitrogen stored within the soil environment, or whether it is force-fed from the applied nitrogenous fertilizer. The point is academic anyway since the soil nitrogen levels are reduced in either case.

Soil tests have been conducted by the University of Missouri at the Missouri Agricultural Experimental Station and on their Sanction Fields since the late 1800s. Soil nitrogen levels have been studied in great detail for over one hundred years. In one illustrative set of tests, nitrogen levels dropped 45% over a 25-year period. During the period, nitrogenous fertilizers were added at a constant rate each year to supply 25 pounds of nitrogen per acre. At the beginning of the tests, the soil contained over 6,000 pounds per acre of soil nitrogen. During this 25-year period the soil nitrogen content dropped by 110 pounds per acre per year, despite the addition of the 25 pounds per acre of nitrogen in the nitrogenous fertilizers. If the added fertilizers are included, the nitrogen loss was actually 135 pounds per acre, which is

way above plant requirement, as was reported in *The Half Life of Soils* by Dr. William A. Albrecht and published in *National Food and Farming* in 1966. It is reproduced in full in the publication, *The Albrecht Papers*.

EXTRA: THE ALBRECHT PAPERS

The Albrecht Papers are a treasury of information on the evolution of soils and the change in soils caused by long-term farming. They are a very large collection of documents published in two volumes by Charles Walters, Jr. of Kansas City Missouri, owner and publisher of the agricultural journal *Acres U.S.A*. ISBN Number 0-911311-07-06. Library of Congress catalog card number. 83-81673 *Volume 1 Foundation Concepts*, and *Volume 2 Soil Fertility and Animal Health.*

The papers include some notes and writings by students but mainly they are the collected talks and lectures of Dr. William A. Albrecht. Dr. Albrecht was Chairman of the Department of Soils at the University of Missouri, College of Agriculture. He became a member of the staff at the college in 1916. *The Albrecht Papers* contain many important observations relating to soils, but in particular, they contain the most detailed collection of thoughts and results on ideal levels of rainfall to produce optimum soil fertility levels I have ever seen.

Albrecht clearly and logically defines the rainfall requirements that developed the rich fertile soils of the plains, the savannas and the prairies of the world. His papers also point out very clearly that rich soil produces healthy animals.

Regular rainfall encourages forest development. High and regular rainfall produces rainforests and tropical jungles. The resultant high levels of surface litter almost totally eliminate surface erosion. However, leaching of essential minerals is continuous and so the development of deep rich healthy soil becomes impossible. Grazing animals barely survive in the poor and limited food supply available in forests.

With very low and irregular rainfall the build up of soil organic matter and soil fertility is limited. Poor grasses and "scrubby" trees predominate these landscapes.

Slightly higher but intermittent rainfall is where the grasses grow. Grasses produce copious quantities of seed and although a grass plant will often die in a drought period, the seeds are there to germinate with the next rains. Grasses germinate and grow and quickly produce another seed crop, whereas the same long drought will kill a tree before it can produce seeds.

The ideal situation for soil development exists when rainfall is reasonably regular throughout the year and total rainfall is between say 20 and 30 inches (500 mm to 750 mm) per year. Under these conditions and provided tree growth does not take over, soil fertility and organic matter content will stabilize at extremely high levels and the soils will be remarkably enriched. Naturally, highly mineralized underlying geological structures ensure a higher fertility potential. In colder climates, rainfalls should at least be regular throughout the warmer growing season. These parameters effectively determine the areas where man grows his best crops.

If rainfall levels significantly exceed 30 inches (750 mm) per year then the rainwater doesn't all end up back in the air. Some sinks away into the earth. Plant minerals become exposed to the drift process for a short period each time plants reach the end of their life cycle and go through the decomposition phase. With consistent high rainfalls a constant downward drift of soil moisture becomes established which takes with it some of the minerals released. The loss of soil nutrients is termed soil leaching. The minerals are lost to the soil life cycle; effectively forever.

Transpiration is the evaporation of water from leaf surfaces that occurs during the photosynthesis process. The perfect rainfall is therefore when evaporation from the soil added to transpiration from plants equals total rainfall. There is then abundant water for growth but not enough to generate excessive leaching. High levels of organic matter in the soil can slow the leaching process.

But we are losing organic matter from our soils. The rapid initial decrease in organic matter content of soils to approximately half of pre-cultivation and pre-farming levels, caused by poor cultivation and the high use of inorganic fertilizers, is considered in detail in the Albrecht Papers. This is also seen in the **EXTRA: ON THE DESTRUCTION OF CANADIAN SOILS**, later in this chapter on page 124.

The Albrecht Papers document widespread fertility losses in a variety of soils of 40% in the first 40 years following the commencement of cropping. They also describe a subsequent 40% fertility loss in the following 40 years and indications are that this 40% loss in 40 years is an ongoing phenomenon. Albrecht noted that 120 years is about the maximum time that Missouri farmlands, in general have been cropped and the fertility tests confirm the loss rates. What has always offset the fertility declines and kept farming possible was the, until recently, constant addition of farm manure, compost, and farm waste to the cycle. As far back as 1933 Professor Hans Jenny of the Missouri Agricultural Station reported (*Bulletin* 324 of 1933) a similar but lower repetitive fertility loss pattern in Missouri silt loam prairie soils. His tests related specifically to soil nitrogen levels and showed a 33% loss per 60 years. We are also reminded that whether it be 40 years, 50 years or 60 years, no nation can survive such ongoing losses.

The Papers also dramatically contrast the benefits of spreading and incorporating good organic matter, such as animal manures, into soils and they document the extremely long-term beneficial effects of such treatments. The papers discuss these factors in considerable detail.

Albrecht discusses the "liming" of soils to reduce soil acidity. He totally rejects this concept and argues that the benefits of liming are not in some modification to soil acidity, but simply results from the addition of large quantities of calcium to the soil.

These, and many others are the wise and thoughtful messages contained within *The Albrecht Papers*.

The loss of soil nitrogen goes hand in hand with the destruction of soil organic matter. The simple inorganic nitrogen compounds left when organic matter is broken down are generally water-soluble and are easily washed away, or in the case of ammonia, escape as gas into the atmosphere.

As soil nitrogen levels diminish and soil life becomes decimated, the rate at which nitrogen can be absorbed into plants diminishes even more quickly. At the same time the natural biological production of soil nitrogen is reduced to negligible amounts. The bacteria that normally fix nitrogen for plant use have all been poisoned. At that point, crop yields become totally dependant on the constant and excessive injection of ammonia gas and nitrogenous fertilizers.

