Better than Organic

a Conversation with Agricola

By Michael Astera

Q. You were saying Organic farming and gardening aren't really working. How are they not working?

Agricola: They're not working on several levels, including corporate greed, business ethics, and of course "We're from the government and we're here to help you." But that's not what I'd like to talk about today. I'd like to focus on the nutrition aspect, and on soil, plant, and animal health. Specifically, why most Organic food isn't necessarily more nutritious than chemically grown food.

Q. It isn't? That certainly isn't the conventional wisdom. The people who grow it and buy it seem to think it is.

Agricola: Yes, there's definitely a myth or misunderstanding that organically grown means more nutrition. But when tested or assayed for vitamins, protein, minerals, etcetera there is no good evidence that organically grown food is more nutritious than chemically grown grains and produce. Organic growers and consumers don't like to hear this. They seem to believe that it *has* to be better, and of course it is better in one way: it has fewer pesticides, herbicides, and other nasty chemical residues. But these are all negative things, saying what organic food doesn't have. They say nothing about what it *does* have. And the simple fact is that it is possible to grow more nutritious food with standard NPK fertilizers and lime than with just composted organic matter..

Q. What? That's heresy! (Laughing)

Agricola: I know. How dare I say such a thing? Well, for one thing, we're not farming much virgin prairie soil any more. The virgin prairie soil was gone a hundred years ago, and all of our best agricultural soils have been farmed and cropped steadily for at least a hundred years. [In the USA] Most of them are worn out, and many of the soils we're farming today weren't that good to start with. Sure, a lot of them need organic matter, they need humus, but they also need minerals. Manure and compost don't have any more in them than the organic materials they're made from–mostly Carbon, Hydrogen, and Oxygen, which the plant gets from air and water, plus, usually, an unbalanced amount of Nitrogen and Potassium and some humic acids. High Nitrogen and Potassium levels can grow big, lush, healthy looking crops, but they're not balanced nutritionally and they may even be harmful.

Let me give you an example. If you have ever wandered around in a cow pasture you have seen these lush green little patches growing where the manure has landed–big, tall bright green grass that the cows won't touch, won't eat. They'll graze right up to it and all around it but they won't eat it. Why not? It's not just because they're finicky about grazing where they pooped. That lush green grass can actually be poisonous to them. It will make them sick if they eat much of it. It's full of nitrates and incomplete proteins and probably too high in Potassium. After maybe a year, after the winter rains and snow have leached and diluted the manure and the soil microorganisms have gone to work on it, and the grass roots have maybe pulled up some Calcium from the subsoil and mellowed things out, then the cattle will graze that spot again. What do they know that we don't know? Well, they know instinctively what is good for them and what is not; whereas we humans seem to have lost that ability.

And that's the kind of food that most organic growers are growing. They add tons of manure and compost–the more the better, they think–and grow these same kinds of crops that the cattle won't even graze on–big, lush, green, watery crops loaded with nitrates. And too often that's what we're getting when we buy organic.

Q. So are you saying that you think chemical fertilizers are better?

Agricola: Don't get me wrong. I'm no big fan of chemical fertilizers. The right ones used in the right way can grow good, healthful food, but seldom are the right ones used in the right way. Usually the wrong ones are used in the wrong way and they end up killing off the soil life: bacteria, fungi, protozoans etc. which of course leads to erosion, ground water pollution, etc.etc.

However, let's say you used some high quality ammonium sulphate for a Nitrogen source, some single superphosphate, which is just a concentrated form of natural rock phosphate, and a decent Potassium fertilizer like Potassium sulfate or Potassium nitrate (*not* muriate of potash, Potassium chloride. That stuff has the same effect on soil life as pouring Chlorine bleach on your soil would). These are all considered "chemical" fertilizers. And let's say you had spread some gypsum or some limestone or even some dolomite lime on the field or garden the previous year.

Now instead of this imbalanced high Nitrogen, high Potassium situation from manure and compost, you might have the proper amounts of Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulfur plus whatever trace minerals might be in the soil or in the limestone or gypsum you applied.

You will hopefully have a little organic matter in the soil from last years crop roots and residues; you're going to be able to grow much healthier and more nutritious crops than you could possibly get from manure and compost alone, simply because you have a wider and more balanced array of nutrients available. It may not be ideal, but you'll certainly grow better food than from just adding organic matter to a depleted soil.

Q. I guess that makes sense. So would you recommend throwing out the conventional organic approach and using a combination of chemical fertilizers and compost or manure?

Agricola: Not exactly. More like a combination of science and nature. But let's back up a bit. I'd like to talk a little about how we got to this situation with Organic growing in the first place.

Q. Going back to Sir Albert Howard?

Agricola: (laughs)You got it. Albert Howard was a British agriculturalist who was stationed in India for a number of years, from about 1905 to 1924, in an area of poor and worn out soils. He hypothesized that what was wrong with the soil was a lack of organic matter, so he had the locals round up a large quantity of manure and crop residues, which he composted and applied to this worn out soil. I imagine this soil had been farmed for hundreds if not thousands of years. Howard claimed he grew marvelous, abundant crops and that the animals fed these crops were healthy and disease resistant All well and good, but I've always wondered if that was any kind of a solution for the locals. I mean, if they'd been farming and gardening there for hundreds of years, they must have been well aware of the benefits of adding manure and organic matter to the soil. I imagine if the locals had had the ability to round up all their neighbors' manure piles to use on their own crops they might have done so, but their neighbors might have objected. Anyway, Howard didn't invent composting, it was well known in Asia, but he seemed to *think* he'd discovered something new.

Q. Why is that? Weren't they composting and using manure in England?

Agricola: Oh, of course, but not so much as they had done in the past, and it certainly wasn't the modern, scientific thing to do and wasn't taught or encouraged in the colleges Sir Albert attended. In order to explain why, I'll need to go back a little further.

Q. Go ahead.

Agricola: OK. Well, you see, chemistry as we know it really isn't a very old science. Modern chemistry, which is based on knowledge of the 92 natural elements and their properties, didn't really begin until the late 1700's. Dalton isolated Calcium in 1804. Dmitri Mendeleyev didn't publish his Periodic Table of the Elements until the 1870's. Before Mendeleyev, though, some people had come up with some very useful things to do with the new science. In the 1840's, a Paris trained German chemist, Justus von Liebig, burned some barley grains to ash and analyzed what was left. He came up with Nitrogen, Phosphorus, and Potassium. NPK. Von Liebig showed that if he added just N,P and K (K is for Kalium, the name the German alchemists used for Potassium) to the soil, the plants grew well. He reasoned that certain elements had been depleted from the soil over the years and needed to be replaced, and he was right. Von Liebig rejected the prevailing agricultural wisdom of his day, which was the *old* idea that humus, totally broken down organic matter, supplied plants with food. NPK worked great, and it was relatively cheap and easy to manufacture. His discovery was immediately seized upon by the German industrialists, and thus was born chemical agriculture. Humus, composting, and manure were off the fashion runway. All one needed was NPK to grow huge crops and the chemical factories made money hand over fist. So did the farmers, for a while, until it got to the point of diminishing returns, where they had exported the reserve fertility from their soil and had to dump more and more chemical fertilizer on their soil to get results. At that point, which was reached anywhere from ten to twenty years after the introduction of chemical fertilizers to the soil, the chemical factories kept on making money but the farmer didn't. His profit was going to make the industrialists rich. And that's how things have remained to the present day.

