Introduction

“As above, so below; as without, so within.” –*Ancient Proverb*

What is Quantum Agriculture?

In a nutshell, *quantum agriculture* takes a holistic view. Nothing is left out of consideration, and many things that have long been ignored assume key importance.

Quantum physics grew out of the realization that matter arises due to wave functions which perfectly meet themselves as recurring vortices. These are self-reinforcing resonance patterns and thus are stable. There are no waves without particles and no particles without waves.

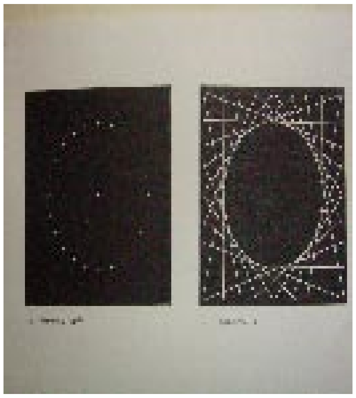
Basically this means that everything in the universe consists of vibration, either free as waves such as photons of light, or bound as ‘in’ or ‘out’ vortices in self-reinforcing, spiraling fractals[1*] as with protons and electrons. Quantum physics shows us that all tangible matter results from self-reinforcing, self-organizing patterns.[2†] This points us toward using patterns, such as colours, sounds, homeopathic remedies or biodynamic preparations, to accomplish seeming miracles while reducing inputs and improving quality.

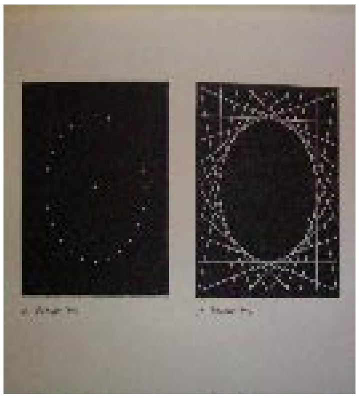
Agriculture, in historical times, is the source of society’s nutritional vitality. We eat food to obtain life rather than mere substance. Since organization is the basis of life, the vitality of our food depends on how well organized it is.

Particularly in the last hundred years, agriculture has focused on one thing — greater yields. However, this neglects agriculture’s purpose of providing nourishment. Even worse, science — which should place truth above money — is only applied where it yields economic advantage for those at the reins, irrespective of other consequences. The result has been social and ecological disaster.

The idea behind ***quantum agriculture*** is to make a quantum leap in agriculture by bringing it to the cutting edge of science. In doing this ***quantum agriculture*** would assure maximum complexity and nutrient density in all that we produce.

With quantum agriculture the quest for quality must lead research, while everything must be reckoned with from the most minute particles to the vast surrounding cosmos born of these particles, and from the immediate goals and resources of growers to the path of human evolution and its significance. Once vitality comes to the fore in gardens and farms so that food of the densest nutrition is produced, then quantum agriculture will stand for quality assurance.





Quantum agriculture looks at the patterns of context as much as content, (*see point-wise and line-wise demarcation of a circle*) and the big picture is as important as the chemistry. Both our starry heavens and our soil chemistry make better sense once the patterns of content and context are seen to be hand-in-glove.

Polarity and Symmetry

The fertile soil, water, rocks, inner warmth and all below the surface of the land provides nourishment and is digestive in its activities. The grasping, greedy nature of lime[3*] is central to this character, expressing itself in consumption of energy from carbon compounds, elaboration of minerals, nitrogen captivation and the soil's living digestion which provides nourishment for plants. It would be descriptive to say lime sucks, as it draws in everything including the coy and elusive nitrogen. As far as plants are concerned, lime's ability to fascinate nitrogen is its key activity.

However, we've tended to ignore the starry cosmos, the solar seasons, the atmosphere, its weather and all that moves above the surface in the sky. This too quickens our environment and is fully as important as the soil.

In contrast to the soil's lime, the atmospheric patterns all partake in the expansive, generous character of silica.[4†] This expresses itself in photosynthesis, blossoming, fruiting and ripening. As far as plants are concerned the key silica activity is harvesting carbon and storing energy in carbon structures.

Many growers consider the primary *formative* activity of plants is carbon harvesting. If nature had no carbon fuels it could not feed energy into nitrogen fixation in the soil. Here animals act in symmetry to plants. Their *transformative* activities release carbon while elaborating nitrogen.

Thus quantum agriculture acknowledges that plants grow in symmetry with animals between these two fundamental polarities, the gravitational lime and levitational silica.

Origins, Balance and Mediation

There is debate about which came first, the earth or the agencies that brought life to it. Many believe there is an intelligence at work in the universe that brought the earth into being. Others debate this as myth. However, there is no debate that if life energy is to build up to high vitality in our gardens or farms, the first and foremost thing we must do is to catch carbon. This is an atmospheric activity. What happens in the soil in terms of unlocking minerals, nitrogen fixation and nutrient release is secondary because soil activities and the microorganisms that do these things depend first on photosynthesis — *i.e.* carbon fixation — for energy.

This is a reversal of viewpoints from the past when emphasis was always on the soil, though it might be noted that in the past hundred or so years roughly 70% of the earth's carbon rich topsoils have been lost. We've reached a point where soil building can no longer be ignored. A renewed understanding of carbon harvesting is needed to rebuild our soils, which means we can no longer ignore the role of silica.

Of course, neither sky nor soil have much significance without the dynamic interplay between the two. This points to a third factor. What is it that mediates between sky and soil, cosmos and earth, and in particular governs the rhythmic ebb and flow of sap in plants? This is clay.

Basically clays are aluminum[5] silicates, of which the forms and combinations are many. Clays may hold onto a variety of other minerals from metals such as iron and manganese to lime, potash, phosphates, humus and other nutrients, releasing these to algae, bacteria, fungi, and so on which protozoans and higher soil animals digest and excrete.

Generally clays provide rich substrates for microbial activity in the soil. The resulting ecosystems can be so rich and diverse that a single teaspoon of biologically active soil may contain 40,000 or more different species, to say nothing of large numbers of those bacteria and fungi most important to healthy plant growth.

Natural Self-Sufficiency

Quantum agriculture aims to mimic as well as enhance nature, whose most fertile ecosystems are self-sufficient — barring the wrong kinds of human intervention.

For example, agriculture in Indochina was self-sufficient for thousands of years up into the third quarter of the twentieth century when Vietnam, Cambodia and Laos were so ravaged by bombs and defoliants that their agriculture collapsed. A similar story is true for many other age-old self-sufficient ecosystems which have fallen in the twentieth century to chemical agriculture.

There are also many examples around the world of biodynamic farms which have increased in fertility the more self-sufficient and self-organizing they become. Permaculture and Masanobu Fukuoka's style of natural farming provide other examples. These are well known in English speaking circles, but many examples in other cultures exist. It must be realized that people have and still *can* make gardens or farms self-organizing, fertile and self-sufficient even though considerable food is harvested from the farm.

Self-sufficiency and thriving abundance are key features of workable ecosystems. A garden or farm is not thriving until it achieves a significant degree of self-sufficiency. This does not mean it makes its own tools and manufactured goods or generates its own ideas. It exchanges its harvests for these. But ideally in terms of its weather and fertility it should not have to go anywhere or get anything in order to maintain rich productivity.