If you play golf, then worm casts dotted over the putting green, are considered a "removable hazard". The permanent removal of these hazards is of course a golfing preference. It is generally best achieved by "fertilizing" the green with a liquid fertilizer. The ammonia in the fertilizer makes the putting greens greener, and the worms all die. There are no more worm casts and the procedure is called a success!

And this is what almost all government advisers recommend we do to all the croplands of the world. The end result of the constant use of nitrogenous fertilizers is always the same. And that is, even more nitrogenous fertilizer will be needed and recommended by government advisers.

Nitrogenous fertilizers not only destroy soil organic matter and cause it to discharge into the atmosphere as carbon dioxide; they are also implicated in destroying one of the few natural processes that remove methane from the atmosphere. Methane is an extremely significant greenhouse gas, about twenty times as potent as carbon dioxide. Research at both the University of New Hampshire and at the Woods Hole Marine Biological Laboratory in Massachusetts confirm that the activity of aerobic bacteria in soil is the most significant process by which methane is removed from the atmosphere. They also suggest that inputs of nitrogen based fertilizers can materially suppress this atmospheric cleansing action.

Another common chemical fertilizer, superphosphate, contains the element phosphorus, also essential for plant growth. Naturally occurring phosphorus is derived from primary geological material broken down by organic activity. Much of the phosphorus in rich topsoil is chelated onto the surface of humic acid molecules and therefore usable by plants. Alternatively, it may be bound within the humic acid molecule and can be released for plant use by the action of microbes breaking down and restructuring these large molecules. Because phosphorous is so essential, the microbes usually keep most of it for themselves. They nevertheless constantly release small but generally significant quantities to plant use.

Some countries, particularly Australia and India, have soils with extremely low levels of natural phosphorous. The phosphorus actually "available" to plant life can be almost non-existent in some areas. High levels of soil fertility and microbe activity are needed to release enough phosphorous to grow a crop. To speed up soil development in these soils, one light application of superphosphate is often enough to correct the natural shortage and get the cycle started. Superphosphate provides phosphorous in a form directly usable by plants and capable of being chelated onto humic acid. With fertility enhancing agriculture, this application will usually suffice until the enhanced biological activity releases previously unavailable phosphorous to the nutrient cycle.

Normally recommended by advisers however, are massive continuous superphosphate applications. Admittedly, initial results can be spectacular. But subsequent crops require more and more to get the same result. Then finally and inevitably the stuff just doesn't seem to work anymore. The soil has become dead; poisoned by excess superphosphate.

In New Zealand for example, it has been regular practice to apply superphosphate at annual rates of up to one ton per acre (approximately 2,000 kg/ha). Applications of 500 to 1000 pounds per acre are very common and is, unfortunately more than sufficient to massively damage soil biological activity.

High dose rates of superphosphate have an unusual affect on plant cells and it's one of the main reasons it is used. High quantities of superphosphate affect the cell chemistry and force the cell to absorb large quantities of water. The bloated cells in turn bloat the grain or fruit. The fruit or the grain is thus bigger and heavier and so the saleable yield weight is higher. The actual nutrient levels have not risen and may more likely have even decreased. That's why it lacks taste. It's all water. The plants, and their edible products, are sick and unhealthy. But the sick bloated crop still goes to market.

In total contrast to high and destructive application rates, quite small and regular applications of superphosphate can be very beneficial. Phosphorus in particular is not easy to extract from its original geological form, and phosphorus is an absolutely essential element in plant and animal life. In the phosphorus deficient soils common in Australia, small and safe quantities – fifty pounds per acre (50kg/ha) down to twenty-five pounds per acre – will actually increase organic matter and humus content; often considerably. To appreciate the amounts involved, twenty-five pounds of superphosphate could be contained in a common household bucket. It would be about half full. Whereas a thousand pounds would fill two 40-gallon drums. (For a hectare, we are talking just over 25 kg, say a full bucket, compared to one tonne, or two 200-litre drums.)

It is not all bad. In contrast to their head-office bureaucracy, some state agricultural field officers in Australia, and I suspect elsewhere are thinking and using common sense. They are recommending and advising farmers to switch to more "organic" forms of agriculture. They are recommending considerably reduced use of agricultural chemicals. These recommendations are resulting in healthier crops and more profitable and sustainable farming.

We must stop the extensive use of ammonia and urea and all the other varieties of nitrogenous fertilizers in agriculture. Superphosphate, in its various forms and strengths, must no longer

be dosed onto the land in poisonous quantities. The use of all forms of water-soluble chemical fertilizers must cease.

CHEMICAL "FERTILIZERS" ULTIMATELY NECESSITATE THE USE OF PESTICIDES AND FUNGICIDES

Chemical fertilizers kill soil life. The dead soil life ultimately converts into atmospheric carbon dioxide, and that's what we have to stop. As a contributor to increasing atmospheric carbon dioxide levels and Global Warming, the use of agricultural chemicals ranks with coal-fired power stations. This has never before been highlighted. Using agricultural chemicals not only contributes to the release of carbon dioxide, it poisons and kills the very soil biological activity that offers the only real and practical hope of rapidly reversing Global Warming. And just in their manufacture, there is an oft-quoted rule of thumb that says it takes three tons of oil to make one ton of agrochemicals.

The use of chemical fertilizers promotes sick and unhealthy crops. While these unhealthy crops are growing, pesticides are needed to ward off insect attacks. The insects are only doing their natural thing. Insects have the job of eliminating sick and unhealthy plants from the environment. This is actually their preferred diet, as mentioned.

The metabolism of insects is different from animals. Each operates in its own niche in the food chains of life. What tastes good to an insect does not taste good to us. A blowfly will turn his nose up at a fresh slab of fillet steak, especially if a nice piece of warm rotting intestine is available nearby. In World War I, maggots were used by doctors to eat away the dead tissue in soldiers' wounds, where gangrene would otherwise fester. The maggots would not touch the healthy tissue. Today the technique is being revitalized and maggots are being bred in sterile conditions with new trials underway.

Nor do insects like the fresh tasty fruit that we humans find so appealing. They like, what to us is an unhealthy crop. They like fruit that has been on the table a little too long and is starting to go off. Insects have different digestive systems and have a natural and different role to play.

