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Introduction:

Even though Eliot is the sole author of this paper, we have both written frequently on this topic. All of our books extol the virtues of a biologically focused agriculture and each of Eliot's contains a chapter introducing the "plant positive" concept. We are puzzled by how the practical success of the many farms managed on "biological" lines can co-exist with the almost total lack of interest within scientific agriculture in exploring the parameters of that success. The foundation upon which this farm operates -- our sense that the systems of the natural world offer elegantly designed patterns worth following -- appears to be an indecipherable foreign language in our culture. We have come to feel a great affinity with Gruenblatt (see the final page of this document.)

This paper suggests that the techniques espoused by chemical agriculture are based upon a mistaken premise. Therefore, that system requires enormous patch-up artifice in order to function. It is a familiar tale in the history of science. Apparent temporary accomplishment is not proof of concept. For example, if we had a book of the long discredited geocentric astronomy of Ptolemy, we could still locate Jupiter in the sky at night. The orthodoxy of chemical agriculture is now up against its own Galileo. It will be interesting to see who eventually recants. *Eppur si muove*.

THE OTHER SIDE OF THE TAPESTRY

AN AGRARIAN UNDERSTANDING OF THE NATURAL WORLD

"When knowledge is not in order, the more we have of it,

the greater will be our confusion."

Herbert Spencer

The classic agrarian image of the independent yeoman farmer that has been enshrined by rural philosophers for over 3000 years, lay on its deathbed in the Western world in the years after the Second World War, its body ravaged by a rapidly spreading disease. In odd corners of the rural world there were still a few "self-sufficient, non-pecuniary husbandmen"[1] like the agrarian stalwarts of yore, but not really enough for anyone to notice. The nefarious forces of the modern world had almost totally prevailed. It is hard to imagine much life left in a philosophy based on the proud superiority of agriculture over the debasing activities of industry, when the presumptive champions of that philosophy, the farmers, were heavily in debt to industry for massive fossil fueled machinery, had their soil hooked intravenously to the industrial anhydrous ammonia pipeline, and willingly had their farms aerially sprayed with industry's latest chemical poisons.

[1] Clifford B. Anderson, "The Metamorphosis of Agrarian Idealism In The 1920's And 1930's," *Agricultural History*, 35, 4, 1961, p. 182.

Fortunately, for those who find virtue and sustenance in the agrarian dream, all was not lost. At about that same moment in the post-war years a new group of rural idealists, following an alternative line of agricultural thinking that had sprung from numerous food quality concerns, were rising up to take over the agrarian banner. This alternative agricultural thinking started in the late 19th century in both Germany and England. A growing coterie of farmers, landlords, citizens and rural philosophers had begun questioning the wisdom of the chemically based agriculture that had grown so prominent from its tiny beginning in the 1840s. They were bolstered by the advances in biological science during the late 19th century, such as those that explained the workings of nitrogen fixation, mycorrhizal association and soil microbiology, which set the stage for a deeper understanding of natural processes, and offered inspiration as to how a modern biologically based agriculture might be formulated.

Despite the popular assumption that what is called organic agriculture sprang full born from the delusions of 60s hippies, it has a more extensive provenance. If you look back at its first flush of notoriety in the 1940s, the names most often mentioned, Sir Albert Howard and J. I. Rodale, rather than being the initiators, were actually just popularizers of a groundswell of new ideas that had begun to develop some 50 years earlier. The new ideas were focused on three issues – soil fertility, the role of pests, and the nutritional value of food crops.

The first rumblings in Germany came from the Life Reform movement in the 1890s. At the time there were concerns in many quarters about the detrimental effects on human health of declining food quality due to chemical fertilization and the toxic residues of lead and arsenic pesticides. In response, the movement stressed the benefits of food grown in fertile soil with natural methods. Gustav Simons' 1911 book, *Bodendüngung, Pflanzenwachstum, Menschengesundheit*, (Soil Fertility, Plant Growth, Human Health) was one of the earliest works expressing the growing sense of a direct connection between the quality of the soil, the quality of the plants grown, and the quality of the resulting human nutrition.[2]

The English physician, G. Vivian Poore, published *Rural Hygiene* in 1893 with a chapter titled "The Living Soil." Poore's book celebrated the indispensable role of organic matter as the basis of soil fertility and the biological activity of the soil creatures as the power behind it. "Farmers and market gardeners will tell you that artificial manures have 'got no bottom in them,' that their use is, so to say, a speculation . . . With organic refuse, however, the case is entirely different, and the effect of the application of organic matter . . .to the soil is plainly discernable for three or four years . . . until

[2] Gunter Vogt, *The Origins of Organic Farming*, in Organic Farming: An International History, edited by William Lockeretz (Wallingford, Oxfordshire: CAB International, 2007).

finally . . . these organic matters become fertile 'humus,' which is the only *permanent* source of wealth in any country."[3]

In 1910 the American Cyril Hopkins, director of the Illinois State Experiment Station, published his best-known book, *Soil Fertility and Permanent Agriculture*.[4] (A very up-to-date sounding title today when we are looking for sustainable systems.) "For all of the normal soils of the United States . . . there are only three constituents that must be supplied in order to adopt systems of farming that, if continued, will increase, or at least permanently maintain, the productive power of the soil. These are limestone, phosphorus, and organic matter . . .. The supply of organic matter must be renewed to provide nitrogen from its decomposition and to make available the potassium and other essential elements contained in the soil in abundance, as well as to liberate phosphorus from the raw material phosphate naturally contained in or applied to the soil."[5]

