

Oh my gosh! I couldn't dream of accepting a dinner invitation

by Phil Gregory, 25 Sept. 2019

I would have to ask you so many questions about the source of your ingredients, for the meal you so lovingly put together. What if all the ingredients were just fine, except for the black pepper you sprinkled all over? I panic at the thought of how I will offend you, be deemed completely lacking in social graces or at best highly eccentric.

But wait a minute, shouldn't everyone be concerned about the source of their food? Have you not heard that you are what you eat? It turns out that science is now providing a sound basis for this belief, perhaps just in time, because we have been spraying every living thing with more and more toxic chemicals under the slogan of feeding the world. Under this industrial agriculture paradigm, referred to as the "Green Revolution," many farmers wake up asking what chemical they are going to use today and how can they keep their children safe from the sprays.

Now you are beginning to get a taste of my life or more correctly our lives, as my wife, Jackie, is on the same page. We have been on a journey of health discovery for almost 40 years all the while maintaining active careers in teaching and research. I started this health journey late in my 30s. I was a young professor at the University of British Columbia in the Physics and Astronomy Department. For years I had suffered occasional migraines but they became more frequent and I was experiencing a lot of brain fog and occasional intestinal pain. As an academic, brain fog is incapacitating. Imagine, I would have to read each sentence 3 times for it to register. I decided to go off coffee and tea because of intestinal pains and their negative effect on my sleep. I started having apple juice instead and took pride in finding the best price. I look back in horror from my current state of knowledge, because apples are regularly high in the so-called "Dirty Dozen," the 12 fruits and vegetables with the highest concentrations of pesticides. To think I was drinking the cheapest variety!

A naturopath to the rescue

The brain fog made it very difficult to prepare and give lectures. I did the rounds of doctors and specialists and they all declared that they couldn't identify any problem. Meanwhile Jackie was having her own health issues. After an operation she asked her surgeon why she had needed the operation. The only answer she got was a recommendation to lose weight. Fortunately, she decided to try out a naturopath which I have to admit I was very skeptical about at the time. On her first visit to the naturopath I received a call to come and collect her because she had just fainted. When I arrived she assured me that she was fine apart from a migraine.

Her visits to the naturopath were clearly of great benefit because she rapidly lost her excess weight and her energy level soared by eating real foods and more organic. I went knocking on the naturopath's door and came away with lots of interesting reading about yeast infections and testing for food sensitivities using an elimination diet. I tried out the elimination diet, where you go off all the foods you regularly eat, which left me with some vegetables and rice. After 5 days, I started feeling absolutely amazing. My brain was firing on all 8 cylinders. I was cured! It was really a black and white change. I was clearly reacting to many of the foods I was eating. Once I went back to my regular diet

the fog and migraines came right back. The slow disciplined process of only adding one new food back every two days took another 3 years with many minor setbacks. One of my most challenging food sensitivities is black pepper because it is in so many products.

I came across frequent mention of a leaky gut being responsible for food sensitivities and that it was due to an overgrowth of yeast which was making my gut lining porous. I tried repeated yeast kills followed by probiotics but only noticed temporary improvements that would last for about 6 weeks. With leaky gut we become sensitive to the foods we eat most commonly so I started rotating my diet. I don't eat the same thing again for at least 3 days. Since I adopted this approach, I have not developed any more food sensitivities, but it requires considerable discipline to keep this up. Fortunately, Jackie is very supportive but it often means we are each cooking our own but different meals. Our kids are now accustomed to the fact that when we visit we usually bring our own meal or provide many organic ingredients for the Christmas dinner, for example. Some of them have their own food sensitivity challenges and it is becoming much more common in the population. Restaurants are generally accommodating but it is still the rare restaurant that offers all organic, so we eat out very infrequently.

Over the years I have learned to manage my health by eating all organic and plenty of garlic (a natural yeast killer). I have also noticed significant benefits from using a digestive supplement and probiotics. I am particularly pleased with my mental acuity because I so much enjoy my academic interests. The eating and drinking side of our social life has changed fundamentally. It was too painful to go backwards, so we started training our friends that we would prepare and bring our own meals to any social function we attended. We were only light drinkers before but now we have abandoned alcohol altogether. I had discovered it was one of my migraine triggers.

It was especially challenging for me to attend conferences because a lot of the bonding with other scientists goes on over meals. I always have to find accommodation which enables me to cook. Juggling shopping, food preparation and attending a busy conference in a foreign country is a big challenge. I recall on one occasion two scientists asked to join me for lunch at a meeting in Porto, Portugal to ask me about my research. I invited them to join me at the nearby railway station that had some street vendors selling roasted chestnuts. The station was decorated with beautiful ceramic tiles. We found a quiet bench on the platform where we could talk and enjoy the chestnuts. In the long run being a food sensitive canary has increased my consciousness of the growing toxicity of the modern world.

A turning point, the end of farming

Forty years have gone by. I have been retired now for 17 years but I am still active in research and affiliated with UBC. Until 4 years ago, I was immersed in one of the most exciting adventures in astronomy, namely the discovery of planets orbiting neighbouring stars in the Milky Way. I was looking forward to the discovery of life on another planet in perhaps the next few decades. However, there was a problem, at least one that was new to my consciousness.

“Only 60 Years of Farming Left If Soil Degradation Continues.” This announcement by the UN Food and Agriculture Organization appeared in *Scientific American*^[1] on 5 Dec. 2014 and the world carried on, but not quite. I was sufficiently shocked by that announcement that I decided that I needed to drop what I was doing and carry out my own investigation to see what, if anything, could be done. I like to think that I transitioned from exoplanet research to exploring what is necessary to sustain human life on planet Earth. The importance of my decision was reinforced in 2017 when the UK

Environment Minister, Michael Gove, warned^[2] that the UK is 30-40 years away from eradication of soil fertility. You have to wonder what the situation will be like once half that time has elapsed.

The start of my journey

My decision led me on a fascinating 4 year journey into current agricultural practices, soil biology, desertification, animal grazing, climate change, and plant and human health. I learned about some amazing advances that have been made in the last 20 to 30 years and especially in the arena of soil biology, and understanding nature's complexity. As part of this journey I completed 4 courses given by one of the pioneers of this soil biology revolution, Dr. Elaine Ingham.

Along the way I kept running into the interconnections between agricultural practices, soil health, climate change, and human health. In the course of this essay I will try to make these connections clear.