Indeed insects must wonder at the strangeness of men. Apparently, these humans like to produce sick crops in enormous quantities, seemingly especially for insects. And then they spend fortunes on chemicals to kill all the guests they have so well catered for.

Pesticides are chemicals that are designed to poison insects. But they also poison just about everything else that wriggles, crawls or burrows, on or in our farm soils. The non-selectivity of pesticides is obvious by simply observing what household pesticides kill. Even spiders with their eight legs, that are not insects but are a naturally occurring insect control, have a hard time with household insecticides. These are the same chemicals used on farm crops. There is no selectivity in their action, and chemicals for farm use are usually stronger and more potent than household sprays.

Healthy plants, growing in rich living fertile soil, do not require the dubious assistance of pesticides for their survival. Insects and all their cousins quite happily co-exist with healthy plants and animals in rich and fertile soil environments. The health of the plant is the factor that ensures its own survival. Undesirable insect pests will always be present, but kept in check by other insects and birds in any healthy agricultural environment.

Unhealthy soils produce unhealthy crops. The insects that thrive and proliferate on these sick crops are then killed by the billions with pesticides. But because the insects are in ideal conditions, they also breed by the billions. This rapid breeding often allows them to evolve resistance and develop tolerance to the pesticides at a rate far greater than their own natural predators. The numbers of predator insects are always far less than the numbers of prey insects, and chances of favorable mutations decrease with smaller population size. The insect predators therefore always lag behind in developing chemical tolerance and resistance.

Bird life fares even worse. The birds that dine on these swarms of insect pests become poisoned and sicken and die. The birds rarely, if ever, have

time to evolve a resistance to the chemicals. Their numbers are relatively few, and their life cycle is much longer. Also, predators invariably accumulate and concentrate in their bodies the pesticide poisons carried in the bodies of their prey. Non-fatal doses soon become fatal doses as they are passed up the food chain.

Rachel Carson's book *Silent Spring*, highlighted a new countryside as dead and devoid of all bird sounds. The birds, she foresaw as all poisoned by agricultural chemicals. Many have described *Silent Spring* itself as an excess of overkill. But if it was, it was not by any great margin, for despite her book, the worldwide use of pesticides increased dramatically in the subsequent years. *Silent Spring* was published in 1962, although much of the material was first published prior as a series of articles in The New Yorker. Rachel Carson was originally a biologist with the US Fish and Wild Life Service before becoming a writer. H.R.H. The Duke of Edinburgh once said in an address "I strongly recommend Rachel Carson's *Silent Spring* if you want to see what is going on". Good advice.

It is time that pesticides be put aside and used only as a weapon against plagues, as only that can be considered as a practical and legitimate function. For general agriculture, they cannot be, and must not be, the normal way of life.

A similar story applies to fungi. Fungicides are designed and produced by chemical companies to kill some particular target fungus. At least that is what they claim, but it is not so. There are thousands of varieties of soil fungi that form part of healthy soil and are actually essential in the very creation of that healthy soil. There are also some that do attack crops, especially unhealthy crops. Fungal life is massive and a prerequisite for any healthy soil, but unfortunately, agricultural chemical fungicides are known not to be particularly selective. The injection of fungicides into the soil can kill them all. Consequently, the use of fungicides inevitably and massively decreases soil life and soil fertility. Again, yields soon drop. Fertilizers, produced by the same companies, are now needed and recommended and always in staggering quantities, just to maintain production. It's the same old story.

There are some possible exceptions with chemical fungicides that are applied to above ground foliage. They often can be made to break down harmlessly before leaching into the soil and so are not able to kill soil fungal life. They can be relatively safe to use and not contribute to the breakdown of soil fertility. Remember that our aim is to circumvent Global Warming by the massive increase in the organic matter and humic acid content of our soils. A chemical that helps us achieve this aim should be used where necessary. It is not a requirement that food produce must conform to the almost excessively strict definitions mandated for "Organic Food" labelling.

Insect pests will always be around, and some bothersome fungal activity will always be present. Just as there will always be a few unhealthy plants for them to relish. A fungus or an insect that attacks a particular plant species is rarely significantly harmful to the healthy plant. Only to the unhealthy plant are they a disaster.

Fungal plant diseases can be eliminated or controlled by producing a much healthier plant, and good soil does that. Where mono-cropping is practiced for any length of time, large areas of any particular crop can always be an invitation to insect breeding and fungal development. Crop rotation solves these problems. One terrible example occurred in Ireland in the mid to late 1840s. By that time the newly structured poor in Ireland lived on potatoes. They were grown repeatedly on the same land. It was mono-cropping on a national basis. Then a fungus, *Phytophthora infestans*, that probably originated in a variety of Peruvian potatoes, got to Ireland around 1845. The blight decimated the closely spaced crops. Deaths due to starvation and malnutrition resulting from the infestation of potato blight in Ireland exceeded one million people.

The concept that crop rotation and fertile soils produce healthy plants, and the concept that healthy plants readily resist pests and diseases, is not only obvious in the field, but is an evolutionary inevitability. A healthy plant or animal or even a

healthy insect survives, an unhealthy one doesn't. So, wise and thoughtful farming practices become a natural form of biological control. Encouraging the development of beneficial insect predators, either birds or other insects, along with other similar forms of biological control of pests have always been there on the sidelines. These forms of control must now be used more widely to solve the problems of crop pest infestation. Chemical companies have managed to keep them always on the sideline. And obviously they will try to keep them there for as long as they possibly can.

THE USE OF HERBICIDES IN AGRICULTURE MUST RECEIVE CLOSE AND CONSTANT SCRUTINY

The chemical agricultural industry also developed a range of products generally described as herbicides.

In agriculture, when a plant is growing even vaguely in competition with a desired crop, that plant becomes a weed. Roses in a wheat crop are weeds and wheat plants in a rose garden are weeds. Herbicides are agricultural chemicals specifically designed (using the above example) to selectively kill the rose bushes or the wheat.

There are many environmentalists that advocate the total elimination of all foreign chemicals in the production of food. Many thinking people see such extremes as illogical and excessively impractical. Extreme views, if professed too vehemently, can in fact harm a community's sense of environmental responsibility. People don't want to be associated with what they see as illogical options. Issues are avoided. The environment suffers in consequence. And chemical companies win another battle. But big increases in soil fertility mean big increases in human health, and big decreases in Global Warming. Most herbicides do not destroy productive soil biological activity. Ones that do and ones that don't should be labelled accordingly. Insecticides, fungicides and the majority of chemical fertilizers are broad-band destroyers of soil biological activity. In designing herbicides to kill specific plants the chemists have been much more successful. In general, herbicides are chemically quite different to the chemical poisons and fertilizers produced that kill fungi, insects, bacteria, actinomycetes (branched bacteria) and our friendly earthworms.