This clearly is not the case with the imperiled soils and environments where modern agriculture is practiced today. In adequate and high rainfall areas mineral inputs often are needed to optimize their biology. However, in droughty, saline environments mineral overloads need to be buffered by increasing the biological carbon buildup in the soil — which would attract more rain and reduce salinity.

In fact, as the earth's biological flywheel increasingly loses momentum and weather becomes increasingly unstable, restoration of atmospheric organization and natural rainfall becomes a necessary part of ecosystem repair. The means of establishing and conserving the organization of both soil and atmosphere needs to be better understood in order to achieve self-sufficiency. Where previously we relied on luck, now conscious control is required.

Control

Since the essence of control is to use the exact amount of force necessary, and no more or no less, it can easily be counter-productive to use energy and materials wastefully. Moreover it is wrong to use the word 'control' to indicate domination, no matter that with chemical agriculture 'control' is a euphemism for killing. Ideally however, control is the ability to initiate, modify and curtail things. If any of these three is missing control is lost. Starting a car, driving it and stopping it are all three necessary to control it. Achieving and maintaining self-sufficiency relies on this sort of true control.

Fostering self-sufficiency is a necessary first step. In self-sufficient ecosystems, plants harvest carbon abundantly and serve soil microorganisms rich energy banquets flush with sugars. In return soil microorganisms unlock the bones of the earth for minerals which they use to fix nitrogen and transform carbon compounds. Thus these microbes feed plants a rich smorgasbord of minerals and amino acids.

Orchestrating this process requires good control, a lot of which involves getting *out of the way* of nature. If growers have insight and integrity they can quicken nature's infinite patience in building organic momentum over centuries and eons. Supplying the missing pieces can speed things up to where eco-repair occurs as fast as eco-destruction did.

Life to the Fullest

One of the common misconceptions is thinking plants end at their root tips. Actually they exude their sap out into the soil. Within a quarter inch around a young feeder root this sap can nourish a territory teeming with forests and armies of symbiotes and co-workers more populous than all the human beings on earth. Ideally this abundant ecosystem feasts on plants' rich carbon harvests. Then the fungal forests mine and elaborate the mineral riches of the soil for sufficient lime, phosphorus, potassium and micro-nutrients to coax nitrogen away from its fascination with itself. Using these minerals, soil bacteria manufacture proteins while protozoa and higher animals transform these proteins into pre-digested amino acids, feeding the plant in the same places where the root exudates flushed forth.

Viewed a little differently, the soil food web is an extension of the plant that supplies a more or less ideal mix of minerals and amino acids, while plants photosynthesize and shed energy rich carbon compounds at their roots. Thus microorganisms feed plants milk in exchange for honey. The harder and more efficiently the soil's forests and legions work at providing plants with the means for growth, the harder and more efficiently plants work to provide energy for the forests and legions to elaborate nutrients.

Since plants do not end at their physical boundaries but extend their vital fluids a little further into the soil, in biologically active soils, roots the size of a 16-gauge wire can hold sway over a territory that may be a half-inch in diameter. This is like turning a roadside produce stand into a metropolitan farmers' market. Where this gets going plants have their needs supplied much more abundantly and diversely than chemical inputs can possibly achieve. Getting this to occur requires throwing out the old paradigm of uniformity and competition and thinking in terms of diversity and cooperation instead.

In biodynamic experiments with no fertilizer inputs at Union Agricultural Institute in Georgia, market gardening in meter wide beds with meter wide paths provided a biological reservoir in the paths so that desirable symbiotic microbes were never more than half a meter away. Beans were planted 2 cm. apart in the row with some beds having two rows on either side of centre and some with three rows, one down the centre and one on each side.

The competition model predicted there would be more beans per plant where there were two rows instead of three, though perhaps there might be more beans per bed where there were three rows. However, because of early root exudate overlap in the three row beds mycorrhizal colonization was earlier and more intensive and the individual plants yielded between 30 and 50% more beans *per plant* in the three row beds than plants in the two row beds yielded.

A similar result occurred with ginger. Beds planted with three rows of ginger roots 20 cm. apart in meter wide beds yielded roots that were nearly twice as large *per plant* than plants in beds with two rows planted 30 cm. apart. Corresponding results, though not as dramatic, occurred with garlic and corn. There needs to be many more experiments of this type, as there is compelling evidence that diversity and cooperation are the winning strategies in nature.

Ultimately Humanity only has a bright future if it maintains fertile, self-sufficient environments for growing food, since this is what nourishes crops in the richest and most balanced way. Fertility inputs and water use can become far lighter and more sophisticated wherever this goal is pursued. In the process we can develop an approach that works with minerals, biology *and* the fundamental patterns of energy that quantum physics shows us are at the basis of all that we think of as solid and real.

Minerals

Of the three basic levels where we can work to make agriculture healthy and productive, the grossest, and often the most costly, is applying minerals. In many cases at least some minerals must be supplied to achieve enough balance to get soil biology going. As we increase a soil's living organic matter levels the resulting buffering and balance reduces the need for further inputs. Initially, however, missing or deficient minerals must be supplied.

Also, we must keep in mind there are low rainfall soils where too much of something is the problem rather than too little. Again increasing the soil's living organic matter levels buffers these imbalances, though in the meantime we may need to grow vegetation tolerant of imbalance.

To supply missing minerals we can use traces of soluble nutrients or larger amounts of powdered rocks to add what physically is needed. For example, two common deficiencies are boron and silica. Soluble boron should be buffered by humates or compost, while powdered granite, basalt or diatomaceous earth would be appropriate silica sources. One of the commonest powdered rock applications is finely ground limestone to supply calcium. Of course, if magnesium is deficient the choice often is dolomite lime. For major applications rock powders are usually best, though for micronutrients salts buffered by humates or composts may be preferable.

In general any mineral input is improved when it is buffered with carbon compounds, enhanced with microorganisms and catalyzed with patterns. Another rule is if a little bit is good, a little bit less more frequently is better.

Biology

Providing we have sufficient minerals, it is cheaper and more effective to work at the dynamic, self-organizing, biological level.

By introducing diverse populations of microorganisms and managing vegetation wisely we can bring the soil to life so the ecosystem self-corrects and self-regenerates. Biology has the benefit of holding on to nutrients while making them available to plants. This exposes the fallacy of thinking nutrients should be soluble. When they are caught up in the cycles of soil biology they are insoluble but available. By introducing key organisms and fostering favourable conditions we can turn a small number of helpers into a great army.

Working at the biological level is more economical than working at the mineral level and it stands to yield more profound results. This partly explains why such things as crop rotations, companion cropping and succession planting, as well as general plant and animal diversity, are so important. But we must do more than simply introducing appropriate organisms. We have to create the conditions for them to thrive.