Von Liebig has gotten somewhat of a bad rap over the years and has been blamed by some for the excesses of chemical agriculture, but what he really stated was that whatever needed nutrient was in the shortest supply was going to be the limiting factor in how well the plant grew. He called it the "Law of the Minimum".

Von Liebig did realize by 1850 that humus was essential, but by then the industrial chemical factories had taken over and no one listened. The manure piled up in the barnyards and the "modern" farmer didn't need to get his hands dirty with it.

So by the time Albert Howard was going to school in England in the late 1800's it was all chemical fertilizers, all NPK, and organic matter and humus were forgotten.

Is this getting too detailed here?

Q. No, it's fine. You were saying, then, that Albert Howard, later Sir Albert Howard, *rediscovered* the value of humus and organic matter in the soil?

Agricola: Exactly. And, back in England, he proceeded to put his ideas into practice and to write a couple of very influential books–An Agricultural Testament in 1940 and The Soil and Health in about 1947.

Q: And that was the beginning of the Organic movement?

Agricola: More or less. Around 1940 in Pennsylvania, a young health magazine editor named J.I. Rodale happened to read an article about a boy's school near London where the food was grown by the Howard method. A dramatic decline had been seen in the incidence of flu, colds and scarlet fever, except in new arrivals, who soon became well. Rodale read Howard's book, and was so excited that he began corresponding with Howard and soon bought a farm where he began growing crops by this "new" method. Rodale had been sickly. When he noticed an improvement in his own health, he soon became a fanatic.

Q. You're calling J.I. Rodale a fanatic? (laughter) I can see your point. But was that good or bad?

Agricola: Both, I guess. It was good that he was inspired to preach the message of Organic agriculture and to start the magazine that became Organic Gardening Magazine, which got the message out to millions of people. Bad, in that he was pretty much what one might call a one trick pony. Organic matter, compost and humus became the litany and the dogma of the Church of Organic Gardening, no heretics need apply. Understand, I mean no disrespect to either Howard or Rodale. Both of them made valuable contributions in waking people up to the dangers of chemical agriculture and the importance of a healthy, living soil. They just sort of got stuck in simplistic answers. They neglected the all important mineral balance. Howard was of the opinion that composted leaves from forest trees would supply all the minerals necessary. He figured the tree roots would go deep into the earth and pull up any that were needed, which may be true *if* the needed minerals are down there. Pine trees and maple trees, however, don't necessarily need the same mineral balance as cabbages and wheat. Howard's books contain almost no mention of minerals. Neither Howard nor Rodale were well informed chemists or nutritionists.

Although Rodale did recommend the use of lime, phosphate rock, and greensand in his later work, it was never strongly emphasized and was largely ignored by his followers. Rodale himself didn't seem to have much understanding of minerals. Neither of them ever advocated a soil test beyond measuring pH, as far as I know. And how is one to really know what's going on without a soil test?

Q. I agree, although interpreting a soil test is rather complicated, and knowing what to do with the results is even more complicated, isn't it?

Agricola: Sure. And many gardeners and farmers aren't willing to invest the time, expense, and effort in getting a soil test and educating themselves, especially when it's so simple to just pile on more manure, compost, mulch etc. Which is fine, I think, unless they're actually trying to grow real food to grow healthy bodies and keep them healthy.

I've been fascinated for many years with nutrition, medicine and agriculture. In my opinion, real scientific agriculture trumps medicine and it trumps nutritional science. Nutritional science these days is mostly concerned with supplements–vitamins, minerals, amino acids, enzymes, hormones, herbal extracts and all the pills and potions on the health food store shelves. All of these are only needed because the nutrients that should be in our food aren't there. And why aren't they there? Because the minerals aren't in the soil the food is grown in. For example, Zinc has been shown to be necessary for over three hundred metabolic and enzymatic processes in the body. With no Zinc, or not enough Zinc, you're looking at over three hundred vital processes in your body that aren't going to happen. Could this have an effect on your health? And going back to Howard's mulch of leaves, if the rocks that broke down to form that forest soil didn't contain Zinc, there won't be any Zinc in the leaves, will there?

Q. And how does Agriculture trump Medicine?

Agricola: Because Medical care for disease, as opposed to injury, is mostly dealing with the results of malnutrition. Cancer, heart disease, diabetes, arthritis, chronic infections etcetera are largely diseases of malnutrition. This has been shown in thousands of scientific studies for the last century. How much sense does it make to treat malnutrition with drugs and surgery? How much proof do we need? None of these diseases are caused by a deficiency of drugs or surgery. The real nutritionists realize this, so they attempt to alleviate problems by having people change their diets and take supplements, like vitamins and minerals. That wouldn't be necessary if the full complement of nutrients was in everyone's everyday diet.

Q. But Organic farming, at least by the Howard/Rodale method, isn't the answer?

Agricola: Well, I'm sure you can see from what I've said so far what I'm leading up to. Mineral balanced agriculture is the only thing that *can* work. It's the puzzle piece that's been missing from organic gardening, and from nutrition, and from medicine. What we need to do first of all is to figure out exactly what constitutes a perfect or nearly perfect diet for the human body. We can do this. Nutrition is a well advanced science, unlike most of today's agriculture. Much of what has been discovered in nutritional science isn't being taught in the colleges, but the information is there for those who look.

Once we've figured out the nutrients we want in our food, then we figure out how to grow crops that contain those nutrients. And in order to grow crops that contain those nutrients, we have to figure out how to build soil that contains the elements the crops need to make those nutrients. When I first grasped this concept it seemed overwhelming because I thought we'd have to start from square one, but as I did more reading and research it turned out that a lot of the work had already been done, mostly in the period from 1930 to 1950. And just like in nutritional science, the research was shut down and the results buried by the chemical/industrial cartels after World War II.

Did you know that there has been *no* basic research done on soil science in American agricultural colleges since the mid 1950's? None. Zero. What's with that?

There has been plenty of research on hybrids bred to produce bulk tonnage on an NPK diet, and more recently on genetically modified organisms created to survive lethal doses of herbicides etc., but nutrient content and health hasn't even been in the picture. The entire picture has been greed, monopoly, and short term gain. Don't look to corporate agribusiness or the chemical companies to solve world hunger or malnutrition problems–they *are* the problem.

Q. Tell us about the work that *has* been done.

Agricola: Gladly. There are several major figures who have done original research on soil minerals, people whose work has gotten enough attention to actually make some difference. I already mentioned Von Liebig, who got the ball rolling. Another early contributor of note would be Julius Hensel. In 1893 Hensel published Bread From Stones, an overview of the experiments he had done in Germany using rock powders, ground up rocks, to fertilize farm crops. Hensel was a serious chemist as well as an agriculturalist. He argued against the use of large quantities of manure, saying it weakened the plants and the soil. He also blamed the overuse of chemical fertilizers for ruining German food production, and claimed he got greater quality and quantity of crops using only rock powders. Needless to say, the industrial chemical cartel did their best to discredit him and bury his message, but his book is still in print and well worth reading.

The two biggest names in what has become known as Eco-Agriculture, however, are William Albrecht and Carey Reams.