We have been converting living soil to dirt

Here are some of the initial surprises I came across. The common plow is responsible for turning living soil into dirt. Healthy soil is teeming with billions of microbes in every teaspoon. The microbes include bacteria, fungi, and a host of their microscopic predators. The bacteria and fungi, using biotic glues and fungal strands (called hyphae) create underground cities to live and work in. The doors and windows in their buildings allow air and water to penetrate to great depths, allowing plant roots to grow up to 30 ft deep in some healthy soils. There is a stunning diversity of these microbes in each gram of healthy soil.

The microbes are nature's way of providing all the nutrients that plants require without the use of fossil-fuel based chemicals. Apart from their role in re-cycling dead plant and animal matter, bacteria and fungi secrete enzymes and organic acids that allow them to extract all the other nutrients plants require from the rocks, sand, silt and clay, as well as nitrogen from the atmosphere. We only recently learned that the largest mining operation in the world is run by fungal microbes^[3]. They literally tunnel through the rocks, sand, silt, and clay and extract all the elements they are made of and provide them to the plants in just the right proportions. We can see their mining tunnels under a microscope^[4].

All this changes when we plow the soil. This devastates the homes of the microbes which are held together by biotic glues and fungal strands. Without the soil structure, soil is easily washed away or blown away by winds. For every ton of food produced by conventional agriculture we lose approximately 7 tons of topsoil^{[5][6][7]}. In addition, for every 10 calories of input energy we put into the food system, we only deliver about 1 calorie for human nutrition^{[8a][8b]}. Nitrogen fertilizer production uses large amounts of natural gas and some coal, and can account for more than 50 per cent of total energy use in conventional agriculture^[8c]. Since we need to get off of fossil fuels, the industrial agricultural model clearly has no long term future.

According to Dr. Elaine Ingham, the so-called green revolution, the use of fossil-fuel based fertilizers, simply reflects the damage we have done to our soils. Without the microbes to provide the nutrients plants require and build soil structure, soil becomes dirt and then the only way to grow plants is to add chemicals. We just haven't understood nature's important role for the microbes. Fortunately, we can restore the microbes to the soil by inoculating the soil with good compost or by spraying with a compost extract or tea made from the compost. It is important to ensure the compost is teeming with a good selection of soil microbes using a soil microscope.

Nature's barter system

Another important part of the soil biology revolution, is the discovery that plants release up to 40% of the sugars they produce from photosynthesis directly through their roots, to attract and feed the soil microbes. These carbon compounds, which are called root exudates, provide the energy source to run the microbe recycling and mining operations that provide the other 39 elements that plants need to grow strong and healthy. As mentioned above they are able to mine the nutrients from the rocks, sand, silt, and clay. This is nature's barter system in which the plants provide the microbes with sugars in return for all the other elements they require. Lichens (a symbiotic relationship between a photosynthesizing alga and a fungus) started making soil on this planet over 400 million years ago, a process called pedogenesis.

In this picture, it is important to acknowledge the crucial role of the microscopic predators of the bacteria and fungi which include protozoa, nematodes, and microarthropods. Most of the bacteria and fungi store the nutrients they extract in high concentrations in their bodies because these are the nutrients they need for their life. Their microscopic predators do not require these nutrients in such high concentrations and so when they eat the bacteria and fungi they poop out the excess in a plant available form. As we will see shortly, this is all happening right next to the plant roots. In addition, there is a hierarchy of larger predators including springtails, mites, millipedes, centipedes, fly larvae, beetles, earthworms, spiders, burrowing animals. In nature high biodiversity translates into population stability and resilience.

Unfortunately, in chemical-intensive agriculture, plants soon become addicted to the nitrogen, phosphorus, and potassium fertilizers and stop providing the carbon compounds (root exudates) to power the microbes. The plants are weakened from not receiving the full complement of elements in just the right proportions nature intended. The plants become susceptible to insects and disease, leading to the need for insecticides and fungicides. The chemical route produces plants that look like plants but are deficient in many trace elements. This was established in a study that lasted from 1927 to 1991^[9]. Since the introduction of genetically engineered crops in the 1990s, there has been a massive increase in the use of chemical herbicides that are chelators^[10a]. These bind to metals like zinc, magnesium, manganese, iron, and copper making them unavailable to the growing plant. You need to eat many oranges today to get the same nutrients that your grandparents got from one orange when they were young.

Our choice, we can put more carbon into the atmosphere or sequester it in the soil

In the 1990s, Dr. Don Reicosky and colleagues of the USDA made a surprising discovery. They found that 15 times more carbon dioxide was released during a 24 hour period after the soil was plowed to a depth of 28 cm, than from the neighbouring untilled soil^[11]. When the sample period after plowing was extended to 21 days the emissions were still 10 times higher. Now carbon dioxide gas is invisible and odourless so it came as a real shock to find out how much extra greenhouse gas was produced by plowing and how unsustainable plow based agriculture is. Apparently, plowing wakes up opportunistic r-strategist soil bacteria which rapidly increase in numbers. They convert stored soil carbon into carbon dioxide that escapes into the atmosphere.

Another huge role that microbes can play is sequestering carbon in the soil, a powerful way to draw down carbon from the atmosphere. Even if we stopped all human emissions today the climate would still continue to warm. We have to actually remove some of the excess carbon from the atmosphere. It

now appears that we can [efficiently return carbon to the soil](#)^{[12a][12b][12c][12d][12e]} by utilizing nature's biological solutions to change the way we do agriculture. If we make these changes, nature will do a lot of the work for us through the actions of the soil microbes.

It is expected that as the soil takes up more carbon from the atmosphere the ocean will release some of its excess carbon to the atmosphere in a re-balancing, so it may take a long time before atmospheric carbon actually declines. Of course, this re-balancing will be good for life in the oceans and the extra carbon in the soil will increase soil fertility and rehydrate the soil allowing for more plant growth, more transpiration and more cooling. Each gram of extra soil carbon can hold approximately 5 grams of extra water.

The soil carbon sponge

Didi Pershouse, author of '[Understanding Soil Health and Watershed Function](#)', uses a useful analogy between soil that has been turned to dirt and a pile of baking flour. If you simulate raining water onto a pile of flour it erodes off the surface layer. Very little water penetrates into the pile because the smaller flour grains fill the surface voids between the larger grains and just below the surface the pile is dry. But when you add biology to the flour in the form of yeast, a fungus, and make bread, the flour now has structure and acts like a sponge. When you rain water on the bread it soaks in (infiltrates) and is stored, and there is no erosion. The microbes in healthy soil provide a similar sponge like structure which is referred to as the soil carbon sponge.