For example, spread the cost of establishing deep-rooted legumes and forbs[6*] in a grassy pasture over the long term. These forages foster mycorrhyzal fungi that unlock all the major and minor nutrient minerals and bring them into the topsoil for the benefit of bacteria, some of which fix nitrogen. To get these legumes to take hold and thrive it may cost a bit to prime this pump with lime, rock phosphate, boron, molybdenum, a carbon buffer, vitamin B-12,[7†] and biodynamic preparations as well as seed. However, once these plants are established the need for further inputs is greatly reduced.

Patterns

The subtlest and cheapest level to work with, however, is the dynamic patterns underlying the activities of nature. Here we can work directly, using quantum techniques,[8‡] to apply organizational patterns such as colour, homeopathic fertilizers, Steiner remedies or radionic rates. Many use dowsing to choose appropriate patterns of homeopathic and radionic applications. Dowsing or intuition is often used to develop pattern treatments to nullify or fend off insects and other pests. One can also dowse or intuit energy grid lines and power spots for setting up pattern energy devices such as boundaries, prayer wheels, cairns, energy circles, field broadcasters, environmental harmonizers and atmospheric reorganizers.

At the level where energy takes form, patterns can have the most profound effects on crop quality. Most farms and garden can establish far more ideal patterns at every level including minerals, soil biology and plant functions all the way out to weather cycles.

Energy Forms and Dynamics

Since many think of energy as something obtained from an electrical outlet or a combustion engine it may help to explain what is meant by pattern energy and energy taking form.

Radiant energy from the sun takes form and becomes bound when plants combine light, carbon dioxide and water. The fuel in a combustion engine is bound energy until it is burned. Water falling through a turbine transforms mechanical energy into electrical current, which can be turned back into mechanical power.

There also are many elements, and each element has its particular patterns. By itself carbon may form diamond or graphite matrices as well as chains, rings and even spheres. However, in combination with other elements carbon's patterns are of wondrous variety and complexity. In carbohydrates energy takes form as various patterns based on carbon along with oxygen and hydrogen.

Nitrogen, in combination with carbohydrates, expresses forms with great specificity, integrity and uniqueness, as nitrogen is attuned to its context as if it were intelligent.

Living organisms as self-organizing carbon/hydrogen/ oxygen/nitrogen forms persist, grow and reproduce by concentrating a stream of order on themselves. Chemical reactions follow some interesting dynamic patterns. Chief amongst these resonant, self-organizing and imploding patterns is the *Phi*[9†] growth curve that living organisms express in fractal forms such as sea shells, cow horns and fern leaves.

Order from Chaos

One of the more popular proposals in nineteenth and twentieth century physics was the idea that any heat driven, *i.e.* thermodynamic, system disperses its heat, moving ever toward increasing disorder, entropy or chaos. During the nineteenth and most of the twentieth centuries it was not realized that there is order inherent in chaos. Chaos was taken to be thoroughly random.

Despite the obviously orderly and dynamic nature of star systems, galaxies and galactic clusters the universe as a whole was believed to be inexorably moving, not toward greater order and charge compression as now seems likely, but rather toward greater dispersion of heat and waning usable energy. Entropy was said to increase. Living organisms were seen as "islands of order amidst a general sea of chaos"— evolutionary theories notwithstanding.

The discouraging but popular idea was that everything is running down so that energy will become scarcer and scarcer and cost more and more. This was known as the second law of thermodynamics.

However, nineteenth century physicist James Clerk Maxwell (1831-1879), pointed out that if we had a gate that let fast particles (*i.e.* warm molecules or their momentum) through but held slow particles back we could store up warmth or momentum and use it for mechanical power. Maxwell popularized this idea by depicting a tiny demon who opened a one way gate for hot molecules and closed it for cold ones, and the term, a *Maxwell's Demon* came to mean any device that defied the second law of thermodynamics.[10*] Solar, hydroelectric, wind, wave and geothermal power production were disqualified as they tapped into natural differentials instead of achieving a net gain by removing heat from a chaotic medium.

Spider webs and the sort of casting nets we used in my youth that fanned out, sank, drew together at the bottom when pulled and caught fish by the bucketful were also ruled out for similar reasons. But even if they don't achieve a net energy gain these devices show there are patterns that characteristically organize and harvest various forms of energy.

An example of how organizational patterns of energy can radiate throughout a system from a single point is a bell or a tuning fork. Striking a bell or a tuning fork in one spot makes the whole thing ring. Furthermore, any bell or tuning fork of like dimensions nearby will vibrate in resonance *without being struck*. This shows energy can be transferred, even without contact, by resonance, which is what allows an opera singer to shatter a crystal glass without touching it by loudly singing at the right pitch.

Organizing Weather

Since weather patterns are easy to see, they are a good way to show how profound the effects of organizational patterns can be. Often in the midst of droughts there is plenty of moisture in the atmosphere, but it is disorganized and forms haze rather than clouds. By timing evening and morning radionic applications of appropriate patterns to a survey map of an area, organizational patterns can be imparted that result in dense cloud formation and rain. These patterns may include written intentions, biodynamic remedies and colours which establish self-organizing patterns that gather moisture into clouds strongly enough to precipitate rain.

Using pattern energy like this is far cheaper and more effective than seeding clouds with silver iodide or irrigating.[11*] Since the water in such rain is highly organized it is very beneficial for plant growth. Thus making rain to establish deep-rooted pastures would be more desirable than irrigating.

It is important that quantum agriculture makes pattern energy understandable and accessible. Then we can work simultaneously at all three levels — minerals, biology *and* patterns. Then we will get the most bang for our buck.

Part II: A Higher Calling

As a practical matter a boatload of tasteless oranges prone to rot is a boatload of junk. Quality matters. It shouldn't be much of a leap to see what consumers most want as quality. So what do we mean by quality, and how can we measure it?

The highest purpose for growing food is to nourish the development of human potential to its fullest. Growing food without regard to its role as nourishment is an omission that has visited untold ills on society. Since organization is the basis of life, the to which degree our food is organized is a measure of its vitality and ability to give us life. Taste and smell are two of the best methods of food analysis that have ever been developed, and we carry them around with us at all times. They are our first clues to the quality of our food. Quality smells great and tastes great.

Nitrogen's Role

Although carbon is basic to organic forms, nitrogen is key to quality. Much of what we identify as flavours and odours, either pleasant or disgusting, is associated with nitrogen. Nitrogen's role as carrier of the blueprints or master plans is apparent in the DNA, RNA and protein chemistry.

Obtaining unusual excellence goes back to the way nitrogen works when it is integrated, healthy and *intelligent* within the farm's unique organization. Complex and sophisticated — or crude and rude — nitrogen is what gives us the character and flavour of what we grow. It's important to communicate how this works in terms of growing crops, as so few farms are consciously run with the quality of their nitrogen in mind. It really makes all the difference in the world how nitrogen gets in our food.

This makes engineering a farm's production a challenge, as there are few role models and people generally don't think about how to maximize the delicate sophisticated nitrogen that holds back its smells and minimize the crude and rude stuff that bowls one over with its stench. What has to happen is farms need to get their nitrogen directly out of the atmosphere as a product of how they operate. To produce the best results each farm must become attractive to nitrogen, bait and capture it, gaining its enthusiastic participation in every way.