Albrecht was head of agricultural research at the University of Missouri from the 1920's until the mid 1950's. He was very much a classical scientist. He and his colleagues made the single most important discovery in soil science to date, the role of the clay fraction of soil in cation exchange capacity, abbreviated CEC or just EC for exchange capacity. Briefly, it's the ability of the clay and humus in the soil to hold and release tiny particles of certain positively charged minerals, for instance Calcium, Magnesium, Potassium, Sodium, Manganese, Copper. When we talk about clay we are actually talking about colloids, particles so small that they suspend in water and wont settle out. They're not dissolved in the water. The negatively charged clay particles can hold onto positively charged ions of Calcium, for instance, that would otherwise be leached away into the subsoil by rain and irrigation. The clay keeps these minerals from washing away, but gives them up easily to a plant's roots in exchange for Hydrogen (H+).Albrecht discovered *why* different soils have different exchange capacities. A soil with a lot of clay in it can generally hold onto a lot more minerals than a sandy soil. Humus also has a high exchange capacity, which is a good argument for maintaining soil humus in the ideal 4-5% range.

Albrecht and his crew made this discovery about clay in the 1920's, and this led to many years of experiments with the mineral balance of the soil and its relationship to plant, animal, and human nutrition and health. He believed that animals had a finely tuned sense for what was good food and was good for them. If the pigs, rabbits, or cows wouldn't eat forage that was grown on a certain soil or fertilized in a certain way, or would eat it only if starving, he wanted to know why. His published work, collected in four volumes by Charles Walters, is called The Albrecht Papers. It covers a vast amount of territory, from geology to soil organisms to animal husbandry to human nutrition, and in my opinion it stands as the greatest agricultural work yet written. Yet Albrecht's name doesn't even get a mention in modern soil science textbooks, though they have entire sections devoted to cation exchange capacity and the structure of clays. Sort of like Nikola Tesla or Kary Mullis. Tesla gave us our entire worldwide electrical system, Mullis gave us the polymerase chain reaction that is the basis of all DNA work today, and neither of them get a mention in the textbooks.

Q. Linus Pauling comes to mind, too.

Agricola: Yeah, and Pauling spent the last years of his life working out the links between mineral deficiencies and disease. Pauling and Mullis both won Nobel prizes too, and I imagine that million bucks took a bit of the sting out of being shunned by the textbook writers. Albrecht was just shuffled off out of the way when the chemical companies took over the ag colleges in the 1950s. If it hadn't been for his friend Charles Walters, who recognized the importance of his work, Albrecht's work might have been lost and forgotten.

Anyway, Albrecht concluded that he got the best results when the exchange capacity was saturated with about 65% Calcium, 15% Magnesium, 5% Potassium, a couple percent Sodium, and a few parts per million of some other minerals–Zinc, Copper, Manganese, Iron. That leaves about 10% of EC which is saturated with Hydrogen. If you add in some humus and organic matter, Phosphorus to equal the Potassium level, some Sulfur and a tiny bit of Boron, you have the basis of the Albrecht method. These ratios will give you the balanced mineral base for a healthy soil, and you should be able to grow bountiful, healthy, highly nutritious crops. The Albrecht method works very well, but of course it's not the whole answer. Carey Reams gave us another big piece of the puzzle.

Q. Yes, I'm curious about Carey Reams. From the little I know I've gotten the impression that he was pretty eccentric.

Agricola: Well, if you ever try reading him, I think you'll agree that he was unconventional, at least. Reams was not the same sort of classical scientist as Albrecht was, even if he did have a PhD, but he was an awesome scientist nonetheless. What makes him difficult is that there were no accepted scientific terms for what he was observing and measuring, so he either borrowed terms like cation and anion from mainstream science and used them in his own way, or he made up his own, like his fabled millhouse units of energy. Reams can be obtuse and often verges on the mystical, but he undoubtedly got results.

He was certainly involved in determining the ideal mineral balance in the soil, although he used what's called the LaMotte method for soil testing, which uses a weaker extracting solution and measures easily available nutrients. But his more important focus and contribution was on the energy balance or imbalance of the soil; the flow of energy in the soil.

One way of describing his energy ideas might be the comparison of a dead battery and a fully charged battery. Their elemental makeup is identical: the same amount of Lead, Sulfur, and water are in each, but one of them can do useful work while the other one just sits there. There's an energy flow when you connect + and – on the charged battery, nothing on the dead battery.

Let me see if I can make that a bit more clear. The charged battery has the same mix of elements in the same proportions as the dead battery, but there are a lot of potential chemical reactions that haven't happened yet, chemical reactions that release energy. Sort of like a bottle of vinegar and a dish of baking soda; when you pour the vinegar onto the baking soda, things start fizzing, heat and energy are released. When the fizzing stops, things have reached chemical equilibrium and there's no more energy release. A *living* soil with the right balance of minerals always has a certain amount of chemical imbalance, things being born and dying and decomposing, plant roots exchanging Hydrogen for Calcium or Potassium, grains of sand breaking down and releasing new minerals. Nutrient elements are constantly shuffling around and energy is being released. In a dead soil, nothing is happening, new nutrients are not being released and exchanged, and the only way to get plants to grow is by feeding them synthetic fertilizers.

So one could have two soils of identical chemical composition but of different energy potentials, and the energized soil would grow good crops while the "dead battery" soil just sat there. This is a valuable observation Reams made, one that has been overlooked by many agricultural researchers.

Reams and his students also popularized the use of the refractometer in agriculture. A refractometer is a fancy name for a simple tube and eyepiece with a prism lens at one end that is used to measure dissolved solids in a liquid. It measures in the Brix scale and has long been

used by professional winemakers to measure the sugar content of grapes–the higher the Brix reading, the sweeter the grapes.

Now this is a simple little device that anyone can use. One could even take it with them to the fruit stand and measure the sugar content, hence the mineral content, of an orange or a tomato before buying a bagful. If that orange has a Brix reading of 16%, buy it! If it's only 4 or 6%, don't waste your money on insipid, tasteless food. Pretty cool.

What the refractometer measures is how much light is bent, or refracted, by the dissolved solids in the plant's juice or sap. A thin, watery sap devoid of nutrients won't bend the light passing through it like a sweet, richly mineralized sap will. So a person can use a refractometer to measure the quality of their own homegrown fruits and vegetables.

Q. That has to be easier than learning to interpret a soil test.

Agricola: Sure. And you don't have to wait a week or two for your results to come back. Refractometers only give you a snapshot of where you are, though. They can't tell you what minerals are involved. But back to Reams.

Reams was a strong advocate of Phosphorus, and he claimed that all nutrients should enter the plant in phosphate form, a claim I've never quite understood. He lived and worked in Florida, which has vast phosphate deposits, so he had plenty of Phosphorus available to experiment with. Now, Phosphorus is sort of a mystery element in the soil. Other elements will readily leach out, but Phosphorus stays put. And no one seems to know exactly why. We know from Albrecht's work that the positively charged cations like Calcium and Potassium are held by static charge to the clay and humus. But we don't know as much about what's going on with the negatively charged anions like Sulfur, Chlorine, and Phosphorus. We do know that these other anions will readily leach out, but not Phosphorus.