Through plowing and chemicals we destroy the biology and soil structure. This results in more frequent floods, much greater sensitivity to drought, and landscapes more prone to fire. The way we have been practising agriculture has reduced soil carbon from about 4% in native soils to 1% or less in most agricultural soils today. We need to rehydrate our soils by building up the soil carbon sponge through a healthy soil biology. That sponge structure is created by the microbes building their underground cities. The Australian soil ecologist, Dr. Christine Jones, provides an excellent explanation of how soil biology can restore soil carbon and rapidly build topsoil^[13].

Nature's complexity is amazing

Well after two pages on the magic of soil, I have just scratched the surface of what has emerged in the past 20 to 30 years. I think you can probably gather there has been a paradigm shift in our understanding of how to do agriculture in a sustainable way and it is all about biology. Much of the new findings have to do with the soil's microscopic organisms. It turns out we have also learned a lot recently about how nature evolved large herbivores and their predators to build and maintain healthy grasslands.

For 10,000 years we did not understand the complex web of interactions between grassland, herbivores, and their ferocious predators. In our ignorance we have turned much of the world's grasslands to deserts. As the African biologist Allan Savory has shown, it is not the numbers of animals that is responsible for desertification, it is our failure to manage the grass recovery time that was achieved by nature through a balance of herbivores and predators. The predators keep the herbivores bunched together and moving so they don't get to eat the grass a second time as it starts to regrow and recharge the plant roots. By the time they return from their migration, the grass is fully grown and needs to be eaten. With our new understanding, we now see how herbivores like cattle, sheep, and goats can be a big part of the solution to desertification and global warming^[14]. For more on

this see the last 1/3 of my video^[15] [‘The Magic of Soil’](#). This new form of grazing is very different from current grazing practices and the use of feedlots. It is not herbivores that are responsible for the damage it is how we manage them. Its not the cow it’s the how.

Nature is so complex any human planning is bound to fail sooner or later

Everything in nature, from the microbes to the largest animals, has a role to play in maintaining our complex biosphere. We need to recognize that we are not separate from nature, but instead treasure our growing understanding of its complexity. Nature is a bank of natural capital that our very existence depends upon. Most current human management systems are rapidly depleting this natural capital. Our society is too set up to reward individuals who claim to have created a new magic bullet to solve some particular problem which almost invariably has massive unintended consequences.

We need to acknowledge, that in the face of the almost unlimited complexity of nature, any human solution to an isolated problem is almost certain to fail at some point. According to Allan Savory, management systems need to assume this from the outset and be constantly monitoring for the first signs of this failure so we can act proactively and re-plan. This is essential thinking for military planners on the ever changing battlefield. The complexity of nature, of which we are part, warrants no less. Allan Savory has spent 40 years developing such a management system. His latest book^[16] on the subject written with his wife Jody Butterfield is entitled ‘Holistic Management: A Common Sense Revolution To Restore Our Environment’. I have attempted to provide a viewpoint of this topic from 30,000 ft entitled, ‘Co-creating with Nature: An Exploration of Holistic Management’^[17].

Sustainable agriculture is not enough

Earlier, I mentioned the move towards sustainable agriculture. Actually, this is not sufficient because that means sustaining a badly degraded resource. We need to move to regenerative agriculture where we rebuild the soil biology and sequester atmospheric carbon at the same time as we grow food. Regenerative agriculture is all about mimicking nature, based on our new understanding of soil biology and nature’s complexity. After a transition period of several years this can eliminate the need to use fossil fuel based chemicals. Through regenerative agriculture, we have the possibility of drawing down each year as much greenhouse gas as humans are emitting^{[12a][12b][12c][12d][12e]}. Of course, we still need to cut our emissions at the same time.

Some of the other benefits of regenerative agriculture are greater water infiltration and storage, reduced flooding and erosion, drought-resilience, reduced use of fossil fuels (for plowing, making fertilizers and pesticides), reduced input costs for farmers, greater biodiversity both above and below ground, and more nutritious chemical free foods.

Soil foodweb and soil microbiome

Healthy soil contains approximately 15 tonnes of biological organisms per hectare, equivalent to the weight of 20 cows^[18a]. This includes a huge diversity of bacteria and fungi, and a hierarchy of predators. This is commonly referred to as the soil foodweb and all the genetic material these microbes contain is referred to as the soil microbiome. This is nature’s impressive underground work force that we can harness, if we stop focusing on killing it the way we have been doing with industrial

agriculture. For too long, we have been unaware of the essential role these soil microbes play, just as we have been unaware of the importance of the vast array of microbes that live in and on every human.

Recently, a new census was carried out of the estimated 550 Billion tonnes of carbon that is distributed among all of the kingdoms of life on Earth^[18b]. Plants account for 82.5% of the total carbon based life. Remarkably, microbes account for 17.1%, and all the rest (including insects, fish, molluscs, livestock, humans, other animals and birds), accounted for only 0.4%.

Human microbes and the human microbiome

It turns out we have a vast array of microbes, resident in our bodies and on our skin. While bacteria are thought to be a big player, they also include fungi, archaea, viruses, and others. The biggest concentration is about 3 to 4 pounds of microbes living in our gut. We are dependent on these microbes to help digest our food, produce certain vitamins, make neurotransmitters needed by our brain, regulate our immune system, and keep us healthy by protecting us against disease-causing bacteria.

It wasn't that long ago that we thought almost all bacteria were pathogens. In reality the pathogens are kept in check by the much greater number of beneficial bacteria. Every day we are learning more about how our health depends on our microbes. It is currently the hottest topic in medicine. Our microbes even outnumber the cells in our body. Current estimates of the number of human microbes range from 1.3 to 10 times the number of cells. You might think we are human because of our DNA but our microbial DNA has from 100 – 1000 times more genes^[19]. So open your mind and behold our new idea of you.

Effect of antibiotics on our microbiome

Antibiotics have helped bring about an amazing decline in infectious diseases but at the same time there has been a rapid rise in chronic diseases. Back then we thought all bacteria were pathogens and we didn't know about all the bacteria living in our gut. Now we know, but in the meantime it appears that these antibiotics have been destroying essential human microbes^[19b]. Since the 1950s we have been adding antibiotics to livestock feed because it accelerates animal growth and is cheaper than other supplements^[20]. We now use 5 times more antibiotics as feed supplements than for all of human medicine and, no doubt you are aware, that antibiotic resistant strains have become very common in medicine.