By laying out in broad strokes how nitrogen cycles within a farm individuals can tinker and fine tune, adding complexity as they go to achieve truly individual one-of-a-kind farms that blow everyone away with their awesome flavour, beauty and nutritional density.

The Nitrogen Process

Plants photosynthesize and send a portion of their sugary carbohydrates to their roots as food for symbiotic microbes in the soil. Their first step is feeding the fungal mycorrhizae that unlock silicon, calcium, phosphorus and other minerals in the soil. The phosphorus is key to breaking down the carbon compounds plants give off, and the calcium is key to nitrogen fixation.

Various soil bacteria are able to fix nitrogen, but on low organic matter, mineralized soils where the boron, silicon, calcium, phosphorus, etc. are locked up legumes act as the soil's lungs and draw oxygen, the generator of acids, into the soil. By providing oxygen legumes ensure an especially good relationship with mycorrhizal fungi, which need lots of oxygen to unlock the minerals in the soil and make them protoplasmic.

With the calcium and phosphorus released by their mycorrhizal symbiotes legumes can then form calcium rich nodules around symbiotic nitrogen fixing microbes called Rhizobia. Generally each type of legume has it's own favorite species of the Rhizobia genus that it feeds carbohydrates and calcium to in exchange for amino acids.

Nitrogen Fixation

Nitrogen fixing bacteria contain an enzyme called nitrogenase that opens up the first of nitrogen's triple bonds with itself. Calcium then reacts on either side of the nitrogen molecule and unzips the other two bonds so that a pair of amino acids are formed. The enzyme is a biocatalyst and is not used up in the reaction, but the calcium and the carbon compounds have to keep coming in steady supply — a job legumes and their fungal symbiotes are good at.

So it's not really the legume fixing the nitrogen. The legume brings the oxygen into the soil and feeds the fungi. The fungi unlock the calcium and the legume feeds this calcium along with carbon compounds to the nitrogen fixing bacteria that do the actual nitrogen fixation.

Legumes may trigger the availability of several times more calcium than is used in the nitrogen fixation feeding the legume's growth. Much calcium is caught up in the fungi and the legume gets only a portion of that. Fungal feeding protozoa, microarthropods, nematodes, ants and so on will get a portion of the rest and the biology of the soil increases its momentum.

At this point a variety of free fixing bacteria such as Azotobacters begin to have access to the calcium and phosphorus they need. Now they can live off the more abundant root exudates of plants such as cereal grains, corn, sugar cane, bananas, ginger and so forth. Though these plants are superior to legumes at catching carbon, they don't have nearly as much ability to draw oxygen down into the soil to create acids and unlock minerals.

Digestion

In general mineral releasing fungi and nitrogen fixing bacteria do not simply give off minerals and amino acids to plants. Something eats them and digests them, releasing their nutrients. then plants take these up very much like we absorb nutrients from our intestinal tract. In our case we surround the food and microbes and absorb our nutrients. But plants have this digestive activity going on all around their roots, and they absorb their nutrients from the centre of this digestive activity instead of its periphery.

These relationships are very complex and involve thousands upon thousands of different species, and little more than the broadest outlines are known. Yet, nursing this process into vibrant life is practical and rewarding.

Compost, compost teas, biological inoculants, biodynamic preparations, rotations, companion and succession crops, mulches, molasses and so forth can assist in getting this process going. What tends to be counterproductive is large quantities of undigested organic matter, long periods of excessive clean cultivation and compaction with heavy machinery. What is worst is monocropping and the use of agricultural chemicals.

Phosphoric acid preparations such as mono and diammonium phosphate and especially single and triple super cause a brief drop in soil pH that burns fungi up like cotton candy in a flame. Nitrogen fertilizers suppress or kill nitrogen fixing microbes as well as poisoning the critters in the soil that would eat them and release their amino acids.

The nitrogen itself feeds the breakdown of the soil's organic matter reserves starting with the microorganisms it poisons. As organic matter levels plunge from a healthy 3% or 4% down to 1.5% or less, nitrification leaches boron, silicon, calcium, sulphur and other minerals. What does not leach locks back up with the clay in mineral form, perhaps as calcium phosphate, iron phosphate and various aluminum silicates.

Soil porosity is lost, and both air and water no longer penetrate so well. Erosion, contamination of ground water, and the need for bigger tractors and larger doses of lime, NPK fertilizers and other chemicals follows — which takes us back to where we started from if we were modern conventional growers.

Nitrogen's Role

Nitrogen is key in the formation of amino acids and their assembly into the DNA and RNA in cell nuclei. Every living organism in our soil's ecosystem must have its share of nitrogen. So to bring a soil to life get it teeming with living organisms requires a fair bit of nitrogen. To put this out as chemical nitrogen is risky because it takes less than we might think to shut down the nitrogen fixation processes in the soil that are heavily dependent on calcium. As a quick fix some growers have cut back to 20% of their normal nitrogen applications and used calcium nitrate. At least this supplies calcium even if it's not so good for silicon, boron and carbon. But the trick is to coax nitrogen into the farm from the atmosphere where it is abundant. For this process to be self-sustaining requires soil fungi to have the support of oxygen, boron, silicon, calcium and phosphorus.

Whatever nitrogen inputs we bring in to the farm to light off this process need to be thought of as medicine rather than feedstock. Ideally this nitrogen should be in the form of living organisms, such as well-made composts, compost teas and the like.

Think about nitrogen in terms of everything associated with chlorophyll in the leaf — or better yet, everything associated with hemoglobin in the blood.

We aren't going to achieve the same degree of organized, integrated, healthy and *intelligent* nitrogen activity in our farm if we get our nitrogen in the form of blood transfusions instead of generating the farm's blood from the farm's own bone marrow. It can't be done. Blood transfusions are not a cure for anemia and should only be thought of as a stopgap measure while true self-organizing vitality is built into the stem cells of the farm's bone marrow.

How We Get Our Nitrogen

Though poor protein digestion and 'leaky gut syndrome' is increasingly common in western society, ideally we each build up all our own unique proteins and our own DNA by digesting proteins, absorbing the amino acids and using them to assemble our own unique brand. However, plants have no guts, and the digestion and intelligence of nitrogen works into them from their surroundings, since digestion and the release of amino acids takes place outside of the plant itself. In this regard plants are at the mercy of their surroundings, unlike animals, who shop around and choose what they eat.

This means plants have to be tough and versatile. Thus they can and do survive on crude nitrogen salts that would kill us in far shorter order. But ideally they too would like to absorb their nitrogen entirely as amino acids and build up all their own proteins and DNA from there. The way nitrogen gets into the plant makes all the difference in the world in terms of the complexity of its proteins and the degree to which it is organized.

Personality

Even without considering anything else, textures and flavors show what a difference it makes whether nitrogen enters plants by way of complex microbial activity or by way of chemical fertilization. In the former case microbes give plants by far the larger part of their nitrogen as amino acids. In the latter, most of the nitrogen, or at least far more, is taken up as soluble salts which dilute protoplasm and interfere with protein synthesis making cells weak, watery and subject to disease.