Can you believe this? We *don't really know* how the negatively charged elements are stored or how they move in the soil or get into the plant's roots. In the 1920's Albrecht and crew discovered the CEC connection to clay in the soil. As far as I can tell, that is the last major discovery in soil chemistry–made 80 years ago. And the last one before that was Von Liebig in 1840. And before that?

Nope. That's it. As I count it, we have exactly two major discoveries in agricultural soil chemistry, plus Reams' observations about energy flow. And one from the petroleum engineers and geochemists. More about that one when we talk about Calcium.

So we really don't know very much about the soil. The soil of Mother Earth, that feeds us and upholds us, has been the redheaded stepchild for most of the history of modern science.

During the dustbowl years of the 1930's, when the topsoil was blowing away on the wind, people were scared and some in the government were scared so between 1930 and the end of the second world war agricultural science was relatively well funded. Not, of course, funded like research into weapons of mass destruction, but at least enough to learn a few things of practical importance.

This all ended as the multinational corporations took aim at the American family farm in the late forties and through the fifties. By the late 1950's they had bought every ag college and land grant university in America, bought as in " We'll give you a bunch of money but you have to put the people we want in charge and do only the research we pay you to do." And the foolish, greedy administrators and trustees went for it. They sold out. There has been no real

research in soil chemistry since then, only research on pesticides, herbicides, chemical fertilizers, hybrids, and now GMOs. [ed. note: Genetically Modified Organisms]

OK. Let me try to get back to Reams and Phosphorus. Reams said that Phosphorus is necessary for the production of sugars, particularly complex sugars, in the plant. No Phosphorus, no sugar. Phosphorus is also essential to the production of DNA. And it is also the element in shortest supply in the soil over most of the world. I don't mean that there's less Phosphorus than the trace elements, but that Phosphorus is one of the major elements required for plant and animal health. Bones and teeth are made of Calcium and Phosphorus. And it's in short supply in most soils. Reams said that there should be twice as much available phosphate as potash for most crops and four times as much phosphate as potash for grains, grasses and legumes like alfalfa.

Q: That disagrees with Albrecht, doesn't it? Didn't Albrecht call for an equal amount of Phosphorus and Potassium?

Agricola: (smiling) I see you are paying attention. Very good. Actually, Reams and Albrecht are saying the same thing. Phosphate is P2O5, two atoms of Phosphorus and five atoms of Oxygen. Potash is K2O, two atoms of Potassium and only one of Oxygen. If you do the arithmetic, based on the atomic weights of the elements, you will find that phosphate is only about 44% Phosphorus by weight, while potash is 83% Potassium by weight. One hundred pounds of potash contains eighty-three pounds of Potassium. Two hundred pounds of phosphate contains only about eighty-seven pounds of Phosphorus. So if you want the amount of Phosphorus in your soil to equal the amount of Potassium, by weight, you will need to have twice as much phosphate as potash.

It's worth noting here that the numbers on a fertilizer bag, the NPK numbers, don't actually stand for Nitrogen, Phosphorus, and Potassium, they stand for actual Nitrogen, an amount of phosphate, and an amount of potash. So if the NPK numbers say 5-10-5, for instance, there is about an equal amount of Phosphorus and Potassium. If the numbers say 5-5-5, there's only half as much Phosphorus as Potassium. I don't know why they started doing this, listing phosphate and potash instead of Phosphorus and Potassium, maybe to make it look like there were higher percentages of nutrients in the bag. I said earlier that Phosphorus stays put in the soil. If you spread Phosphorus on top of the soil, that's where it stays. What little we do know about Phosphorus indicates that it readily forms insoluble compounds in the soil that apparently can only be made available through the action of soil microbes and fungi. So you can end up with a situation like we have in the prairie soils of the great plains of Canada and the US, where there is plenty of Phosphorus in the soil, but because the soil is biologically dead, the farmers have to apply large amounts of highly soluble phosphate every year to grow a decent crop, which of course the chemical companies love.

Okay, I was talking about Carey Reams. Reams had some memorable sayings. One was *see what you look at.* Another was *well grown produce doesn't rot, it dehydrates.* He claimed to have entered the same watermelon in the county fair three years in a row. I'm just repeating what I read.

Q. That melon must have been *extremely* well grown. I'm developing more respect for Reams and his work after what you've told me. Who else needs a mention?

Agricola: Charles Walters, for sure. None of the people presently working in this field would know much if Charles Walters hadn't had the vision to start his magazine Acres USA.

Walters was working as an editor for agricultural newspapers in the 1950s and 60s when he became friends with William Albrecht. The agriculture newspapers that Walters worked for

were the same kind that are mailed out free to farmers today, every other page a full-page ad for the chemical companies. Walters was intelligent enough and cared enough to realize the importance of Albrecht's work, and he realized that this work would be lost if someone didn't make it available to farmers. The commercial ag newspapers wouldn't touch this info, because it showed how to grow superior crops without using any of the toxic chemicals that their advertisers were selling. So Walters started AcresUSA in the early 1970s, and it remains to this day the magazine that makes the most significant contribution to sustainable agriculture.

Acres USA isn't just focused on Albrecht's work, though. They are just as likely to publish an article on biodynamics or composting or herbal or Homeopathic medicine, all without prejudice. If it's about natural health, sustainability, Eco-Agriculture, organic gardening, or just better and more efficient farming you will find it there. I can't speak highly enough of this magazine and the work that Charles Walters has done. Anyone interested in the subjects I mentioned owes it to themself to subscribe to it and read it cover to cover. There's just nothing else like it.

Walters also gathered together and published William Albrecht's work in four volumes. Volume II, *Soil Fertility and Animal Health* is required reading, I would say, along with Walters' own tour-de-force *Eco Farm*.

He has also edited, written, or published dozens of other books on sustainable agriculture and natural health, many written by students of Albrecht or Reams, and all worth reading. The real reason that we have several million acres being farmed *sustainably* today is mostly due to the vision and work of this one man, Charles Walters. Albrecht and Reams may have laid the foundations of the science, but few would have heard their message without him and AcresUSA. One caveat, though, on reading Walters' books and essays. Somewhat like the old alchemists, he doesn't always give the information in a straightforward manner. Reading his work requires a little patience.

(a long pause.)

OK, that's enough history for now. I am leaving out over a dozen people who have been and are making great contributions to the field, but if I start listing them this wouldn't be an interview, it would be an encyclopedia. Let's get back to "Why Organic isn't Really Working and How it Can."

Agricola: Let's get back to "Why Organic isn't Really Working and How it Can."

Q. Absolutely. And after that background I think I have a pretty good idea of how it can. It has something to do with minerals, doesn't it? (Laughing)

Agricola: You got it. It has a lot to do with minerals and it has a lot to do with pulling all the different pieces together. Right now we have a lot of different viewpoints, a lot of different pieces of information, and, unfortunately, a lot of different "sects" in agriculture and gardening, all of them seemingly determined to prove that they're right and everybody else is wrong. To a certain extent this is just human nature–everyone likes to be right. But no one that I've talked about here is wrong. Von Liebig wasn't wrong, and neither was Rodale and neither was Reams.

They all had important pieces of the puzzle.

One thing I would very much like to get across is that until about two hundred years ago we didn't even have a science of chemistry. That science was unfortunately kidnapped in its

infancy by the corporate industrialists, who have kept it in chains in the basement ever since. Analytic Chemistry is a tool we have never before had in the eight-thousand-plus year history of agriculture. Properly used, it can tell us what we need in our diets for *optimum* nutrition, and what we need to add to the soil to achieve that in our food.. That sounds doable, to me.