All this pales compared to the effect of glyphosate, the biggest agricultural biocide spray in the world. It is not well known that glyphosate is also a very effective antibiotic^{[10a][10b]}. When glyphosate was first introduced in the 1970s it was promoted as perfectly safe for mammals. Back then we didn't know about our gut microbiome. In 2018, the U.S. alone sprayed 300 million pounds^[21] of glyphosate which is a staggering 39 times the 7.7 million pounds of antibiotics used in the U.S. for medicine. We are now in the midst of a first world epidemic of chronic diseases which is predicted to bankrupt the U.S. economy within only 17 years^{[22][23][24]}. The threat of antibiotic overuse goes far beyond resistant infections.

Glyphosate, the active ingredient in Roundup[®], is much better known as a broad-spectrum herbicide that is used in more than 700 different products from agriculture and forestry to home use^[21], to kill anything deemed to be a weed. Glyphosate is a potent chemical that kills any plant it is sprayed on that hasn't been genetically engineered^[22]. The pace of spraying greatly increased when genetically engineered glyphosate-tolerant crops were introduced in 1996. Then, instead of needing to be sprayed

selectively, it became possible and convenient to spray the whole field with the herbicide, including the cash crop. The amount used has been doubling every 6 years. Worldwide we are now about 5 billion pounds per year. This is leading to a rise in glyphosate resistant weeds which is posing a serious problem for farmers relying on this technology^[25a]. Actually, herbicides do not induce resistance in weed species, rather they simply select for resistant individuals that naturally occur within the weed population. Once a resistant plant has been selected, repeated use of a herbicide over multiple generations allows resistant plants to proliferate as susceptible plants are eliminated.

Monsanto has patented glyphosate as an antibiotic, an anti-parasitic, an anti-malarial, and as a chelator (ties up minerals so they are not available for essential aspects of the plant biology)^{[10a][10b][10c][22]}. It is also water soluble and has now infiltrated every sector of the water cycle. It even comes down in the rain.

Glyphosate sprayed on some crops just before harvesting

Glyphosate is also commonly sprayed on crops just before harvesting, to kill the crop^[25b]. It allows farmers to harvest crops such as wheat as much as two weeks earlier than they normally would, reducing the risk of a poor harvest in northern, colder regions. The killing of crops with glyphosate began in Scotland in the 1980s but is now common in wheat-growing areas of North America such as the upper Midwestern U.S. and Canadian provinces such as Saskatchewan and Manitoba^[26].

Remember glyphosate is a very effective antibiotic, especially for our intestinal microorganisms^[10b], so we are getting antibiotics freshly delivered to us in our food ready to decimate our gut bacteria. According to Dr. Bush, this increases the gluten to fibre content^[26] of the wheat, creating wheat that is abnormal for the body to handle. This, coupled with the synergistic effect of the glyphosate absorbed into the crop, causes the gluten sensitivity leaky gut effect that started to appear in the 1990s. This was the beginning of an epidemic of celiac disease and frequent issues around bloating, fatigue, brain fog, insulin resistance, poor sex drive and infertility. According to Dr. Bush, when people took gluten out of their diet they started to get better.

Our gut, where a lot of the microbes reside, is part of the gastrointestinal (GI) tract that takes in food, digests it to extract and absorb energy and nutrients, and expels the remaining waste as feces. It is lined by a single one cell thick membrane that has the area of two tennis courts. The cells of the gut membrane are joined by velcro like molecules that are designed to loosen temporarily, to allow only certain digested food into the body and waste matter out. Dr. Bush's lab has shown how glyphosate can damage this velcro, giving rise to a leaky gut^[22]. This can allow undigested food particles to enter, triggering the immune system to attack, creating food sensitivities and long term inflammation leading to a wide range of chronic diseases. These diseases are epidemic in scale, which implies environmental triggers rather than genetic or age-related causes.

How does glyphosate kill

Glyphosate blocks an enzyme pathway, called the Shikimate pathway^[27], in plants, bacteria, fungi, algae, archaea and some protozoans. These enzymes are responsible for making from 4 to 6 essential amino acids that produce some of the most important compounds in food and are some of the building blocks of proteins in our body. According to Professor Don M. Huber, glyphosate gives the plant, and many of the supporting microorganisms, the equivalent of AIDS^[28]. It essentially shuts down plant immunity. The plant then dies from disease due to its compromised immune system. Huber, is

Professor Emeritus of plant pathology at Purdue University. For many years he has advised U.S. agencies on bio-terrorism and biological warfare. Many of his invited talks and interviews are available on YouTube.

Plants are normally a source of organic compounds called alkaloids. Alkaloids have a wide range of beneficial activities for human health including anti-parasitic, anti-diabetic, anti-cancer, anti-hypertensive, anti-mood disorder, anti-depressant, anti-Asthma, anti-eczema, antimalarial, analgesic, to name just some. About 20% of plant species accumulate alkaloids, which are mostly derived from amino acids, e.g., phenylalanine, tyrosine, tryptophan, and lysine. The first three of these amino acids are not produced when the shikimate pathway is knocked out by glyphosate. According to Dr. Bush, if we added a chemical to our food chain that wipes out all the production of alkaloids in our food, we would have just lost the medicinal quality of our food that has existed for thousands and thousands of years^[22].

Table 1 New First World Epidemics

Autism 1:36	(in 1975 one in 5000 children with autism, by 2010 one in 100) by 2035 expect to hit 1:3 children with autism	
Attention deficit 1:8		
Asthma 1:10		
Allergy 1:4		
Diabetes 1:4		
Obesity 1:3		
Major depression 1:2		
Cancer 1:2	(expect this to reach 70% by 2035, does not include skin cancers)	
Infertility	1:4 females infertile	1:3 men infertile

**In 1965, 4% of the US population had a chronic disease
Today, 46% of the children have chronic disease**

Reference: Dr. Zach Bush, Jan. 2019 <https://www.youtube.com/watch?v=HL6OPzQe9Is>

The rise of autism and other chronic diseases

Table 1 summarizes the current state of affairs for 9 of the more common chronic diseases^[22]. Some of the building blocks that are being deleted in the human gut, because of the effect of glyphosate on our microbes, include phenylalanine, tyrosine, and tryptophan^[27]. These are needed for the production of neurotransmitters like dopamine, serotonin and melatonin. We are seeing a rapid rise in all kinds of neural disorders. For example, the incidence of Autism in the U.S. is now 1 in 36 people (1:36), up from 1:5000 in 1965. The projection is that it will reach 1:3 by 2035. It turns out that our gut microbes are responsible for the production of 50% of our dopamine and 90% of the serotonin^{[28][29]}. Deficient dopamine is associated with a decreased ability to feel pleasure and with low drive and motivation. Serotonin is responsible for our sense of happiness and well being.