To get a notion of the difference, break a free roaming barnyard hen's egg in a skillet where the egg white is firm and gelatinous alongside a confinement chemical fed hen's egg where the white runs almost like water around the skillet.

Slice into a potato or a zucchini. If beads of water gush out on the surface of the cut and the texture of the vegetable is coarse, it is low quality and full of crude nitrogen salts. It will neither keep well nor taste wonderful. But if it is fine textured and moist but not watery it got most of its nitrogen as amino acids and will have good and maybe even subtle flavor.

Needless to say, eating better quality foods has a corresponding effect on the quality of our consciousness and the way we feel. This is even more beneficial in the diets of young children than it is in mature adults.

The Seven Sisters

Along with the polar opposites polarities of silicon and calcium, plants (and animals) are more than ninety percent hydrogen carbon, nitrogen, oxygen and sulphur. These five in particular are a free gift. If nature's patterns function properly these need not be purchased for the garden or farm. Rather, they can be harvested in a much more organized way.

Probably the top range of quality can *only* be achieved when these five are caught, conserved, and integrated directly into the farm organization instead of being brought in from elsewhere.

Functions

One of the underlying ideas of quantum agriculture is that for every substance there is a significance, an importance, a function, a pattern, a dynamic principle, or in other words *something that it does in the overall scheme of things*. For instance, lime works with the soil and helps to harvest nitrogen, while silica works with the atmosphere and helps to harvest carbon.

The significance, function or dynamic principle associated with a specific thing is not easy to measure as function has no spatial dimensions. Yet whatever we see as substance has function inherent in it, even when this defies measurement. Substance cannot exist without function, nor can function exist without substance. Or we might say mass cannot exist without significance or significance without mass. Rudolf Steiner (1861-1925) sometimes said that spirit cannot exist without matter, nor can we have matter without spirit.

Since living organisms are primarily made up of lime and silica along with hydrogen, carbon, nitrogen, oxygen and sulphur it is important to understand these other five as well.

Hydrogen

Hydrogen is the most fundamental element, the most insubstantial substance. As such, it is the gateway to what quantum physics calls the zero point field[12*] or the realm of pure energy, or perhaps more correctly pure significance. In olden times this was referred to as the realm of spirit. On the other hand a modern physicist might imagine this as a transcendental, hyper-reality, a plenum/void whose three dimensional oscillations give rise to our notions of distance, duration and acceleration. We are free to pick our descriptions.

Hydrogen, the first substance, is associated with water, whose organizational principle is tone. A devout Christian might be inclined to refer to the creation story in the Gospel of St. John — In the beginning was the *Word*, which was 'made flesh' or gave rise to all else in physical universe. Or he might go back to the creation story in Genesis where God *spoke* (tone, water, hydrogen) and said "Let there be light" and there was light. This brings to mind suns condensing hydrogen into heavier elements and thus lighting up the universe.

It wouldn't matter if you went back into the most ancient Sanskrit traditions out of which Indo-European languages arose. There the universal *OM* is the *sound* of creation. Hydrogen is the OM, the doorway, through which the vibrations of spirit enter the universe.

Carbon

Beyond hydrogen, amongst the first octave in the periodic table, are carbon, nitrogen and oxygen. Carbon stands in the middle of all things and forms combinations with virtually every other element, with the possible exceptions of the nobel gasses. One might say carbon picks up where hydrogen leaves off. Where hydrogen gives rise initially to form, carbon embraces and internalizes the entire spectrum of form. It gives rise to every shape, manifests every function. Carbon is the great plastician or sculptor, through which all the wondrous cosmic imaginations manifest.

Where hydrogen is the gateway of spirit, carbon soaks in spirit to its very core, embodying its many forms. For starters, carbon's strong affinity for hydrogen results in methane (CH_4), which is believed to be widely prevalent throughout the universe. Methane is one of chemistry's simplest and most fundamental compounds, as well as one of geometry's stablest shapes, the tetrahedron. This fully hydrated carbon, is the 'natural' gas we burn, and it is the 'free' state of carbon in the absence of oxygen. However, carbon also has a strong affinity for oxygen, forming carbon dioxide, which is the basis for life on our planet.

Silicon, carbon's later and larger kin in the next octave of the table, is a far less active substance, conveying only the warmth and light of these forms to our senses, not their internal chemistry and life as carbon does.

Nitrogen

Nitrogen, the first anion (negatively charged element) beyond carbon, internalizes awareness rather than form. Just as silicon outwardly shows us the form forces of carbon, nitrogen's later, larger kin, phosphorus, outwardly displays as light and color the forces that nitrogen internalizes.

To get some idea of the magnitude of the difference between the first octave of the periodic table and the second octave, consider how nitrogen is so explosive that a wheelbarrow load of dynamite can put out a raging oil well fire by instantly consuming all the oxygen in the near vicinity. A ship loading nitrogen fertilizer once at Texas City sparked and nearly blew this seaport off the map. Phosphorus, by comparison, merely conveys light and color to our senses when it burns. A phosphorus flare is bright, but hardly explosive.

Nitrogen internalizes awareness so strongly it can be said to embody the light and intelligence of the stars, or the astrality, giving rise to consciousness, which we experience as the dual principles of feminine sensation and masculine desire.

Also, nitrogen triple bonds with itself to form N_2 gas, and these triple bonds are so strong they turn this extremely versatile and reactive element into an inert gas which concentrates all its attentions in on itself.

The key role of nitrogen in proteins, protein structures and nucleic acids, is to convey its intelligence or awareness of the organic blueprints that govern how carbon reacts. When protein chains fold, their chemical possibilities would allow them to fold in ever so many ways. How do they invariably know the 'right' way in healthy organisms? Or how is it they forget the right way in the case of cancers? Nitrogen is the embodiment of intelligence, which is why DNA, RNA, organelles, peptides, etcetera are based on protein, *i.e. nitrogen*, chemistry.

Oxygen

Oxygen, the generator of acids, internalizes dynamic, fluid order and organization just as carbon internalizes form and nitrogen internalizes awareness. The basis of life is organization (order, organ, organize, organic, organism). The English word for this element is quaintly symbolic, as the 'O' symbolizes spirit while the 'X' symbolizes corporeality. Oxygen is where spirit and matter really do the dance and come alive.

For example it is only where calcium meets oxygen that it becomes enlivened as lime, or where silicon meets oxygen that it becomes enlivened as silica, and so forth. In the earth's biological economy, hydrogen combines with oxygen to form water, plants release oxygen through binding carbon dioxide into sugars, animals require oxygen to free carbon.

Without oxygen there would be no life as we know it. With the help of the sun, plants release oxygen so it is free in the atmosphere. Thus plants, along with the sun, are primary agencies of life as we know it.

The organization that oxygen internalizes can be called the ether, or the life force. In later chapters we will deal more fully with the understanding that there is no fixed ether field that objects move through, as was believed until almost the end of the nineteenth century. However, the realization is occurring in physics that anything and everything that exists has an organizational or etheric field associated with it. In this text the term *ether* is used for life force or organizational energy rather than some other term (*e.g. Reich, orgone energy; Hieronymus, eloptic energy; Reichenbach, odic force*) as an elephant is an elephant no matter if all one sees is an ear or a tail.[13*]

Sulfur

Sulfur shows its versatility in the fact it can assume a variety of valence states from minus two as sulfide to plus six as in sulfate.[14*] Its role is to get things moving as it will overcome many an impasse. Instead of the strong binding of life chemistry characteristic of oxygen, sulfur, its heavier and larger kin, merely teases it.