Fertility in the soil *is* minerals. Minerals are elements, and elements are what this physical reality is *made* of. Each of these elements has its own unique structure and properties.

What Iron can do, Copper can't. Iron oxidizes easily, as in rust. Copper doesn't readily combine with oxygen. So we have Iron to transport Oxygen in our red blood cells, not Copper. And neither Copper nor any other element can replace Iron in hemoglobin. Our bones are a crystalline lattice of Calcium and Phosphorus, and no other element can replace either one and still have healthy bone, even though some fools have tried to do it with Fluorine. Has anyone noticed any decrease in tooth decay?

Q: Not me. I've brushed with fluoride toothpaste most of my life and I've had terrible problems with my teeth.

Agricola: Exactly. You and just about everyone else. Each element can do things that no other element can, and each is needed in the correct proportion, in the soil, in plants, and in living things. And guess what? We don't even know what the correct proportions are. We probably should by now, don't you think? This is what science should be used for, not for thinking up new patentable poisons to make someone a buck. We don't even know how Nature is *supposed* to work, and instead of trying to figure that out we've spent the last century and a half trying to *improve* on it? How does one improve something they don't even understand?

There has been some basic work done with mineral deficiencies in nutritional science; we know what happens to an experimental animal or a human if they don't get any Zinc in their diet. But we don't know what happens if they don't get any Zinc *or* any Copper *or* any Boron, all at the same time. Natural Science, and it's *all* Natural Science, is in its infancy, an enforced, perverted neoteny. [ed. note: a term used in biology for an organism that remains in an immature state] The poor baby has been chained in the basement (or is it under the stairs?) and forced into prostitution since it was born. This is not hyperbole or exaggeration. It's a nearly perfect analogy.

People are attracted to science because of their natural curiosity and love of learning. A true Scientist is inquisitive, observant, and madly infatuated with his subject. He does science because he *loves* Science. I knew a fellow who graduated with a PhD in Entomology from a university in Arizona. He loved bugs enough to spend eight or nine years of his life living in poverty while going to school to study them. And he loved nature. He was a camper, a hiker, and a mountain climber. Along the way he got married and soon had a family to support. There wasn't much call for Professors of Entomology and what was available to a new graduate wouldn't support a growing family, so he took the only job his education qualified him for that paid well enough: he went to work for an exterminating company, spraying poisons to kill insects. Even though he was an organic gardener and a fitness freak, he died of a massive heart attack at age 49. I'm sure the years of exposure to pesticides that one has to have a license to handle were a major factor, but there's a lot of heartbreak in having to prostitute one's self that has to be factored in too.

I spent some time investigating a cancer research institute in the Midwestern US, so I know a little whereof I speak. With an annual budget of hundreds of millions of dollars, this cancer institute was basically a factory for spending research dollars. Whoever could write the best

grant proposal and get the most money to blow was top dog. I assure you, this place had *nothing* to do with finding a cure for cancer. They had a seven story building as big as a hotel that held room after room after room of experimental animals in little wire cages all stacked up on roll-around carts. They had an assembly line (or should I say a disassembly line) of underpaid women who worked all day slicing up freshly killed white rats, mice, and hamsters and putting the slices on microscope slides and then putting a thin little glass cover over the rat tissue. This took up an entire floor of another large brick building and was called the department of Histology. And what happened to the slides? They were shipped out to a "storage facility" in the boonies where they were stacked on shelves. I was there, once, at this "scientific specimen" storage facility. Imagine a good sized single-story library with high ceilings and high bookshelves throughout, but instead of books there were boxes and boxes of glass microscope slides all carefully labeled, each with a little slice of animal tissue between the slide and the cover glass. Thousand and thousands of boxes of glass slides. And this had been going on for a while, and the housekeeping was none too great. When one walked down the aisles between the shelves one walked on six or eight inches of broken glass slides and had to be careful that a crumbling box full of slides didn't fall on one's head. I swear I am not making this up. And you wouldn't believe the toxic waste from "cancer research" they stored out there in the hinterlands. Barrels and barrels and more leaking barrels. If you're trying to give animals cancer you generate a lot of toxins. You don't want to know how awful this place was.

I have to tell you one more story while I'm thinking about this. That seven story building full of rats, mice, and guinea pigs generated a lot of waste. Down in the basement they had a sort of commercial dishwashing setup with a conveyer tunnel that cleaned the cages with high pressure hot water and soap, and all day long there was a constant stream of six foot high rolling racks of dirty animal cages coming down the elevator. Down in the hot, steamy, stinking cage washing area there was a crew of underpaid young black guys who spent all day emptying the mess out of the cages, hosing them off, and re-stacking them to go through the washing tunnel. The cage waste, manure, food, and bedding, most of it highly contaminated with carcinogens, was augered up to a big hopper bin. At least twice a week the bin had to be emptied, so they pulled a large open dump truck up to the hopper, filled it up and proceeded to drive it, uncovered and wafting carcinogenic rat waste, about twenty miles through the city to the municipal dump, where it was dumped right in with the household garbage. These researchers never gave a thought to the fact that they were spreading carcinogenic waste across the city and contaminating the landfill with it. They were strictly in it for the money.

I swear, if you were a researcher at that place and you came up with a cure for cancer they would knife you and stick your body under six feet of cement in the cellar, where no one would ever find you. You would be putting them all out of a job.

Q. Unbelievable. That's science? That's where the thousands of millions of dollars we've been spending every year on cancer research for the last thirty five years has been going?

. **Agricola**: I'm afraid so. And I'm afraid that's where your money goes when you have a walkathon to raise money for research on whatever,-- pick a disease. If you find a cure, you're out of business as a researcher. Of course, if you can come up with a synthesized drug that affects the disease's *symptoms,* some drug that is patentable and that people can be convinced they must continue taking for the rest of their life, you can be a rich hot shot too. What is so incredible to me is that this is accepted as normal, rational behavior. It's not, of course. People who don't care what the consequences of their actions are, who don't care who or what they hurt as long as they get theirs, are known in psychology as psychopaths or sociopaths-- dangerous and mentally unbalanced menaces to society. And these kinds of people are who we have *running* science. And industry. And government.

We have to be able to do better than this. Why are the very people who shouldn't be allowed anywhere near the job running the world?

I'm a little off the subject, here.

Q: Yeah, that's OK. I wonder about the same things myself. But you believe that we can fix this mess and get science back on track, so it would be a joyful pursuit for the good of humanity?

Agricola: We have to. The human race is smarter than this. We can and we will do it. Right now the whole corporate/industrial paradigm is going through its last tango. Its on its way out, but the death spasms aren't going to be pretty.

The system is just too broken to be fixed. No matter who we elect, appoint or allow they are not going to be able to fix a system that *can't* work. Taking more than you give back is not sustainable, by any economic or philosophical theory I'm aware of. It may somehow be justified or rationalized but I don't know of any sane person who would call it *sustainable.*

What we'll have to do is start from scratch and build a system that does work. If there are two systems running side by side, one that is sustainable and even increasing in abundance and efficiency, alongside a system that is only interested in short term gain and the heck with the consequences, which system is going to survive and prosper in the long run?