We now realize that autism, attention deficit disorder, major depression, allergies, obesity, diabetes, cancer, and infertility, are just some of the many chronic diseases that have exploded in the last 20

years. According to Dr. Huber there is an epidemic of 32 diseases that are related to glyphosate shutting down our access to key nutrients.

Glyphosate in breast milk and safety regulations

In 2014, a non profit consumer education group, “Moms Across NA,” raised money to test for glyphosate in the breast milk of 10 of their members who were trying to stay away from Roundup® and glyphosate^[30]. Five had detectable levels and sadly three had levels that were 760 to 1600 times levels allowed in EU drinking water. The study also found that urine from American mothers contained levels of glyphosate ten times higher than urine from European women. Note, the maximum acceptable level of glyphosate in Canadian drinking water^[31] is 2800 times higher than European levels^{[32][33]}.

We were always assured that glyphosate biodegraded rapidly, but this appears not to be the case. According to Dr. Huber, glyphosate is a very robust chemical^[28]. When it gets into soil the majority of it binds to soil minerals and degrades only very slowly, on time scales ranging from 220 days to 6 years^{[34a][34b][34c]}. The remaining glyphosate, that is not bound up, is broken down quickly on a time scale of the order of 10 days^[34a] to a compound called AMPA^[35]. This latter value is typical of the time scale that is widely reported for the half-life of glyphosate. Unfortunately, AMPA is just as toxic as glyphosate^[27] and the carbon phosphate lyase enzyme, required to break down AMPA, is extremely rare in our soils^[28]. Thus, the degradation of all toxic stages in the breakdown of glyphosate, all the way down to CO₂, phosphorus, and water, can take a very long time.

Dr. Mercola interviewed Dr. Huber in 2013 on ‘The Failed Promises and Flawed Science of Genetic Engineering’. Here is a quote by Dr. Huber pertaining to glyphosate^[36]. “The EPA is repeatedly approached by the companies that say that we have to increase the amount of glyphosate that we can have in our food, so we can have a safe product – not based on science but based on how much chemical is actually in our food. May 1, they just doubled the amount of glyphosate that can be in our food. In soybean oil, you can have 40 parts per million. Dr. Monika Kruger’s research at the Leipzig University shows that a tenth of a part per million is all that it takes to kill your Lactobacillus, Bifidobacterium, and Enterococcus faecalis. Soybean oil is now allowed to contain a whopping 400 times the limit at which it can impact your health.”

According to Dr. Huber unless we stop using glyphosate right away we are doomed! Recently, Zach Bush, a triple board certified U.S. doctor, weighed in on the topic. He spent 20 years working with cancer patients using radiation, chemotherapy and surgery until he realized that cancer had gone from a genetic disease (according to the prevailing view of the medical profession) to an epidemic along with about 30 other chronic diseases. According to Dr. Bush, we are dealing with one of the most extraordinary explosions of disease this human planet has ever seen^[22]. We are killing our microbiome especially with our massive use of agricultural antibiotics. Recently, Dr. Bush’s lab has come up with an antidote to glyphosate called Restore. It works by restoring communications between gut bacteria based on signalling molecules extracted from soil. It promises to be a major breakthrough in our understanding of the basic mechanism of disease.

Fake science on trial in the courts

On Aug. 10, 2018, a San Francisco jury found in favour of a school groundskeeper dying of cancer, whose lawyers argued that a weed killer made by the agribusiness giant Monsanto likely caused his disease. The jury awarded the plaintiff, Dewayne Johnson, \$289 million in damages^{[37][38]}. According to

the Associated Press, Robert Kennedy Jr., a member of Johnson's legal team, said "The jury found Monsanto acted with malice and oppression because they knew what they were doing was wrong and doing it with reckless disregard for human life." Johnson's case was particularly significant because a judge [allowed his team to present scientific arguments](#). Later on Oct. 22, 2018, San Francisco Superior Court Judge Suzanne Bolanos upheld the jury's verdict that found that Monsanto's weed killer caused a groundskeepers cancer, but she slashed the amount of money to be paid from \$289 million to \$78 million.

On Mar. 27, 2019, a federal jury awarded \$80 million to another plaintiff, Edwin Hardeman, after determining that Monsanto's popular weedkiller, Roundup[®], was a substantial factor in causing his cancer, and that the corporation is liable^[39a]. The jury in San Francisco awarded compensatory damages at \$5.27 million and punitive damages of \$75 million.

In May 2019, Monsanto was ordered to pay a couple \$2 billion in the largest verdict yet over a cancer claim^[39b].

In April, 2017, Professor Don Huber gave a talk^[10a] entitled 'Disrupting the Integrity of Nature: Pesticides and Genetic Engineering', at the 35th National Pesticide Forum at the University of Minnesota. In his closing remarks he put up a slide that read, "Future historians may well look back and write about our time, not about how many pounds of pesticides we did or did not apply; but about how willing we are to sacrifice our children and jeopardize future generations with this massive experiment we call genetic engineering that is based on false promises and flawed science, just to benefit the bottom line of a commercial enterprise."

It is now abundantly clear that genetic engineering in agriculture^[40] is really about maximizing the profits of giant chemical companies and seizing control of the world's seed stocks.

Glyphosate in Canada

In case you think this is not a Canadian problem, recent testing of glyphosate in foods by the Canadian Food Inspection Authority show that Western Canada produces food with some of the highest levels of glyphosate in the world. This testing commenced following the announcement that glyphosate is a probable carcinogen (World Health Organization's Agency for Research on Cancer (IARC) 2015). The data was released under a freedom of information request filed by Tony Mitra from Richmond BC^{[41][42]}.

The testing was carried out for all regions of Canada as well as food imported from other countries. The breakdown in Canada is for each individual province, except BC, Alberta, Saskatchewan, and Manitoba which are simply identified as Western Canada. It turns out that glyphosate in food produced in Western Canada was higher than in any other region of Canada^[41]. Quebec was the lowest at 1/3 the Western Canada average. The average level in organically grown produce was 1/4 that for conventionally grown produce. On average, food grown in Canada had a glyphosate level almost double that of imported food from the US. The average for imported food from the rest of the world was about 1/8th the value for Canada. Clearly, you can reduce your glyphosate intake by eating organic or growing your own food.