It is often not particularly difficult to design unique chemicals that kill very specific plant species, and I believe their use should not arbitrarily be prohibited. Simple, sensible and safe rules however should apply. The herbicide must break down fairly rapidly after use. The breakdown process must occur automatically and well before it can in any way decrease soil biological activity.

Herbicide use can decrease the amount of tillage required in crop production and thus maintain soil structure. The enhancement of crop yields due to lessened competition can also possibly enhance soil development and increase soil biological activity.

Because of the natural association of herbicides with other chemical agricultural products, they are often given undue criticism when they are simply made by the same companies. The more accurate design of herbicides, and their sensible use, can actually increase food production and could simultaneously increase soil organic matter.

Good soils, soils rich in organic matter and containing thousands of pounds of humus per acre, are fortunately much easier to create than they are to destroy, provided the use of powerful agricultural chemicals are avoided. The propaganda machine of the petrochemical industries has had to hinder and distort public awareness of this simple fact wherever and whenever possible. They try and keep us all in the dark. The general public, the consumers, the people concerned about Global Warming, are now beginning to see these facts in the true light of day. For the petrochemical industries, it must be like sunlight to a vampire.

SECOND: THE SAME CROP, YEAR IN AND YEAR OUT

It's called "mono-cropping", and it too destroys soil organic matter and soil fertility.

Immediately following World War II, war-ravaged Europe had to be rebuilt. It was also desperately short of food. The United States

devised the European Recovery Plan. It became known as the Marshall Plan after the then United States Secretary of State, George Marshall. There were many factors involved in aid given under the Marshall Plan, but food supply is what concerns us here.

Under the plan United States farmers were encouraged to produce huge quantities of food to feed a starving Europe. This was simple. Recipients of vast amounts of tax dollars rarely complain. The United States government bought food from United States farmers at hugely subsidized prices. Production naturally skyrocketed. The food was then in turn given to Europe. United States food production grew astronomically. Food aid was then given to other countries. The United States government and American farmers now found themselves "on the tiger's back" with subsidized agriculture. It became too difficult to get off.

By the late 1940s the single crop concept had become quite widespread in Australia even with negligible subsidies. It was probably for convenience. Also it seemed to be successful in the United States and therefore "the way to go". Farming like everything else has its fads and fashions. In Australia, land was available in vast quantities, and as crop yields diminished new areas could be cleared for farming – as once occurred in the US. World food shortages keep prices at premium levels and in consequence the concept of mono-cropping became established in most of the grain areas all over Australia.

In the years following World War II it soon became common practice by governments all over the world to subsidize food but especially grain production. It was not just used by the United States to feed a war-ravaged Europe; the concept spread widely. Subsidized agricultural systems grew like cancers to become onerous burdens on governments and the taxpayers who fund them. Farm subsidies became, and still are, a political issue in every country where they were created.

One of the results of artificially high commodity prices is that farms became smaller. In farming terminology "a living area" is considered as a farm size that can produce a reasonable standard of living for the farmer and his family. Naturally, the specific size varies depending on the nature of the soil, the type of rainfall, the proximity to transport and many other factors. But most important is how much money can be made from the crops produced.

Now if a living area in an agricultural grain belt is say, 1,000 acres (400 ha) without any subsidies, then when grain prices become subsidized the farm almost automatically becomes extremely profitable. The real estate value of the land soars in response. The size of a living area automatically shrinks. Living areas can often be reduced by half, or even a third of the original farm sizes. It depends totally on how much money is paid to the farm in crop subsidies. A living area of 1,000 acres might reduce to three or four hundred acres.

The original farmer becomes a relatively wealthy man. His children grow up. He retires and sub-divides his land into smaller farms for each of his children. Each builds their own house and buys their own tractor and builds their own barn. More roads, bigger water supplies are constructed by local authorities. More phone lines are installed. New schools are built and more teachers employed. And it all happens because of an artificially inflated agricultural marketing system. The rest of the community pays for it all; in inflated food prices and wasted tax dollars.

The extra farmers and the extra people in the area resulting from this artificial market structure all have a vote, and naturally do not want to vote themselves out of their homes and out of their businesses.

Eventually a new equilibrium is established. The money made and the lifestyles achieved on the new farms becomes comparable with any other business or lifestyle where similar investment in money and effort is required. A new outside owner buying one of these farms is not only buying into an agricultural business, but is also buying into a complex and artificially distorted socio-economic structure.

You will find that no matter what the subsidized agricultural product is, the financial support will be distributed in manipulative ways. It will always be

dependent on following strict rules about specific total land areas, and often specific plots on the farm. The inevitable result is that vast acreage will continue to be cropped with the same crop, year in and year out. And so this second factor in the destruction of soil fertility was born and consolidated. The concept of mono-cropping.

Mono-cropping can often be almost all-pervasive. Australians familiar with the land and agriculture are invariably surprised when driving through the grain areas of the US Great Plains. I know I was. You see no fences. Farming is often a matter of growing grain, and virtually nothing else. There are no sheep or cattle. There are no goats. There are no horses. Many of these farms haven't used fences for sometimes three generations or more. They just grow the same crop year after year. It must be a sad, uninspiring and boring way to farm the land. But the system gives them no choice.

A typical scenario: the farmer wants to borrow money from the bank to put in his crop – O.K. says the bank, provided it's insured – the farmer goes to the insurance company – O.K. says the insurance company, provided it's grown to standard agricultural department recommendations. The farmer goes to the local agricultural department and, for some reason we can only guess, they always seem to recommend huge quantities of fertilizers and chemical sprays and of course herbicides. Grow an organic crop? Sorry not "recommended" – sorry, no insurance – sorry, no loan. And the bank might even foreclose on the farm mortgage.

In every case with subsidized agriculture, it eventually becomes necessary to put a limit on the inevitable massive overproduction of the tax-funded food. As a result an even more insidious and unhealthy system comes into being. The remedy dreamed up by government bureaucrats and politicians to correct this overproduction has been to limit the land area an individual farmer could use to produce the subsidized crop. Logically and naturally the farmer uses every trick in the book to produce the most massive crop from the smaller area. He is advised by government agricultural advisers and trained consultants that a higher tonnage of farm produce can only be achieved by using chemically stimulated production. In doing so the absolute mass of the crop rises, its weight rises but its nutritive value plummets. Unfortunately soil fertility and soil organic matter levels also plummet.