We humans are supposed to be the caretakers of this planet, for God's sake; the gardeners and the park rangers. Instead we have behaved as thieves and poachers. And who are we stealing from? Our children and grandchildren and ourselves and every other living and non-living thing on this beautiful, generous planet. What ungrateful wretches we are. (Pause.)

Let's talk about Calcium for a bit, OK?

Q: OK. You've done quite a bit of studying on that subject, haven't you?

Agricola: Yes, it's been like following a conspiracy theory. One gets caught up in the research, and as you gather more and more facts and clues you wonder, how have they kept this hidden? Why don't people know about this? That's pretty much how I feel about Calcium.

Calcium is an absolutely wonderful element. Calcium is the buffer that keeps our blood at a pH of 7.4, so nutrients can be electrically inducted into our cells. It is also the element that *carries* those nutrients into the cell, releases them, and goes back for more. Calcium ions are what make nerve synapses work. DNA can't be synthesized without Calcium. Calcium can bind to seven oxygen locations on a protein while still holding on to a water molecule and then release them all easily. No other element can do that. Calcium carries the heavy trace minerals like Manganese into the plant from the soil. Have you ever bought a peach or a nectarine where the seed was split open and inside you could see this little shriveled kernel instead of a plump embryo? That seed didn't form because it didn't have any Manganese. Every viable seed requires a molecule, maybe only a single atom, of Manganese to bring the electric charge to the seed and the magnetic force to draw the other elements into the seed. There may be plenty of Manganese in the soil, but if there is a shortage of Calcium to pull it into the plant the seeds will be sterile if they form at all. Or there may be enough Manganese and Calcium, but no Boron, and Boron is needed to move and direct Calcium. It all works together and each part is necessary.

Biologists refer to us as Carbon based life forms, but it's just as arguable that we are Calcium based life forms. Carbon in plants comes mostly from CO2 in the air, but Calcium comes from the Earth, from the soil.

Here's the conspiracy: how have they (whoever *they* are) managed to hide the knowledge that Calcium is such an important element in all living things? In plants, animals and humans, adequate Calcium is absolutely essential for life. But just about the only mention Calcium gets in soil science is as a pH modifier. If you think your lawn or garden grows better after you lime it because you changed the pH, I have a newsflash for you: *Calcium is the single biggest growth stimulant in plants*. pH is a measure of free Hydrogen ions in water. It measures Hydrogen ion concentration, H+ and OH-, and that's all it does. One can change the soil pH with any acid or alkali. You can raise the pH with sodium hydroxide, which is lye, drain cleaner, or lower it with hydrochloric acid, for instance, but they aren't going to give you much growth stimulus. They will probably kill the plant. A slightly acid pH of about 6 or 6.5 is ideal, because it gives just the right amount of electrical conductivity in the soil, but plants aren't nearly as finicky about pH as they are about having the right balance of soil minerals.

Rhododendrons, for instance, are supposed to require an acid soil. What they really prefer is a high Magnesium soil. Experimenters in Scotland *raised* the pH of soil from 5.0 to nearly 8.0 with Magnesium Carbonate, and the rhodies grew better and better as the soil pH went up because the *Magnesium* level was going up. pH had little to do with it.

So, this is a good thing to know if you are trying to grow rhododendrons in New Mexico, for instance, where the soil is frequently alkaline to start with, although there you would want to use an acid form of Magnesium like Magnesium sulfate, Epsom salts. But your garden, your farm crops and your fruits and berries wouldn't necessarily like it (except the blueberries). High levels of Magnesium in relation to Calcium are common in Organic gardening and farming, though, because people are told to lime their soils with dolomite lime, which is high in Magnesium.

Carey Reams recommended a Calcium to Magnesium ratio of 7/1. Albrecht said a 65% Calcium to 15% Magnesium base saturation was about right, which is a ratio of 4.3 to 1. Once again, Albrecht and Reams are both saying the same thing in different ways. Magnesium is more alkaline than Calcium, so it has a greater ability to saturate the soil colloids, a greater ability to displace free Hydrogen. Reams was talking about a 7/1 ratio by weight, Albrecht was talking about their respective abilities to neutralize free hydrogen. If your soil test reads seven times as much Calcium as Magnesium by weight, and there's enough there to saturate the soil colloids to 80%, you will still end up with Albrecht's 65% to 15% ratio. Dolomite lime, which all the Organic gardening books seem to recommend, frequently has a 2/1 Ca to Mg ratio, and may even be 1/1. [ed. note: he means a 1/1 ratio of their ability to saturate the soil colloids] This is far too high a level of Magnesium to have in your soil for a couple of reasons.

For one thing, when organic matter breaks down in a high Mg environment it produces alcohol and formaldehyde, both of which are harmful to soil life. Secondly, the Calcium to Magnesium ratio largely determines the looseness or fluffiness of your soil. This was discovered by the petroleum engineers and geologists/geochemists. They had to drill a lot of deep holes full of mud, clay and water. Sometimes this drilling mud was loose and liquid, even if it was mostly clay, and sometimes it was sticky or like cement no matter how much water was in it. They figured out that the stickiness or non-stickiness was mostly due to the Ca/Mg ratio of the base saturation, the Exchange Capacity of the clay. Add more Magnesium, it gets tighter. Add more Calcium, it gets looser. And the exact same thing happens to the soil in your garden, lawn, or cropland. So if you have tight soil, the most likely reason is your

Ca/Mg balance. Magnesium makes the soil particles attract each other and stick together, Calcium makes them repel each other and keeps the soil loose. One can, of course, go overboard on the Calcium and the soil will lose all structure and be *too* loose and fluffy. (laughing) Don't ask me how I know this. But if you get your Calcium/Magnesium ratios right you can *drive* on your garden and the soil won't compact.

Now is this a valuable piece of information or what? Why isn't this common knowledge? See what I mean when I say it's like a conspiracy?

It's worth mentioning here that if you have an extremely sticky soil, the kind that clumps up an inch or so thick on your boots when it's muddy, you probably have a low Carbon content in your soil as well as a Calcium/Magnesium imbalance. The best cure for low soil Carbon levels is organic matter, or possibly powdered charcoal.

I have made a pastime for a few years of browsing bookstore shelves for Organic gardening and farming books– the ones that have Organic in the title. And I go to the index and look under Calcium, or if there's no listing for that, which there often isn't, I look under lime. I have looked at dozens and dozens of these Organic growing books and none of them *get* Calcium. One or two actually mention that Calcium is a plant nutrient, but most of them only relate it to pH. And *all* of them tell the reader to use dolomite lime preferably or to use it interchangeably with high Calcium agricultural lime (Calcium carbonate). This is just wrong. Yes, there are times when dolomite lime is needed to achieve the correct Calcium/Magnesium balance, but only a soil test will tell you when that is the case.

Q: Why do you suppose the writers of these organic gardening books are so far off base?

Agricola: They are simply uninformed, completely unaware of the importance and the science of soil mineralization. I also suspect that the confusion is a result of some misguided information from nutritional science that they are trying to apply to the soil. Yes, most Calcium supplements, food supplements I mean, have a 2/1 or even1/1 Calcium to Magnesium ratio, so it seems intuitive to think that that's what you'd want in your soil. The Ca/Mg ratio in the human body is about two parts Calcium to one part Magnesium. In the Earth's crust the average ratio is 32 parts Calcium to one part Magnesium. What we want, however, is that elusive 5/1 to 7/1 ratio in our gardens and croplands. As long as enough Calcium and enough Magnesium are stored on the soil exchange sites the soil will be loose and the plants and soil microorganisms will be happy. This is pretty simple, pretty easy to do. But you do need a soil test.