Whose interests do public health regulators serve

All this begs the question: are government regulators working in the interest of public health or the interests of large multinational chemical companies? Consider that one pesticide, glyphosate, could

collapse North America's economies in only 17 years^[22]. Even Europe extended its authorization for glyphosate for an abbreviated period of five years^[43]. The influence of large corporations on government policy is staggering to behold. That was the subject of the 2015 book by Steven M. Druker, 'Altered Genes and Twisted Truth'. Druker is a public interest attorney who initiated a lawsuit that forced the U.S. Food and Drug Administration (FDA) to divulge its files on genetically engineered foods. This exposed how the agency had covered up the warnings of its own scientist about the risks, lied about the facts, and then ushered these foods onto the market in violation of federal law.

As recently as Jan. 11, 2019, Health Canada reaffirmed its 2017 approval of glyphosate use in Canada which it is required to do every 15 years^[44]. They concluded glyphosate products pose no risk to people or the environment as long as they are properly used and labelled. Clearly, this is much easier to justify when you set the maximum acceptable level of glyphosate in Canadian drinking water^[31] at 2800 times higher than European level^[32].

Clearly the quest for short term profit and growth will never guarantee human survival. Many of our leaders are intelligent people but they appear locked into institutional systems that are leading us in the wrong direction. They are unable to remove the blinders that are preventing them from seeing the bigger picture. From a 30,000 ft view they all seem quite content re-organizing the deck chairs on the Titanic.

So what can we do?

In my 4 year investigation to find out if anything could be done to tackle the looming crises in food security and global warming, I came across the epidemic of chronic diseases and their strong connection with current agricultural practices. I found that our new understanding in soil biology and nature's complexity offers tremendous potential to tackle food security, climate change and epidemics of chronic disease, provided we move quickly to regenerative agriculture. This would require us to change the way we manage herbivores, stop plowing and greatly reduce many agricultural chemicals and completely eliminate others which are devastating to human health and soil health. ***By changing the way we do agriculture we can tackle all three of these existential problems. That is quite frankly amazing!*** We would be enlisting nature's soil biology and collaborating with nature, not killing it.

What was just as surprising to me is that this new knowledge is not widely appreciated. As an outsider I have been able to span many different silos of knowledge not hampered by the blinders of specialization. As an astrophysicist, it is almost as if I have come exploring from another planet. Pockets of this new understanding exist all around the world^[45] and it has been happening on some pioneering farms for several decades^[12c]. However, it is sufficiently new for our institutions, that it is still not taught in most agricultural schools. From my observations, many academics in agricultural research are still researching how to fine tune conventional chemical-intensive agriculture. They appear to be unaware of the revolution in soil biology as their papers don't even mention soil biology. The soil microbiome should be the hottest topic in agriculture as the human microbiome is in medicine.

So what is to be done? At this point we need to take a closer look at how our institutions work. Humans have created institutions as an efficient way to provide public services like government, health and safety, military, legal, and academic, based on the operating paradigm of the day. Unfortunately, when the paradigm changes the reward system and dynamics of the existing institutions results in the same institutions resisting any shift to a new paradigm. For example, a farmer who stops plowing is no longer eligible for crop insurance and will not receive a bank loan to buy seeds without using chemicals. Institutions only change when the belief system of the society has moved beyond the old

paradigm and institutions realize they are out of step. In addition institutions, do not generally think holistically but are focused on protecting the funding for their own silo, profession or domain of influence. Allan Savory has given a lot of thought to this topic and his latest insights (Sept. 2018) are available on YouTube^[46].

The path forward is clear. We need to spread awareness of the human health crisis that has unfolded from unsustainable chemical-intensive industrial agriculture. There is an alternative, called regenerative agriculture, where we mimic nature and work with nature's incredible work force of soil microbes. We need to pay close attention to where our food comes from and the ecological footprint of how it is being grown^[47]. This is happening through changes in consumer spending as people decide to eat more organic to avoid a life of chronic disease for themselves and their children. Food distributors have already had to make the change for European markets who are demanding GMO free crops. Jeffrey Smith^[48], a leading American consumer activist and educator on the dangers of glyphosate and GMOs, estimates that it will only require 5% of the population to buy organic for a tipping point to occur away from GMO/chemical producers.

We also need to ask our political, corporate, media and other institutional leaders questions that make it clear they are out of step with the a new ground swell of awareness that:

soil health = food health = planet health = human health.

Once we turn that corner, I will again be able to dream about accepting a dinner invitation.

References

- [1] Chris Arsenault, Scientific American, 5 Dec. 2014
<https://www.scientificamerican.com/article/only-60-years-of-farming-left-if-soil-degradation-continues/>
- [2] Bibi van der Zee , 'UK is 30-40 years away from eradication of soil fertility, warns Gove', Guardian Tue 24 Oct 2017
<https://www.theguardian.com/environment/2017/oct/24/uk-30-40-years-away-eradication-soil-fertility-warns-michael-gove>
- [3] Jenifer Fraser, 'The World's Largest Mining Operation is Run by Fungi', Scientific American, 5 Nov. 2015
<https://blogs.scientificamerican.com/artful-amoeba/the-world-s-largest-mining-operation-is-run-by-fungi>
- [4] R. Landeweert et al., 'Linking plants to rocks: ectomycorrhizal fungi mobilize nutrients from minerals', Trends in Ecology & Evolution 16, no. 5 (2001): 248-254
https://www.researchgate.net/publication/223028235_Linking_plants_to_rocks_Ectomycorrhizal_fungi_mobilize_nutrients_from_minerals
- [5] David R. Montgomery, 'Growing a Revolution: Bringing Our Soils Back To Life', professor of geomorphology
a) paperback 10 July 2018
b) YouTube video 17 May 2017 <https://www.youtube.com/watch?v=c4p-kQ6D8aA>
- [6] Kurt Lawton, 'Economics of soil loss', Corn + Soybean Digest, 13 Mar. 2017
<http://www.cornandsoybeandigest.com/soil-health/economics-soil-loss>
- [7] Jason Bradford , 'One Acre Feeds A Person', Farmland LP, 13 Jan. 2012
<http://www.farmlandlp.com/2012/01/one-acre-feeds-a-person/>
- [8a] Melissa C. Lott , '10 Calories in, 1 Calorie Out - The Energy We Spend on Food' Scientific American, August 11, 2011
<https://blogs.scientificamerican.com/plugged-in/10-calories-in-1-calorie-out-the-energy-we-spend-on-food/>
- [8b] Joe Cornelius, Ph.D., Program Director Advanced Research Projects Agency-Energy, 'Counting Calories'
https://arpa-e.energy.gov/sites/default/files/2017_Cornelius_FastPitch_Final.pdf
- [8c] J. Woods et al., *Philos Trans R Soc Lond B Biol Sci.* 2010, 365(1554), 2991–3006 doi:[10.1098/rstb.2010.0172](https://doi.org/10.1098/rstb.2010.0172)
- [9] David Thomas, 'A study on the mineral depletion of the foods available to us as a nation over the period 1940 to 1991', Nutrition and Health 2003;17(2), 85-115.
<https://www.ncbi.nlm.nih.gov/pubmed/14653505>