Atmospheric carbon dioxide levels climb relentlessly as do tax-funded government stockpiles of farm produce. Nominated land areas are further reduced by government agencies in a continuing endeavour to cap crop volumes. The cycle repeats.

The current system of crop subsidies is used almost universally through the world, and national governments are constantly reducing land area qualifying for subsidy, but never limiting the weight of crop harvested. Chemical fertilizers can stimulate plant growth and increase total crop weight. This means that fertilizers can be poured onto the ground in massive quantities and be a cost benefit to the farmer up to the point where the added fertilizer cost starts to exceed the value of the added yield. Very cute and very convenient marketing!

Why is it that actual production quantities are never limited? Why is it always land area that gets limited? Why is it that often the allowed areas for subsidized crops are confined to very specific and nominated fields within the farm? And of course all these rules and areas are meticulously specified and policed by burgeoning government bureaucracies.

Of course it would have been more practical to pay a subsidy on a specific and limited quantity of produce. But then that might just not have suited certain influential industries. The land area subsidy concept happened to the obvious delight of agricultural chemical companies. Some might even say with their connivance.

The system continues today. It's everywhere. It's in almost every developed society. The farmer is restricted in the size of land he can crop, but subsidized to extract the maximum tonnage out of that limited land area. Under this regime chemical crop stimulants are of course ultimately paid for by the taxpayer. Inevitably using such destructive agricultural practices, pesticides, insecticides and

fungicides become imperative, and they are bought with the same funding, that is with our money.

With the subsidized agricultural system the average farmer is not too subtly induced to mono-crop just one small specific plot on his much larger farm. Even more devious: if a farmer wishes to rebuild his soil fertility levels by switching from grain, to growing a crop of legumes for example, or possibly using the area as a grazing paddock for a couple of seasons, he can often be effectively stopped. Bureaucrats can do this by simply threatening to withdraw the allocated grain subsidy.

Like puppets on a string the governmental authorities argue that, as the farmer didn't appear to want to grow any more grain, he should therefore lose his grain-subsidized area allocation. This puts him out on a limb. He could own a valueless farm. A system of preventing soil fertility improvements and thus ensuring the continuing use of massive quantities of agricultural chemicals prevails, subsidized in effect by tax-dollars.

Agricultural subsidies support agrochemical use and accelerate Global Warming. Agricultural subsidies must go. Alternatively, and to reduce Global Warming, subsidies should be paid based exclusively on a measure of soil fertility improvement.

When subsidies are finally removed, as they ultimately have to be and especially on chemically dependent agriculture, the people who become vulnerable, the people who may well lose their shirts, are sadly not those who created the mess. Manipulated bureaucracy, politics, and time, that's what created this mess we know as subsidized agriculture.

In Australia, sugar production from sugar cane has been freed only just recently from this bureaucratic minefield. The United States is slowly extracting its agriculture from the subsidization mess. The European Economic Community seems simply lost in political infighting and seems not to be getting anywhere, which certainly suits the agrochemical companies. In total contrast, New Zealand in effect and to its credit, went "cold turkey" on subsidies in the 1980s, although it was painful to many.

The constant emphasis on mono-cropping inherent in all extensive agricultural subsidizing structures constantly depletes the soil of its wealth of accumulated organic matter. The available minerals stored in the soil humus are used up, or rapidly leach away as the humus is broken down by chemical applications. Soil structures deteriorate and the ability of the soil to retain necessary moisture is markedly reduced. No new minerals are released from the subsoil or topsoil by soil biological activity. It can't happen as soil biological activity has been almost eliminated.

Mono-cropping also became more pronounced as large, high-powered tractors and wide cultivating and harvesting equipment were developed to reduce costs and farm big areas faster and more economically. This system came to be called "broadacre farming".

One of the major problems with mono-cropping is that the pathogens that harm a particular crop are able to breed and develop in excessively huge quantities. With mono-cropping they have a continuous, idealized, almost exaggerated food supply to support their naturally evolved crop-synchronized breeding cycle. Constantly recurring plagues become the norm. Such plagues just can't occur, or are at least considerably restricted and reduced when land use is continually varied. For example, when grains are grown one year, legumes the next and in the third year the land area is given over to pasture and grazing, plagues don't often happen. The pathogens that damage the crops and constitute the plague have trouble surviving in significant quantities in the varied and changing environment.

With the destruction of the humus, another problem manifests itself. Unpleasant and possibly poisonous minerals and chemicals, once harmlessly chelated onto the large humic acid molecules, are released back into the wider environment. They could be anything from common salt to plutonium. Environmentalists, engineers, and a variety of other experts are called in to solve the "new" soil pollution and soil salination problems. See **THE END OF SOIL SALINITY** in the next chapter.

Yet the answer is obvious. Humic acid is the receptacle or the "shelves" where the elements can be held in store; and in chemically polluted ground there are simply no shelves at the supermarket. The humus, along with its humic acid molecules, has been destroyed. There is no place to harmlessly, safely and conveniently stack the poisons. There are no shelves to hold the nutrient elements, and there are no shelves to safely hold the unwanted poisons.

Mono-cropping requires ever increasing doses of chemicals to support a mad illogical upstream swim in a fruitless effort just to maintain crop production levels. Eventually after not too many years, crop yields deteriorate even in the once good soils. This decline happens when the normally shorter-lived humic acid molecules have been fractured and broken down, thereby releasing any internally held nutrients. Almost nothing is left. Of course at this stage, long gone are those nutrients once chelated on the surfaces of the molecules.

But limited quantities of nutrients still exist within the long-lived humic acid molecules. At this point, new and stronger agricultural chemical fertilizers are applied, supposedly, as is advertised quite erroneously, to replace the minerals actually used by the crop. The stronger chemicals are able to break down the very last, very stable humic acid molecules and release the final remaining nutrients. By doing so, crop yields can be partially restored for another few years; before the next inevitable and final decline.

As the humic acid molecules are broken down, the carbon atoms, the building blocks of those molecules, become carbon dioxide. And now, millions upon millions of tons of carbon dioxide from this source have accumulated in the atmosphere, a source as we have noted to rival that from the exhaust pipes of every car on planet Earth.