Howard and Rodale didn't use or understand soil tests, except maybe for pH. I think they associated soil tests with chemical farming. In the 1940s J. I. Rodale worked, for a while, with William Albrecht and another mover and shaker in the progressive agriculture movement, Louis Bromfield. Bromfield had taken over some worn out farmland in Ohio, a place he called Malabar Farm, and was restoring it to marvelous fertility. I've never heard the details, but there was some sort of falling out between Rodale and the Malabar Farm group over the use of concentrated fertilizers, like ammonium sulfate. I believe Albrecht and Bromfield took the position that if you could use a pure and concentrated source of fertility, one that grew healthy plants and didn't harm the soil, this was just good science and good common sense. And this makes sense to me, too, for a couple of reasons. When you go to the health food store or the drugstore and buy mineral or vitamin supplements, you may want them to be from a natural source, but you don't insist that they be unrefined. For instance, you might want Vitamin E, which generally comes from soy oil, but you don't buy a gallon of soy oil and drink it to get your 400 IU of d-alpha tocopherol. If you want a Selenium supplement you don't buy a pound of ground-up rock to get a few micrograms of Selenium– you might not want the other minerals in that pound of rock. It also makes a lot more sense, economically

and ecologically, to ship a few pounds of a purified substance across the country than a ton of raw material.

I suspect also that Rodale might have been intimidated by the science, the chemistry, like many others are. He was a journalist, after all, not a scientist. But for whatever reason, he split from the Malabar Farm group and from there on it was pretty much manure and compost for him. This had unfortunate consequences because Rodale went on to have a vast influence on sustainable agriculture, but soil chemistry, other than a misunderstanding of the role of pH, has been almost totally neglected by organic gardeners and farmers. Today, if you send in a soil sample to a State Ag College or one of the big commercial soil testing labs, chemical fertilizers are what they will recommend, and generally the cheapest, harshest, and most harmful ones to soil and plant health, like muriate of potash or urea nitrogen. Up 'til now there hasn't been the interest and input from organic growers that would encourage the testing labs to recommend nutrients from natural sources.

Q. But this is only a problem with the recommendations, right, not the laboratory analysis?

Agricola: The soil testing labs generally do a good job of analysis. If you send a soil sample to ten different laboratories it's unlikely that any of them will send back identical results, but they will likely be close. There are variations in equipment and technique. But at least if you have a soil test you have a place to start, and if you send your next soil test to the same lab you can get an idea of what progress you are making. A serious grower needs to find a lab they trust, one they can contact by phone or e-mail and have their questions answered. Hopefully, find one that understands the philosophies of William Albrecht and Carey Reams. Interpreting a soil test, once you have one, isn't all that difficult, you just need tenth grade chemistry and fifth grade arithmetic. As long as you have an idea of where you are now and where you want to get to it's not too hard. Up until now, though, few have had a clear idea where they want to get to, which is the reason I've spent the last number of years putting together my "best guess" chart. [See *The Ideal Soil Agricola's Best Guess* ed.] I've based it mostly on the work of Albrecht and Reams, along with every clue I can come up with from everybody else plus my own experience. If you follow the recommendations on the chart you won't get into much trouble. I've been careful. And I'm hoping for a lot of feedback from the gardeners out there. This soil minerals thing works, and people tend to get excited about things that really work.

Many Organic gardeners and farmers won't be willing to put in the time and effort it takes to really understand the chemistry, but if they catch the vision that I'm talking about here they're going to want to know what to do with the information on their soil test. Some of the testing laboratories that advertise in AcresUSA, which is a magazine that anyone serious about sustainable agriculture should be reading, are associated with Eco-Agriculture consulting firms. I don't know how much they charge for consultations, but, agriculture not being a get rich quick scheme, I'm sure they're reasonable. Ask around in your own area, too. The consultants out there so far, though, are more used to working with larger growers and farmers. We're going to have to develop some sort of grass roots organization to work with small scale and backyard gardeners.

[Editors Note: and there you have the inspiration for SoilMinerals.com]

Most important, though, is that you *get a soil test.* A pretty complete soil test including exchange capacity and availability of a dozen or so major and minor elements only costs $20 to $30 dollars. Then you will at least have a place to start.

Q: But you don't see each and every organic gardener learning about soil chemistry?

Agricola: Only enough to realize its importance. The commercial growers especially. Even if one is only growing a few tomatoes and carrots for summer salads this knowledge would still guarantee the best flavor and nutrition. But I realize that many gardeners just aren't going to want to learn the chemistry and do the math, any more than they are going to learn plumbing or electrical work or structural engineering. They just need to understand how the system is supposed to work, so that when there is a problem, like poor flavor or insect attack or rotting in storage they realize that it is probably a mineral problem. In times past most communities had a physician, and maybe what we will end up with is a trained "soil physician" in each community. (laughs) We will need a lot less experts in the field of medicine once we get the food right!

One of the attractive things about Organic gardening and farming has been its simplicity–just add more compost. Unfortunately, unless you happen to be lucky enough to have perfectly mineralized soil, more compost or organic matter is not going to give you more nutrition. Let me give you an example of how out of wack things can get. Let's look at the Puget Sound region of the Northwest US. A few miles South of the bottom end of the Sound is as far as the glaciers went during the last ice age, and most of the soil around there is a stony glacial till left behind when the ice receded. It's mostly formed from broken down granite and basalt, usually high in Potassium, low in Phosphorus, and any Calcium it might once have had has been leached out by sixty to two hundred and fifty inches of rain per year. You will recall that Albrecht recommended equal amounts of phosphate and potash, and Reams said twice as much Phosphorus as Potassium, four times as much for grasses and legumes. So there in the Northwest, dumping more high Potassium compost on the soil is only going to make things worse, nutritionally. Nonetheless, that is exactly what the Organic books recommend. One size fits all really doesn't work too well in gardening.

Phosphate has been described as the major catalyst in all living systems. It is essential for metabolism and photosynthesis, and is, as I mentioned earlier, needed for the synthesis of sugars and the replication of DNA. If you wonder why the organically grown fruit you buy isn't sweet, it's because the Phosphorus/ Potassium ratio is out of balance, the Calcium/Magnesium ratio probably is too, and more organic matter is *not* going to fix the problem. Another thing that happens when Potassium levels get too high is that the Potassium tries to substitute for Calcium, and though it can latch on to and take some nutrients into the cell it can't get back out again because it's too big, so we end up with cell interiors loaded with Potassium and a deficiency of Calcium and Phosphorus. Excess Potassium can also become fixed to the exchange sites on the clay, *aging* the clay and messing up its EC and expandability. Not good.

I could go on with what we *do* know about mineral nutrients, but anyone who has stayed with me thus far is surely getting the picture. We have within our grasp the ability to grow the healthiest, best food that has ever been grown. A good part of the work has already been done for us. The rest of the work is cut out for us and laying on the table, waiting for us to figure it out and put it together.