For example, where oxygen combines with carbon to liberate it from its other associations, sulfur gets carbon involved in forming associations with an enormous number of other things. Carbon disulfide (CS_2) is one of the most penetrating substances known, as if you get a few drops on your skin it penetrates throughout the body almost instantaneously. Because of its versatile nature sulfur helps carbon to react. Thus it plays a huge role as a catalyst in carbon chemistry, to say nothing of being part of two key amino acids.[15†]

In terms of plant gestures, sulfur reveals itself in branching and creating boundaries. Since life arises at boundaries, sulfur commonly is key for bringing life into dead soils.

Amongst the oldest microorganisms on earth are those that rely on oxidation or reduction[16‡] of sulfur for their energy. Speaking as a sculptor who had to moisten his clay to work it, Rudolf Steiner described sulfur as what 'the spirit moistens its fingers with' to work into the life of nature.

Sulfur is usually the principle component of acid rain, and is released into the atmosphere by burning and by volcanic activity. If our agricultural ecosystems conserved sulfur to the point they were self-sufficient there is enough sulfur in the rainfall to maintain necessary levels in the soil. In this regard deep rooted legumes can be very helpful in bringing up sulfur, which can be an easily leached anion along with nitrate.

Understanding Nitrogen

Knowing that nitrogen is the carrier of intelligence should clarify why it is so important how a plant gets its nitrogen.

Imagine that a plant is fed nitrogen as urea or ammonium nitrate. These are simple salts that must be complexed and integrated into the farm organism before they can share in its intelligence. If the plant takes them up in their crude forms its protoplasm will be salty, watery and weak. It will have to expend energy converting them to amino acids and even then it may still imperfectly integrate them into its nitrogen organization.

A more intelligent choice is to avoid soluble nitrogen fertilizers or use them sparingly. It is better to encourage plants to nourish nitrogen-fixing microbes with carbon compounds as root exudates, while providing adequate calcium, boron and molybdenum, compost teas and perhaps savvy radionic treatments. Plants are able to provide abundant energy for nitrogen fixation at their roots without being flooded with soluble nitrogen.

In a soil low in soluble nitrogen, nitrogen fixing bacteria multiply around roots where root exudates are plentiful. If these bacteria are eaten and digested by protozoans, nematodes and so on, their amino acids will be excreted close enough to roots they can be absorbed as amino acids before they break down into nitrogen salts. This makes plant protoplasm dense and protein rich like a gelatin or albumin. The plant can simply assemble its proteins from its uptake of amino acids, without nitrogen salts and excess water diluting the process. The end result is far greater complexity in the plant's chemistry as well as a more wholesome integration of the intelligence in the grower's environment.

One of the things this mean is the concentration of chlorophyll in a typical chloroplast can be up to half again as rich as it would be in a salty, watery leaf. Thus photosynthesis correspondingly improves. Then the plant stands a far better chance of achieving its full genetic potential, as do any animals or people who eat it.

Best Requires Least

Since the complexity and fullness of its nitrogen chemistrythe more the plant gets its nitrogen as amino acids, the addition of nitrogenous materials to the soil should be kept to a level that maximizes the robust, interactive, amino acid biology of the soil — and no more. This often means that inoculants and compost teas rich in active bacteria and fungi can be more beneficial than heavy applications of compost.

It also can mean that we sometimes can improve the microbial activity of the soil by planting plants somewhat closer together so their root exudates overlap more and create a richer growth medium. Keep in mind that a plant's root exudates are the way it ensures its own ideal mix of microorganisms thrives so that it gets the kinds and quantities of amino acids it needs. No external nitrogen inputs can match this symbiosis for its appropriateness.

Corn for Example

Corn[17*] is a good case in point. As one of the best photosynthesizers it abundantly fixes carbon, providing a huge boost to the soil biology. Up to some undetermined point, high population corn can yield higher than low population corn *per plant*, all other inputs being comparable. Native Americans always planted no fewer than three corn seeds together in order to establish rich concentrations of root exudates at the time of germination and early growth because corn that is only a foot or so high has already established the size of the ear and the number of kernels based on its rate of early growth. Some researchers say that the rate of corn growth in its first seven days determines the size of the crop.

In my own research plots I have seen instances where densely planted open pollinated corn grew robustly with most stalks filling out a large ear.[18†] Yield was nearly two tons of shelled corn/acre, or around 75 bushels/acre. This would not be a particularly impressive crop were it dent corn, which has large, starchy kernels. But considering the variety was a tall, open pollinated high protein flint corn that yields only half as much grain per unit area the yield was comparable to 150 bushels/acre of dent corn. Just as importantly, the organic matter levels in these plots were enriched on average around half a percent the season they grew corn.

This corn, incidentally, was hand picked and graded for both animal and human consumption as well as seed, with more than 50% selected for human consumers and the lesser grade used as high protein corn for chickens. The select grade was ground for corn meal and sold retail for $3 to $3.50 U.S. per pound in the years of 1999 through 2002 — which translates into $170/bushel[19*] at a time when corn prices hovered around $2/bushel. The taste of the corn meal — always a prime indicator of quality and nutritional value — was incomparable and doubtless improved sales.

In sum this meant it was profitable to grow high yielding corn *as a soil improvement crop* without inputs on low nitrogen, robust biology soils with a respectable but not ideal mineral analysis. Thus this deserves more research.

The Quantum Side

One of the key features of this study was the use of a stationary, self-driven agricultural field broadcaster that set up standing wave patterns that enlivened the ether over the entire farm property. The patterns used were homeopathic potencies of remedies derived from Rudolf Steiner's agriculture course. These included *horn manure*, which enriches the organization of the soil ecology, *horn silica*, which improves photosynthesis and atmospheric activity, and *horn clay*, which boosts the ebb and flow of sap within the plants.

This application of quantum mechanics[20†] to agriculture demonstrates how easy and profitable it can be to enliven the ether in growing situations. Further along in this text field broadcasting will be discussed in greater detail, but perhaps a caveat is in order.

Research Renewal Needed

The few experiments cited in this text are on the tip of a large iceberg. So little research has been done compared to what has been spent researching soluble mineral fertilization of soils that we are looking at grains of sand versus rail car loads. The variables in terms of repeatability are large, and we must acknowledge that they include such things as growers' thoughts and emotions, which are as influential as the weather — to say nothing of grower actions.

Indeed a grower's thoughts and feelings affect both the weather *and* his activity as well as his health, motivation and outlook on life. It is deplorable science to pretend otherwise, even though in 2004 this state of affairs still commonly prevails.