- [10a] Don M. Huber, keynote talk at the 35th National Pesticide Forum, April 2017
<https://www.youtube.com/watch?v=dwlTZRWlJYU&index=5&list=PLHSSIfcgFy5cXcht1lxwIbAPekpNPmYQ>
- [10b] Dr. Joseph Mercola interview of Professor Don M. Huber,
<https://www.gentechvrij.nl/plaatjesgen/lelystadmercolaandHuber.pdf>
- [10c] United States Patent US 7,771,736 B2
<https://patentimages.storage.googleapis.com/86/6d/8e/2d98b85f6574ef/US7771736.pdf>
- [11] D.C. Reicosky and D. W. Archer, Soil and Tillage Research, Vol. 94, Issue 1, pp. 109–121, 2007
- [12a] David Johnson, New Mexico State University (NMSU), ‘Rapid Carbon Sequestration’
https://www.youtube.com/watch?v=Fdh_j_KOmY
- [12b] David Johnson (NMSU), 2018 EcoFarm Keynote
<https://www.youtube.com/watch?v=dmj611RfBgs>
- [12c] Gabe Brown, pioneering regenerative agriculture farmer, ‘Dirt to Soil’, Chelsea Green Publishing, 2018
- [12d] P. L. Stanley & Jason E. Rowntree et al., Agricultural Systems 162, p.249, 2018
- [12e] W. R. Teague et al., Journal of Soil and Water Conservation, 71, #2, p. 156, 2016
- [13] Dr. Christine Jones, ‘Save our Soils — Dr. Christine Jones Explains the Life-Giving Link Between Carbon and Healthy Topsoil’, interviewed by Tracy Frisch for ACRESUSA, 1 March 2015
<http://www.ecofarmingdaily.com/interview-sos-save-soils-dr-christine-jones-explains-life-giving-link-carbon-healthy-topsoil/>
- [14] Allan Savory at TED 2013, ‘How to fight desertification and reverse climate change’
http://www.ted.com/talks/allan_savory_how_to_green_the_world_s_deserts_and_reverse_climate_change
- [15] Phil Gregory, ‘The Magic of Soil’, <https://www.youtube.com/watch?v=AWILIYSf5ts>
- [16] Allan Savory with Jody Butterfield, ‘Holistic Management: A Common Sense Revolution To Restore Our Environment’, published by Island Press, 3rd Edition, 2016
- [17] Phil Gregory, ‘Co-creating with nature: an exploration of Holistic Management’
<https://www.phas.ubc.ca/~gregory/papers/HolisticManagement%20BowenGregory10Jun2018Sum.pdf>
- [18a] ‘SOIL ATLAS 2015’ jointly published by the Heinrich Böll Foundation, Berlin, Germany, and the Institute for Advanced Sustainability Studies, Potsdam, Germany
https://www.iass-potsdam.de/sites/default/files/files/soilatlas2015_web_english.pdf
- [18b] ‘The biomass distribution on Earth’, Yinon M. Bar-On, Rob Phillips, and Ron Milo, PNAS June 19, 2018 115 (25) 6506-6511
<https://doi.org/10.1073/pnas.1711842115>
- [19a] Rob Knight: ‘How Our Microbes Make Us Who We Are’
<https://www.youtube.com/watch?v=i-icXZ2tMRM>
- [19b] Marin J. Blaser M.D., ‘Missing Microbes: How the Overuse of Antibiotics is Fueling Our Modern Plagues’, Henry Holt and Co. (2014)
- [20] Mareen Ogle, ‘Riots, Rage, and Resistance: A Brief History of How Antibiotics Arrived on the Farm’, Scientific American, 3 Sept. 2013
<http://winewaterwatch.org/2018/01/glyphosate-5-billions-pounds-of-this-poison-sprayed-last-year/>
- [21] W. Shaw & M. Pratt-Hyatt of The Great Plains Laboratory, Inc., ‘The Importance of Testing for Glyphosate: The World’s Most Widely Used Herbicide’, January 2017 issue of Townsend Letter
<https://www.greatplainslaboratory.com/articles-1/2017/1/23/the-importance-of-testing-for-glyphosate-the-worlds-most-widely-used-herbicide>
- [22] Zach Bush, a lecture connecting soil health, and the widespread use of pesticides in the US, to the rising rates of chronic disease
<https://www.youtube.com/watch?v=HL6OPzQe9Is>
- [23] Nancy L. Swanson et al., ‘Genetically engineered crops, glyphosate and the deterioration of health in the United States of America’, Journal of Organic Systems, 9(2), 2014
- [24] Anthony Samsel, Stephanie Seneff, ‘Glyphosate, pathways to modern diseases III: Manganese, neurological diseases, and associated pathologies’, Surgical Neurology International, 2015, Volume: 6 Issue: 1, Page 45, DOI: 10.4103/2152-7806.153876
- [25a] Mark Jeschke and Samantha Teten, ‘Glyphosate-Resistant Weeds in North America’, Dupont Pioneer, Vol. 10, No. 13, May 2018
https://www.pioneer.com/CMRoot/Pioneer/US/Non_Searchable/agronomy/cropfocus_pdf/glyphosate-resistant-weeds.pdf
 More source material: Heap, I. The International Survey of Herbicide Resistant Weeds. Online. Internet. Wednesday, May 29, 2019.
 Available www.weedscience.org