Without even considering the effects of agricultural chemicals, the combination of "turning the soil" (discussed in the next section) and "mono-cropping" results in a total curtailment in the normal, natural production of humus. Natural soil fertility slowly and inevitably deteriorates and the soil humus reverts back to the atmospheric carbon dioxide from whence it came.

With the widespread adoption of the concept of mono-cropping, world agriculture took a giant step in the wrong direction.

THIRD: TURNING THE SOD DESTROYS THE SOIL

Now let's consider the third most important factor in the destruction of soil fertility, and that is the practice of tilling the soil by turning the soil upside down as part of the cultivation process. It is not as vicious as the excessive use of agricultural chemicals, but it is more insidious and ultimately almost as destructive. The effects of turning the soil develop over a much longer timescale than those of chemical use or mono-cropping. But remember, farmers have now been turning the soil for centuries, long before mono-cropping and agricultural chemicals were invented.

Before the practice of turning the soil became established, man cultivated his soil with a forked stick pulled by a horse or an ox. This ancient technique benefits soil microbiological life in three important ways.

Firstly, rain is able to penetrate the cultivated soil and soak in to be retained for long periods. Without moisture, there can be no soil life.

Secondly, the majority of the bacteria that decompose vegetation and root structures and so produce rich soil, are aerobic or air breathing bacteria. Cultivating in such a way as to allow air into the soil lets these bacteria prosper and get on with the job of creating humic acid. The bad smell of a swamp and the inflammable marsh gas (methane) that bubbles to the surface in the swamp, are produced by anaerobic bacteria. Anaerobic bacteria don't produce soil.

Lastly, root structures can grow and move through the soil more easily if it is loose and friable than if it is hard and compacted. Natural "cultivation" mechanisms exist but they are extremely slow. The growth of tree roots, and the exposure of subsoil when the tree eventually dies and falls, is about as fast as such natural mechanisms operate.

Turning the soil has almost become the standard form of agricultural cultivation, but it was not always so, and unfortunately turning the soil is about the worst form of cultivation we could have devised. It has unfortunate consequences for soil life. The bacteria that break down dead grass root material and produce soil are naturally most happy in the root zone environment. Here there is still sufficient air for them to breathe and they are not exposed to the harsh conditions on the surface. They have been evolving in this environment for millions of years and have modified it and adapted well to it.

The aerobic bacteria that decompose litter laying on the ground surface have similarly adapted well to the environment they created for themselves. They don't actually like to be in direct sunlight as it can get too hot. Conditions can dry out severely and biological activity ceases in the complete absence of water, but in the moist surface litter they thrive, and multiply, and produce rich soil.

However, if the soil is turned over during cultivation, the bacteria that decompose the surface litter find nothing to eat. Their food is buried so deep it is unavailable. The bacteria that happily digested the quite different structures in root material also have nothing to eat. The root material that was their diet is up there on the surface, in the sun – dry, hot and unavailable.

The ancient practice of using a forked stick to cultivate the soil kept it loose and friable but did not separate the bacteria from their food sources. With crop rotation fertility levels were retained or increased. The soil grew rich. The crops grew well. So did everything else, weeds included. Hand weeding, the only drawback to this method of farming, was probably the most time-consuming and tedious task in primitive agriculture. Quite naturally most seeds evolved to sprout on or near the surface, or within the surface litter. Most seeds won't sprout and grow if they are buried too far under the ground. It would have been a wasteful and pointless ability.

Somewhere during the middle ages or a little earlier, a piece of flat board was attached to the forked stick used for cultivation and this turned the shallow cultivated soils upside down. The board was called a "molde board" and the plough became the moldeboard plough. Molde is the Old English word generally denominating the humus rich top layer of soil. (The spelling became mould in English and mold in American English.) Grain was hand sown on the surface of the mouldboard ploughed ground but the weeds were buried too deep to sprout. The grain grew well and had few weeds to compete against. The never-ending task of hand weeding was thus solved with the invention of the mouldboard plough. Suddenly one man could farm an area as big as he was capable of cultivating and sowing. The area was no longer limited by the constant need to weed out competing and unwanted plants. The manpower required to grow the food supply dropped dramatically. Mankind now had time on his hands to really develop his civilizations.

Turning the soil became synonymous with agriculture.

The use of the mouldboard plough and the later development of the disk plough became the new form of "conventional" agriculture. Ploughs were soon made out of iron and could go deeper. Then they were made out of steel. Many ploughs were mounted on a single frame and pulled by teams of horses. Then tractors replaced horses and ploughs got bigger still.

Naturally it was soon found that the vegetation left after harvest would not readily "break down". It stayed there right through until next season and ultimately clogged up machinery. It would not break down because the surface-living aerobic bacteria that normally digested it were too deeply buried by the soil inverting ploughs and so they died. In many places it even became common practice to burn off the residue after harvest, to simplify ploughing and preparation for the following year's crop. As a result even the possibility of producing any significant quantities of humus literally went up in smoke. The time-proven, pre-industrial age concept of rebuilding and reinvigorating the land by the utilization of a planned pasture and grazing animal phase was forgotten. In North America the practice and its

consequences were described:-

"The general custom has been, first to raise a crop of Indian corn... which, according to the mode of cultivation, is a good preparation for wheat; after which the ground is respited... and so on, alternately, without any dressing, till the land is exhausted; when it is turned out, without being sown with grass seed, or any other method taken to restore it; and another piece is ruined in the same manner. No more cattle is raised than can be supported by lowland meadows, swamps etc.... Our lands were originally very good; but use, and abuse, have made them quite otherwise."

George Washington in 1768.

In addition, land subjected to continuous cropping, especially where agricultural chemical fertilizers are used, will develop what has become known as a "hardpan". A hardpan is a thin layer of very hard dense compacted soil that forms just under the cultivation zone. It only forms where the soil is constantly cultivated with soil inverting implements. (Forked-stick ploughing never produced hardpans.)

Roots find it almost impossible to penetrate these hard compacted layers. If you scratch down into these soils you often find a taproot that goes down a few inches, hits the hardpan, then does a sharp turn and spears off sideways, never getting any deeper.

Neither can rain, unless it is gentle and prolonged, get through these hardpans in sufficient quantities to recharge the subsoil with moisture. Storm rains simply run off in torrents. With any heavy rain, run-off will rapidly accumulate into small rivulets that bite into the cultivated material and wash and erode it away. When this happens the impervious hardpan is stripped bare and left exposed. It's like washing soil off a concrete path. It is a very common and highly visible result of the practice of turning the soil during cultivation.