If we just take off our blinders and look around, we can take the very best from all fields of health, agriculture, and ecology, from Organics, Eco-Agriculture, Permaculture, Biodynamics, nutrition and all the accumulated wisdom of native and traditional methods, and come up with some really hot stuff. Hot stuff that is sustainable, increasingly abundant, and ecologically sound.

Q: I think I hear the bugle call. So how do we go about doing it? The corporations have taken over the ag colleges and the government research stations, and they are not likely to see this as much of a money maker for them.

Agricola: That's true. Healthy food, healthy farms, and healthy people will impact things all up and down the line. What do we need drugs, chemical fertilizers, and poisonous sprays for if we have naturally healthy land and naturally healthy people? They wouldn't sell much green and purple sugar-coated genetically modified breakfast cereal if people *knew* that it was poisoning their children and causing disease.

What people want is to feel good *now*, and most of the time most of them don't. Most of us are the result of several generations of malnourished ancestors. At what point were your forebears introduced to unlimited white sugar and white bread?

Q: Me? I'm not sure, but my grandparents who had a farm in the Dakotas were born in the late 1800s, and I never saw anything but white bread and white sugar at their place. When I was growing up there was always a full sugar bowl on the table.

Agricola: Exactly. You and just about everyone else. Dr. Weston A. Price, who did a worldwide survey of aboriginal peoples in the 1920s and '30s, concluded that it took twenty years from the introduction of refined carbohydrates for the first serious wave of degenerative diseases to show up: cancer, heart disease, and diabetes. Albrecht, by the way, was well aware of Price's work. I find it fascinating that the Tohona O'odham people of Arizona, the Pimas, have a 90% obesity rate and a diabetes rate almost that high, even developing in preteen children. Their relatives just across the border in Mexico don't have these problems. Why not? Because the government of Mexico isn't "taking care" of them. They still grow and eat their own traditional foods. They didn't grow up on government cheese and frybread with sugar. And why are refined carbohydrates bad for your health? Because they deplete your minerals.

When plants or animals have been malnourished for generations, the seed starts to run out. Health suffers. Reproductive abilities decline, as does the health and vigor of the offspring.

Once again, problems of deficiency and toxicity, exacerbated by the greed and lies of "profit at any cost" corporations with the collusion of our government. And greed equals neediness: unsatisfied, unhappy, needy people who can never get enough because there's no lasting peace in accumulating material wealth, power, and human social status. This is something we all should know at our deepest level.

It's definitely time for a new model, wouldn't you say?

Think of what we can do with this knowledge once we put it together, *even as we are* putting it together! We can analyze the soil of those places in the world where the people have been shown to live the longest and remain the healthiest–the Caucasus mountains near the Black Sea, the Vilcabamba region in the Andes, maybe the famous Hunza valley in the Himalayas, if it actually exists. We can take this information and use it to recreate the exact combination of mineral elements found in any soil anywhere in the world.

If a winemaker wanted to recreate the soils of Bordeaux in the leached soils of the Pacific Northwest, or if a cattle rancher wanted to recreate the mineral ratios of the buffalo grass prairie soils of the Midwest in the state of Georgia, they could do so

The state of Kentucky is known for raising some of the finest horses in the world. The neighboring states, Tennessee and Indiana for instance, are not. Why? Because Kentucky soils are largely made from broken down limestone, high Calcium and probably high Phosphorus limestone, what strong bones are made of. The same goes for areas of France that have been raising strong, healthy cattle and horses since pre-Roman times–the rocks their soils are made of contain high amounts of Calcium phosphate.

We can recreate any soil we want anywhere in the world. And with a little long term vision, we might only have to do it once.

The soil mineralization that has been done so far has mostly used finely ground stone. Granite, limestone, basalt, glacial rock dust, rock phosphate, trace mineral blends, all have been pulverized as finely as possible in order to make them quick acting. What would happen if we applied them in coarse gravel size and finer, and worked it out so that the minerals would be released steadily over the next five hundred years? Would that work? I think it would.

Of course we're talking about a lot of transportation cost here; rocks are heavy things to be hauling all over the country, but we would end up with little need for the polluting chemical industries and pharmaceutical plants, not to mention most of the whole sickness industry, so I don't doubt that the energy equation would balance out.

Here's another aspect that will appeal to ecologists: with this knowledge we can grow more food, and more nutritionally dense food, on less land, instead of needing to clear more forest land and plow up more prairies. Although we're not plowing up more prairies in this country anymore We're paving them over to build subdevelopments and malls. Some of that is going to be pretty hard to fix.

What we're talking about here, perfectly balanced soil mineralization, would not be something we could afford to do or would want to do everywhere in the world. In the Pacific Northwest, if you don't do anything to the land what you end up with is trees, so that's probably what they should be growing. But the vegetable, berry and flower growers in the valleys could balance their soil minerals one time over the course of a few years and then just replace what they took out of the soil, harvest bountiful crops of increasing quality as the soil life came on-line, and become largely self-sufficient instead of owing their souls to the company store. Those same ideas can be applied to any area.

Will this happen? I'm sure it will. When? It's happening right now, as you read this. There are already millions of acres in the US where the principles of Eco-Agriculture are being applied and are working very well. This is not new information, just deliberately buried and hidden information. Albrecht published most of his work by the 1940's, Reams was teaching and spreading his information in the 1950's and '60's. A few people listened and spread the word, largely thanks to Charles Walters and Acres USA.

Q: OK, so how do we go about finding the answers we want, and who is going to pay for it?

Agricola: Yeah, that's the right question. How will we do it? How will we answer our unanswered questions: what happens to the anions like phosphorus in the soil, what's really going on with paramagnetism, what balance of soil microorganisms is best for which crop and which climate? I suggest that most of this work will and should be done by independent researchers, but I'm not sure who is going to pay for it.

It's tempting to say something like "Just think what we could do with a billion dollars US in government money, why we could fund a *thousand* million-dollar research projects!" But that's not the answer. Our government's money is corrupt; it's extorted under threat of losing your property or going to prison. Taxes stolen from poor waitresses' *estimated tips,* for Pete's sake. And all the government funded research facilities are controlled by the multinational corporations. They are emphatically not interested in supporting their own demise.

Besides which, most of the important work in science has always been done by independent, curious individuals, not by government funded laboratories. Hensel, Reams, and many others

I haven't mentioned never received a dime of government money to support their research as far as I know. Albrecht's state agricultural station work was government funded, barely, but his results were either swept under the rug or appropriated without credit by the chemical fertilizer companies, while he was ignored. Hasn't this kind of stuff gone on long enough? Corporate money, just like government money, always comes with a few slimy strings attached. I say no thanks. We'll do it ourselves.

And yes, this is a bugle call, for all who have ears to hear.

Let's get together and work together, all of us who love and believe in this beautiful emerald gem we live upon. Let's let go of our differences and find our common ground. Let's learn a little bit from each other instead of trying to prove that "our way" is the only right way. As I said earlier, we can bring together the best of Organics, Permaculture, Biodynamics, Eco-Agriculture, native and traditional farming and anything else that is sustainable, healthful, abundant, and *works.* We can grow the best food that has ever been grown, and become the healthiest, happiest people who have ever lived

It's up to us. We can do this. We *must* do this.

Q: So be it. Thank you for your time, Agricola.

Agricola: You are very welcome. It has been a pleasure.