Ever since Werner Heisenberg, winner of the Nobel Prize in Physics in 1932 for his ground breaking work leading to the development of what would later be called quantum mechanics, demonstrated that the presence of the investigator and his measuring instruments was a determining factor in the field of investigation, science has had to deal with the question of how our mental and emotional lives affect everything we do.[21*] Experimenter and experiment are inseparably linked. All research has an agenda as well as limits to the observations considered. In this sense there is no truly 'objective' experimentation though double-blind medical research is an effort in that direction.

Research Projects

Here are some thoughts concerning research beyond the initial demonstration that high yield corn can be grown as a soil improvement crop without fertilizer inputs.

Taking into consideration the parameters described in the footnote about cover cropping with corn, there could be far more research into soils and varieties of corn; soil moisture at planting; heavy rain or its lack in the first week after planting; presence and activity of vesicular arbuscular mycorrhyzae (VAM); presence and activity of free living nitrogen fixing soil microorganisms; presence and activity of predator species on VAM and nitrogen microorganisms; presence as well as activity of nitrogen fixing endophytes; allelopathic relationships between corn, soybeans and various common weeds; the effects of both pre and post planting cultivation on VAM and nitrogen fixing organisms, to say nothing of the relationships between various major and minor nutrient levels in different soil types. It will take hundreds of millions of dollars and teams of researchers to flesh out these details so inputs can be fine tuned and reliable top quality results obtained in various climates and on varied soils. Considering the exhaustion of many soils today there is no time to waste.

I hasten to point out that if the above studies are pursued in the usual piecemeal analytical fashion they may do little to advance holistic investigations.

Suppose we ask questions like this. What of the effects of different seasonal (sun), monthly (moon) and planetary combinations? If we look at this we will look at a broader context. What of the intentions, beliefs and emotional milieus of various growers? All of these influence results so they should be noted in our records. It was all right in a younger era of science to ignore these subtle variables, but with more sophisticated methods of research we must now consider them.

What of the effects of subtle energies and subtle energy devices, such as the Steiner remedies and radionic instruments, on the ether? What of mapping existing organizational fields[22*] on site at the beginning of experiments and monitoring these if and as they change? Since there is no hope of limiting variables to a mere handful, what useful standards can we set for looking at our variables in concert? These are experimental design questions that bring up another issue.

Epistemology

Epistemology is the study of *how* we know *what* we know. To say we can only know things by way of sight, sound, taste, smell and touch ignores *thought, feeling, imagination, intuition* and *cognition,* to name a handful of other aspects of human awareness. Because quantum physics acknowledges the effect of these additional influences on the realities of what we know, we must include them in our epistemology.

This means the human organism itself is our principle instrument of knowing, and microscopes, telescopes, gas chromatographs — and for that matter pendulums, dowsing rods, and rubbing plates — are merely adjuncts and vias in the process of observation.

The foremost and highest means of knowing is the observer himself, as there is no comparable means of integrating all that is observed. This must be clearly recognized if meaningful holistic research — particularly research into quality — is to proceed.

With due respect, isolation and segregation of variables is a great tool. Enormous advances in science have been made through analytical research, but where has this led? Away from the overview? Don't we need an overview? What has this loss meant for our scientific integrity?

If we proceed in the direction of holistic research pointed to by quantum physics then we must view our variables in concert using all our means of knowing including our uniquely integrative perspective as human beings.

One of the great proponents of materialism of the nineteenth century, Herman Helmholtz, complained about his holistic counterpart, Johann W. von Goethe, that despite Goethe's noted scientific genius he could never refrain from incorporating art, poetry and drama into his scientific work.

We need not take this as a criticism if we wish to conduct holistic research. Rather, following the Goethean path is a necessity that shows up immediately in appreciating the aromas, flavours and culinary art to go along with the nutritional vitality we can achieve in agriculture when holistic research places quality at the forefront of investigation.

Uniformity vs. Diversity

Speaking of which the analytical mode of investigation is rooted in the belief that uniformity and competition are the preeminent strategies in nature. This may be true in some human societies, but it is not true in nature as a whole. Nature shows us time and again that in rich, stable environments diversity and cooperation are preeminent.

Growers lose quality with monocrop, clean-cultivated, weed free, insect free, microbe free approaches. Ultimately these environments run down no matter how rich and fertile they were at the start. Growers gain in quality the more they inter-crop, rotate crops, cover crop, and devise systems that maximize beneficial plants, insects and microbes grown in concert with crops.

Let's take just one example of why diversity and cooperation are the winning strategies. Let's look at balancing crop rotations.

Why Rotate and Balance?

Each species of plant has a different mix of root exudates and feeds different populations of microorganisms at its roots, all performing different functions. For example, buckwheat has the effect of making soil phosphorus reserves biological, while hemp, okra or bananas can make potassium reserves biological. Grasses access silica while legumes access lime.

Once these minerals become part of the biological pool they are available through the turnover of minerals via microorganisms to plants that cannot access them more directly. As long as nutrients are held within the cell walls of living organisms or are attached to clay/humus colloids they are not so mobile that they leach or salt out. Leaching or salting out of minerals in soils is nearly always undesirable.[23*] Through crop rotations we can build rich and diverse populations of soil organisms so a wide array of nutrients are insoluble but available because they are held in the soil biology.

Because of their silica nature, grasses are best at fixing carbon from the atmosphere and feeding energy to free living soil bacteria some of which fix nitrogen. However, because of their lime nature, legumes, in cooperation with mycorrhyzal fungi, are the best mineral miners. Legumes make calcium biological, as well as many other major and minor nutrients. In particular microbes need calcium to fix nitrogen. Legumes have developed symbioses with nitrogen fixing *Rhizobia* and form calcium rich nodules on their roots as well as providing plenty of carbon energy for these microbes. Of course, it is the *microbes* that, using nitrogenase and molybdenum, split nitrogen's triple bonds and engage it with calcium. Microbes are the nitrogen fixers even when they are algae at the soil's surface or endophytes living within plant tissues.

Maybe we should clean up our loose talk about legumes fixing nitrogen. They bring oxygen into the soil, which serves to unlock calcium and other minerals, making these elements available to the nitrogen fixing symbiotes living on their roots. They do this whether they form nitrogen fixing root nodules or not.

Bottom Line Nutrients

In any event the bottom line is we do not want our nutrients to be soluble as they will wash away or concentrate too densely where there is insufficient rain or drainage. We want our nutrients to be *insoluble but available*. We will get there by remembering that building biology is cheaper and easier than continually re-stocking minerals. And establishing resonant organizational conditions in the ether is cheapest and easiest of all. This will lead to high quality crops where the starlight, or astral complexity of nitrogen is densest. That will be a quantum leap in agriculture from the twentieth century.

Bon voyage!

§§§§§

(Footnotes)

1 * Fractals are self-similar patterns. They retain their self-similarity no matter what scale they are examined on whether they recede to a point or expand into higher dimensions. Fern leaves, sea shells and landscapes offer examples, as does the branching of our arteries, bronchial tubes, etc.

2 † What we know as space flows into a vortex (a proton) or out of a vortex (an electron), but the dimension or dimensions it flows into or out of are not limited to our physical three. Higher dimensions are immediate and non-limiting and as such 'get around' our three dimensional limitations of distance or time. For example, where the speed of light is constant and a limit in three dimensions, experiments in quantum computing and communication far exceed this limit. Computing and communication may one day be limited only to switching speeds.