Agricultural colleges generally teach that a hardpan is formed because of the constant traversing of tractors and farm implements over the cultivation area. As cultivation is often undertaken as a weed control procedure, it is advocated that cultivation should be considerably reduced. It is then recommended that weed management be controlled with herbicides, and crop growth be maintained with fertilizers. The concept is called "minimum tillage" and it gets a lot of publicity.

"Zero-till", where cultivation is proposed to be eliminated entirely, and "chemicals only" is the promoted method of growing the crop, was advocated and attempted. The system was given a lot of publicity, but it always proved to be a dismal failure.

These processes certainly would suit the agricultural chemical companies, who are great promoters of such systems. For example, the chemical company Monsanto ran advertisements promoting their herbicide "Roundup"; the caption said "See You Later Cultivator". Roundup is one of the most common herbicides in use in Western agriculture. Roundup is even used in cities and towns as a spray along the edges of lawns and gardens to "trim the edge".

I don't believe hardpans are formed by tractors traversing the land a few times a year as is claimed. It makes no sense.

Many years ago, a long time friend of mine, Dave Adams, who farmed several thousand acres near Forbes in Central New South Wales, was driving one of his tractors and his twelve year old son Nick was on the seat alongside him. The tractor was an Australian built Chamberlain Model-354 powered by a 100 horsepower diesel engine, weighing five and three-quarter tons. The ground at the time had not been recently cultivated. It was wet from a recent rain shower, but not boggy. The boy fell off the moving tractor. A rear wheel of the tractor ran up and over both his legs, over his chest and his left shoulder.

My friend was devastated, but then, within seconds the boy sat up. He had some trouble breathing, but not too serious. They took him into the local Forbes Hospital. Amazingly, no bones were broken. There was not even severe bruising. Bruising was no worse than a boy gets playing a

hard game of football. Nick was kept in hospital overnight for observation. He was sent home next day. Years have passed. Nick is now a man and has a couple of children of his own. He is now farming the family property.

How was it that such an apparently horrific accident did such little damage? There were two major factors. One is that the rear tractor tyres on two-wheel drive tractors are huge and are inflated to very low pressures. The other is that the tractor was not under load. It was not pulling an implement and so there was a negligible torque load on the wheels.

When a farm paddock is cultivated, sown and harvested, implements travel over the ground three or four times in the year. There are spaces between the tyres and so some of the ground surface may never feel a tyre tread all year long. Where the tyres do contact the ground, there is very little ground pressure as the pressure applied can never exceed the original tyre inflation pressure as highlighted by my friend's experience. If you regularly drive over your front lawn with the family car, the very much higher pressures in the car tyres will result in some soil compaction. But the classic sub-surface agricultural hardpan never forms in the front lawn. Your lawn might compact near the surface but not deeper down.

I believe, and have always taught, that the formation of hardpans result from a combination of constant cultivation to a fixed depth and general farming practices that deplete most of the organic matter from the soil. Yet agricultural tractor tyres are repeatedly and traditionally blamed for the cause of hardpan formation. Agricultural colleges still teach their students this nonsense.

When plants are potted, the material used always contains extremely high quantities of humus. When you overwater these plants the water comes out the bottom of the pot, and it's perfectly clean. Fill the same container with agricultural topsoil from any extensively cropped and chemically fertilized farmland, and now pour water into the pot. The water again comes out the bottom, but now it's brown, dirty and full of silt. There is a lesson in this little experiment and it is very relevant to understanding how hardpans are formed.

What we can conclude from our observation on potted plants is that when rainwater or irrigation water passes through infertile soil, the very fine dust and clay particles within the soil migrate down through the loose soil material with the water. When they reach the bottom of the cultivation zone they hit the more compact uncultivated soil, or subsoil, and are stopped and effectively trapped. It's like clogging up a filter, and the resulting densely formed hard compact layer is the hardpan.

Excessive cultivation prior to planting does tend to break down the granulated structure of good soil and produce free particles that are prone to migrate downward. It is therefore a valid argument to reduce the total number of times the soil is cultivated or "worked" to what becomes an essential minimum. The argument that says all cultivation should cease (the "zero-till" concept,) is based on the totally false presumption that soil fertility can never be rebuilt, and so the presumed inevitable destruction of soil material should be kept to an absolute minimum. This presumption becomes true only when excessive chemical additives are poured into the soil, killing the soil life that produces the fertility, and mono-cropping is continued.

Water can slowly soak through hardpans but plant roots find them almost impenetrable. The water that does soak through will thus become totally lost and unavailable to any thirsty plant roots. Any subsequent warm weather will quickly dry out the shallow loose topsoil. Plants then wilt and more water is needed. In hot dry conditions water can be needed in as short a time as two or three days. The constant watering carries silt down to form the hardpan. Hardpan formation and the resulting excess use of irrigation water is a major cause of soil salination. The causes and the curing of salination is discussed in the next chapter.

European soils may have been in slight decline for several centuries. The invention of the mouldboard plough probably started the decline but it was insignificant while farm and household

manure along with other organic matter was being constantly incorporated back into the soil. Also, crop rotation and the incorporation of a natural grass phase was established procedure. Those practices ceased and today European soils are now as poor as any found anywhere in the world.

Sadly, rich North American soils were in turn destroyed quicker and more noticeably.

EXTRA: ON THE DESTRUCTION OF CANADIAN SOILS.

In April 1992, Jean Charest, who at the time was Environment Minister for The Canadian Government, released a massive and comprehensive environmental report containing twenty-seven separate chapters. This huge report discussed in detail what it considered an alarming deterioration in Canada's water, soil, air and forests.

Fourteen thousand lakes were described as "killed" by acid rain. The report reminded Canadians that 50% of the original organic matter in the soils of the Canadian Western prairies had gone. The report stated that the soil, because of this massive loss of organic matter, had become vulnerable to widespread erosion.

As is usual farmers received most of the blame. Included in the list of mistakes that they were accused of making was the claim that Canadian farmers had "ravaged some of the richest ecosystems in the world". The truth is those farmers were unsuspectingly and in good faith, taking the advice of their own agrochemical lobby manipulated, government agricultural advisors.