- [25b] Ken Roseboro, 'Why Is Glyphosate Sprayed on Crops Right Before Harvest?', Eco Watch, Mar. 05, 2016
<https://www.ecowatch.com/why-is-glyphosate-sprayed-on-crops-right-before-harvest-1882187755.html>
- [26] Zach Bush in Episode 1 of 'GMOs Revealed' hosted by Dr. Patrick Gentempo, 26 Feb. 2019
- [27] Jeanne D'Brant, 'The Shikimate Pathway, The Microbiome, and Disease: Health Effects of GMOs on Humans'
https://d3n8a8pro7vhmx.cloudfront.net/yesmaam/pages/680/attachments/original/1466869052/GMO_Shikimate_pathway_gut_flora_and_health.pdf?1466869052
- [28] Don M. Huber, 'Nutrition and Disease', Interview by Graeme Sait of nutri-tech – Part 2
<https://blog.nutri-tech.com.au/don-huber-2/>
- [29] Jessica Stoller-Conrad, 'Microbes Help Produce Serotonin in Gut', Caltech, 9 April 2015
<https://www.caltech.edu/about/news/microbes-help-produce-serotonin-gut-46495>
- [30] E. Vinje, 'Herbicide Found In Mother's Milk', Planet Natural Research Center
<https://www.planetnatural.com/herbicide-mothers-milk/>
- [31] CAREX (CARcinogen Exposure) a multi-institution research project that combines academic expertise and government resources to generate evidence-based carcinogen surveillance program for Canada
<https://www.carexcanada.ca/en/glyphosate/>
- [32] EU Drinking Water Legislation, European Glyphosate Environmental Information Source
<http://www.egeis-toolbox.org/documents/4%20Drinking%20water%20legislation%20draft%20v3%20.pdf>
- [33] Lorraine Chow, Results of Glyphosate Pee Test Are in 'And It's Not Good News', EcoWatch, 12 May 2016
<https://www.ecowatch.com/results-of-glyphosate-pee-test-are-in-and-its-not-good-news-1891129531.html>
- [34a] Philip Eberbach, 'Applying Non-steady-state Compartmental Analysis to Investigate the Simultaneous Degradation of Soluble and Sorbed Glyphosate (*N*-(Phosphonomethyl)glycine) in Four Soils', Pestic. Sci. 1998, 52, 229-240
- [34b] Press release Wageningen University & Research, High levels of glyphosate in agricultural soil: 'Extension of approval not prudent.'
 16 October 2017, <https://www.wur.nl/en/news-wur/Show/High-levels-of-glyphosate-in-agricultural-soil-Extension-of-approval-not-prudent-.htm>
- [34c] V. Silva et al., 'Distribution of glyphosate and aminomethylphosphonic acid (AMPA) in agricultural topsoils of the European Union' Science of The Total Environment, Vol. 621, 1352-1359, 2018 <https://doi.org/10.1016/j.scitotenv.2017.10.093>
- [35] Bob Kramer (USDA microbiologist, Prof. U. Missouri) 'Glyphosate in the environment'
<https://www.youtube.com/watch?v=Y0eRsVeudQU>
- [36] Don M. Huber, Dr. Mercola Interviews Dr. Huber about GMOs, published 6 Oct. 2013
<http://mercola.fileburst.com/PDF/ExpertInterviewTranscripts/Interview-DrHuber.pdf>
<https://www.youtube.com/watch?v=yx4UVhJcnp0>
- [37] Daniel Arkin, 'Jury orders Monsanto to pay nearly \$290M in Roundup trial', NBC News, 10 Aug. 2018
<https://www.nbcnews.com/news/us-news/jury-orders-monsanto-pay-290m-roundup-trial-n899811>
- [38] Sam Levin and Patrick Greenfield, 'Monsanto ordered to pay \$289m as jury rules weedkiller caused man's cancer' Guardian, 11 Aug 2018 <https://www.theguardian.com/business/2018/aug/10/monsanto-trial-cancer-dewayne-johnson-ruling>
- [39a] Sam Levin, 'Monsanto found liable for California man's cancer and ordered to pay \$80m in damages' Guardian, 27 Mar. 2019 <https://www.theguardian.com/business/2019/mar/27/monsanto-trial-verdict-cancer-jury>
- [39b] Sam Levin, 'Monsanto must pay couple \$2bn in largest verdict yet over cancer claims', Guardian 13 May 2019
<https://www.theguardian.com/business/2019/may/13/monsanto-cancer-trial-bayer-roundup-couple>
- [40] John Fagan, PhD, Michael Antoniou, PhD, Claire Robinson, Mphil, 'GMO Myths and Truths', 2nd edition published in Great Britain in 2014 by Earth Open Source
<http://livingnongmo.org/wp-content/uploads/2014/11/GMO-Myths-and-Truths-edition2.pdf>
- [41] Tony Mitra, 'POISON FOODS OF NORTH AMERICA: Guide to navigating the glyphosate mine field in our food web', Published 21 March 2017
<https://www.goodreads.com/book/show/34677111-poison-foods-of-north-america>
- [42] Tony Mitra, Resources, Exploring citizens duty on food security, & environmental sustainability issues.
<http://www.tonu.org/resource/>
- [43] Danny Hakim, 'Glyphosate, Top-Selling Weed Killer, Wins E.U. Approval for 5 Years', NY Times 27 Nov. 2017,
<https://www.nytimes.com/2017/11/27/business/eu-glyphosate-pesticide.html>
- [44] CBC News, 'Health Canada stands by approval of ingredient in Roundup weed killer', The Canadian Press Posted: 11 Jan. 2019
<https://www.cbc.ca/news/canada/saskatchewan/health-canada-herbicide-glyphosate-roundup-1.4975945>

- [45] Charles Massy, 'Call of the Reed Warbler: A New Agriculture, A New Earth', Chelsea Green Publishing, 2018
- [46] Allan Savory, 'Hope for Reversing Desertification and Climate Change', 21 Sept. 2018 at Stonewal Farm, Keene, New Hampshire, https://www.youtube.com/watch?v=58Fu1_3EBVU
- [47] Ecological Outcome Verified (EOV™), The Science Inside Land to Market, Savory Institute
<https://www.savory.global/land-to-market/eov/>
- [48] Jeffrey Smith author of [Seeds of Deception & GMO Trilogy \(Book & DVD Bundle\)](#) (2006)
author of [Genetic Roulette: The Documented Health Risks of Genetically Engineered Foods](#) (2007)
video [Genetic Roulette: The Gamble of Our Lives](#) (2012)
video [Secret Ingredients](#) (2018)