3 * Calcium oxide (CaO) and its derivatives — e.g. limestone, gypsum, rock phosphate and calcium nitrate.

4 † Silicon dioxide (SiO_2) and its derivatives — e.g. quartz, obsidian, feldspar, orthoclase, etc.

5 _ In the periodic table the chemical characteristics of the first octave of the table act far more strongly than in the second octave, with the third and fourth octaves acting progressively more and more weakly. Aluminum is in the second octave next to its mate, silicon. It stores and exchanges most minerals with microorganisms and plants, thus it is the basis of both nutrient storage and nutrient uptake. However, aluminum (working with silica) is not buoyant and mobile enough to connect the silica chemistry of the plant with the lime chemistry of the soil. Aluminum is assisted in this task by trace amounts of its more potent, smaller kin, boron. Early morning high brix (a carbon indicator) in leaves is a sign of boron deficiency, as boron activates silica so plants translocate their carbon harvest from their leaves to their roots at night in exchange for amino acids, calcium, magnesium, phosphorus and other nutrients.

6 * Herbaceous plants that are not grasses — usually these are broad leafed herbs.

7 † Cyanocobalamin. Often this is the preferred way of supplying cobalt if it is deficient. Cobalt is a micronutrient necessary for digestion in the soil.

8 ‡ Quantum holography and quantum non-locality or entanglement are two of the surprising rules of quantum mechanics. According to quantum holography every part of any organized whole (e.g. a living organism) is united with or connected to all of its other parts. Any part can represent the whole, just as every cell in a person's body contains the same DNA . Furthermore matter results from vortices that connect three-dimensional space with transcendental or transfinite space. Thus any part of an organism, is entangled with the whole organism regardless of its locality. No distance or time need apply. Imparting patterns to a physical specimen, witness or token of an organism with a radionic instrument instantaneously imparts those patterns to the entire organism no matter the intervening distance. Photos and maps, such as aerial photos or official surveys, allow patterns to be imparted to whole fields and entire farms.

9 † Phi [Greek letter ?], is also known as the Golden Mean is an irrational number approximately equal to 1.61803 . . . Like Pi [Greek letter π, the relationship of a circle's diameter to its circumference], ? is an irrational number, and usually is written as a non-repeating decimal. It can be derived from the Fibonacci sequence in which the next number is the sum of the previous two, i.e. 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, 1597, 2584, 4181, etc. Values for Phi are obtained by dividing the last number in the sequence by the previous one, as for example, 4181 divided by 2584 is 1.61803 . . . . Interestingly, the reciprocal [2584 divided by 4181] is 0.61803 . . . which is why ? is called the Golden Mean. Of course, the higher the numbers used in the derivation of ? the more accurate the value obtained.

10 * It may be that a Schauberger type 'trout' turbine would qualify as a Maxwell's demon. (Who judges these things?) Victor Schauberger, the Austrian 'Water Wizard' observed that trout could remain virtually motionless in a fast moving stream. When startled they would shoot forward against the flow like an arrow from a bow. He also found the temperature on the downstream end of large boulders in a stream was colder than at the upstream end suggesting the water gave up some of its warmth in passing. The same principle held true for air, and he believed one could build turbines to remove the warmth from air and use it for power. Currently wind is the fastest growing electric generation capacity.

11 * The amount of water it takes to cover one acre to the depth of one inch is 193,460 gallons. On a ten thousand-acre watershed this is roughly seven billion, three hundred eighty six million liters of water. The need for *natural* rainfall is clear when we realize that one of the drawbacks of pumped water is it lacks the organizational forces that rain water develops when moisture gathers into clouds and condenses as rain. Since organization is the basis of life, rain fed production is more alive than irrigated production, all other factors being equal.

12 * It may seem a contradiction to call something both zero point and simultaneously describe it as a field, which implies at least two dimensions. Thus some physicists refer simply to "zero point" without mentioning the field.

13 * The story goes that five blind men encountered an elephant. The first found the trunk and exclaimed, "This creature is like a fire hose!" The second ran into an ear and pronounced, "No, this creature is like a big fan." The third bumped into a leg. "Sorry! This creature is like a tree." The fourth broadsided the elephant and assured the others, "This creature is like a wall." The fifth, who found the tail, said, "Bah! This creature is like a rope." Since they were all both blind *and* human, none guessed that all five were right.

14 * Sulfur can assume a valence of minus two, as in hydrogen sulfide gas, H_2S?, all the way to plus six as in sulfate which is the double negative ion, $SO_4^{=}$.

15 † These are cysteine and methionine.

16 ‡ Oxidation and reduction are chemists' terms relating to water — the basis of chemistry and pH — which is made up of oxygen and hydrogen. Thus fully oxidized nitrogen is NO_3^- and fully reduced nitrogen is NH_4^+.

17 * Zea maize. English settlers in North America brought the word 'corn' over from their Anglo Saxon roots where the word 'corn' was applied to barley or virtually any grain that made a hard kernel. In German, for instance, the word for kernel or grain is 'korn.' However, upon seeing maize the English settlers allowed as how it was real corn and the nomenclature stuck.

18 † These corn plots were on high biology, low soluble nitrogen soils with organic matter slightly above 3%, pH between 6.5 and 6.9 with calcium levels in a range of 56 — 78% base saturation, available phosphorus tested under 80 ppm but total P was in a range of 500-600 ppm, planted with *no inputs* other than tillage and seed at 12-13 plants per meter in the row. Corn rows were 56 cm apart in the beds with soybeans down the middles 28 cm from either corn row.

19 * A bushel is eight gallons, or 30.6 liters. Most corn weighs roughly 56 lbs./bu.

20 † As explained in greater detail in the chapter on Quantum Physics, quantum mechanics grew out of the realization that particles existed only at values where their waves perfectly matched in resonance. Because of this particles can only absorb or emit photons that take them to their next resonant level. This is useful, however, since resonance patterns are what manifest particles

21 * Heisenberg, one of the early pioneers of quantum physics, convincingly proposed that the observer and the experiment are linked, and that there is no true separation between subject and object. Erwin Schrödinger won the 1933 Nobel Prize in physics for work that extended and supported Heisenberg's thesis. Acknowledging the inseparability of subject and object amounted to a giant conceptual step in physics in regard to the thinking of the previous few hundred years where it was believed the observer had no influence whatever on what was observed. This explains the simple fact that we find what we look for, and unless we look for things outside our scientific paradigm we fail to discover any. Corollary to this, we participate in creating the realities we inhabit. This helps explain the need for double-blind drug research where neither the subjects nor the researcher knows who gets the drug and who gets the placebo. However, it also points out the need to further investigate the placebo effect.

22 * Mapping of electrical conductivity of soils and magnetic lines is already done in some places. Mapping

of gravity potentials is also a possibility.

[23] * Generally one does not want to flush minerals out of soils, which is a good reason to develop biology in soils so nutrients are held onto. However, sometimes one wants to *deliberately* flush something out. Some elements that can be in excess are magnesium, sodium, mercury, arsenic and cadmium.