The report went on to warn of the deterioration in Canada's fresh water supplies and suggested that this could become a major health hazard. Any such major health hazard would most certainly have resulted from the massive use of agricultural chemicals. These factors were ignored in the report. The report had other predictions. It predicted that within 16 years all the "old growth" forests of British Colombia would have gone. The emphasis is always on "old growth" for a reason unrelated to the reason advertised. Old growth trees are by definition mature trees, ready to harvest, and so compete with plastics and metals, or alternatively, ready to die and rot and ultimately turn into carbon dioxide.

The Canadian Government decreed a $6 billion "green plan" to "address" these environmental problems. One would think that Canadians surely had a right to ask where their agencies would get their advice and information. And surely Canadians had a right to be informed how these vast sums of money were to be spent, or squandered. But it never happens that way.

Jim MacNeill, who was Secretary General of the Canadian Brundtland Commission On The Environment, was cynical of this supposed green plan, as was reported in *New Scientist* at the time. He pointed out that the fourteen thousand lakes stated to be already lost, were destroyed by acid rain produced by burning fossil fuels for energy. He said "The government is spending around $4 billion in subsidies to promote the use of fossil fuels – that is to say we are spending billions to promote Global Warming and acid rain". He further lamented, "We are spending only about $40 million (that is one hundred times less) to promote energy efficiency... It's a loser's game, he concluded.

The Canadian experience is one example illustrating the major environmental ills of Western society created by manipulated government agencies. I believe the Canadian government's stated plan was just plain wrong. There are several fallacies in the arguments propounded.

I suggest that the worth of "old growth" forests as compared to continuous growth forests, regularly harvested for their timber, is nothing more than manipulated public relations to prevent timber competing with oil-derived construction materials. There is negligible to zero environmental logic to these, suddenly discovered, "old growth" theories; yet it is what many in the Canadian environmental movement actually believe.

It also seems obvious that the destruction of

the Canadian soils was caused by a combination of mono-cropping coupled with the massive use of chemical fertilizers, plus the continuous dosing of crops with pesticides, fungicides and herbicides, and all this combined with cultivation techniques that endlessly inverted the soil.

Remember that carbon constitutes 58% of soil organic matter. This carbon, when released by destroying the organic matter by these agricultural practices becomes carbon dioxide in the atmosphere. That is of course, where the carbon atoms go. The generation of atmospheric carbon dioxide from Canadian soils exceeds that from all the fossil fuel burning cars, trucks and power stations in the nation, and by a very considerable extent. It is reasonably argued that it could exceed it by 400%. See Chapter 5: **SOIL FORMATION CAN HALT GREENHOUSE WARMING.**

The deterioration in Canada's fresh water supplies must be at least in part caused by acid rain, but to a much greater extent it is due to run-off from farmlands saturated with agricultural chemicals. Any significant acid rain in the Canadian wilderness would be coming from across their border with the United States. This source of acid rain would be by far the most significant. And this cross border pollution will always be blamed in an attempt to distract attention and responsibility from Canada's massive use of agrochemicals.

Many of these misguided Canadian environmentalists are the same people constantly endeavouring to stop the state-owned Hydro Quebec authority from building the biggest totally pollution-free hydroelectric generating complex in the world. If the world is lucky these so-called environmentalists and their "land rights" activist friends will fail, and the world will be a much better, healthier and safer place.

Whether these green plans work, or whether they are even designed or expected to work is a moot point. The billions of dollars wasted on such government funded green plans usually does little more than placate the lobbyists that infest the halls of power. And it pacifies those taxpayers who still believe that government agencies can be trusted to manage a farm better than the farmer that owns the land.

TURNING IT ALL AROUND

Just south of Lake Superior and Lake Michigan in the United States is Wisconsin. The soil types in this state are very similar to those in the Canadian province of Ontario on the northern side of the lakes. The original richness and fertility of these soils and their incredible productivity was also typical of the soil types that constituted the Great Plains of the central areas of the United States.

There is a small fenced off area of land just south of Milwaukee in Wisconsin. It's been preserved as a piece of original prairie land. It is a wonderful example of the original grasses and the original prairie soils. It is fascinating and almost unbelievable to behold. There is an immense variety of grasses. They stand shoulder high.

I dug down into this prairie soil with my hands. The top surface is a mass of decomposing litter, which turns into true soil as you go deeper. There is no definite demarcation between the top litter and the true soil. And the soil is deep.

Over the rest of the prairies, all throughout the 20th century, mono-cropping and turning the soil upside down, and the eventual dosing of the land with agrochemicals year in and year out, changed this incredible material into what became the American "dust bowl".

And in that process all the organic matter in those rich prairie soils became atmospheric carbon dioxide.

To reverse that process, to absorb millions upon millions of tons of carbon dioxide back into the soil and so commence our control over Global Warming, we simply have to idealize the soil environment so that earthworms, and all microbiological activity can function at their optimum efficiency and recreate rich fertile soil again.

The rich soils of the American prairies, and the rich soils of the savannas of the world, were developed by grasses and soil biological activity alone. But this is a thousand-year process and we

don't have the time. We cannot rely on such a slow process to loosen and aerate and develop our soil to correct Global Warming.

The life cycles of trees as they grow and die and fall and so aerate the soil is efficient, but it is much too slow for our now desperate need to create masses of planet saving organic matter. And even the benefit of an uprooted tree is pointless if grasses are not then permitted to develop for lack of sunlight in the loosened, but shade covered soil. Permanent forests are no answer. Permanent forest soils are always poor soils, and stay poor soils.

Grasses and soil cultivation procedures and the implements involved become the important factors in rapid soil development. With the right cultivating implements, if we are wise, we can do the same job a tree does by growing and dying and falling over, and do it three or four times a year. Not just once in a tree's lifetime. New implements can now produce almost perfect soil fracturing, with the exact degree of looseness and friability that promotes maximum grass growth and maximum biological activity. Soil has to be loosened, but not inverted. Soil must be made ready to allow for the easy entry of air and water, and the easy penetration of meandering roots. Today, with chisel ploughs and subsoiling ploughs, that total process can be unbelievably fast and extremely efficient.

With good soil preparation and following rain, the grass seeds germinate. They then thrive and proliferate in an explosion of soil creation. The presence of grazing animals in the cycle actually accelerates the rapid soil creation.

In the chapter following, **HISTORY OF TWENTIETH CENTURY SOIL CONSERVATION AND KEYLINE**, we discuss in detail how soil is created naturally and how sensible farming practices can accelerate the process. We also discuss how we, the consuming public, can positively ensure farmers create fertile soil.