These soil fertility concepts continued to be investigated in the 1920s in Europe and gained an increasing number of adherents. By the 1930s the concerned farmers had begun formulating an updated, scientifically grounded version of the biologically based agriculture that had preceded the

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[3] G. Vivian Poore, *Essays On Rural Hygiene*. (London: Longmans, Green, And Co. 1893), p. 163.
[4] Cyril G. Hopkins, *Soil Fertility And Permanent Agriculture*. (Boston: Ginn and Company, 1910).
[5] Cyril G. Hopkins, *Shall We Use 'Complete' Commercial Fertilizers In The Corn Belt?* (Univ. of Illinois AES Circular No. 165, 1912), pp. 1-20.

chemical/industrial invasion. The efforts of Heinrich Krantz and Ewald Könemann in Germany,[6] Hans and Maria Müller in Switzerland,[7] Pierre Delbet[8] and Raoul Lemaire[9] in France, and Lady Eve Balfour[10] and Sir Albert Howard[11] in England all led to the development of successful farming systems based upon continuous improvement of soil fertility using natural methods.

By 1946 these ideas were being discussed with sufficient interest among agriculturists that the International Harvester Company sponsored the publication of a 125-page pamphlet authored by Karl Mickey, *Health from the Ground Up*.[12] It was a sequel to an earlier soil conservation volume, *Man and the Soil*, also by Mickey, but this second publication dealt "primarily with the influence of soil characteristics on the individual." Mickey made very positive comments about the work of Weston Price, Sir Robert McCarrison, and Sir Albert Howard, names known today almost exclusively in the alternative agricultural world. When discussing fertilizers he wrote, "It is not uncommon for the addition of a nitrogen fertilizer to a soil low in other nutrients to cause abnormal growth and disease in the plants . . . excessive or unwise use of fertilizers containing of pure chemical salts may hasten the depletion of some of

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[6] Op. cit. Vogt, p. 15 – 16.
[7] Ibid., p. 18.
[8] Pierre Delbet, *L'Agriculture Et La Sante*. (Paris, Denoél, 1945).
[9] A. de Saint Henis, *Guide Practique De Culture Biologique*. (Anger, Agriculture et Vie, 1972.)
[10] E. B. Balfour, *The Living Soil*. (London, Faber and Faber, 1943.)
[11] Albert Howard, Sir. *An Agricultural Testament*. (London, Oxford University Press, 1940.)
[12] Karl B. Mickey, *Health From The Ground Up*. (Chicago, International Harvester Company, 1946.)

the vital secondary elements in the soil. These are conserved by the use of stable manure, the plowing under of legumes, and other methods of replenishing the organic content of the soil."

Starting at almost the same time as the movement advocating naturally based soil fertility, a parallel group of researchers were reevaluating the role of pests in agriculture and coming to equally alternative conclusions. According to this line of thought, pests were not enemies to be killed but rather indicators to be heeded. Pests could not gain a foothold unless the plant had previously been negatively predisposed by inadequate growing conditions. The solution was to improve the growing conditions. This idea had been around for quite a while. In a 1793 letter to his daughter, Thomas Jefferson wrote: "I suspect that the insects which have harassed you have been encouraged
by the feebleness of your plants and that has been produced by the lean state of the soil."[13]

Erasmus Darwin, Charles' grandfather, speculated in 1800 that the leaves of a fruit tree damaged by insects were "previously out of health, which occasioned them to supply a proper situation for those insects which molest them."[14] Thomas Green Fessenden, author of a garden book, *The American Kitchen Gardener*, that was enormously popular in the 1830s, stated: "The

[13] R. C. Barron, ed., *The Garden And Farm Books Of Thomas Jefferson*. (Golden, Colorado: Fulcrum, 1987). p. 169.
[14] E. Darwin, *Philosophy Of Agriculture And Gardening*. (London: J. Johnson, 1800).

preventive operations are those of the best culture . . . choice of seed or plant, soil, situation, and climate. If these are carefully attended to, it will seldom happen that any species of insect will effect serious and permanent injury. Vegetables which are vigorous and thrifty are not apt to be injured by worms, flies, bugs, etc."[15]

In 1870 Vincent Gressent, a market gardener in Paris, wrote *Le Potager Moderne*, an instruction book for Parisian growers: "For vegetable growing chemical fertilizers don't do all that one wants; they stimulate the plant and produce quantity, but to the detriment of quality . . . In principle, insect pests only attack weak, sickly plant specimens lacking proper nutrition . . . In proof of this I offer the market gardens of Paris where vegetable growing has reached perfection . . . One does not see pest problems in Parisian market gardens wherever copious compost use and rational crop rotations are practiced by the growers" [my translation].[16]

Back in the early 19th century the explanation for fungal and bacterial plant diseases was known as the Autogenic theory. According to the autogenicists the effect of environmental factors on the plant was the prime cause of plant disease and the visible symptoms were exterior manifestations of

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[15] Thomas Green Fessenden, *The New American Gardener*.13th edition. (Boston: Otis, Broaders, and Co., 1839), p. 169.
[16] Vincent Gressent, *Le Potager Moderne*. (Paris: Librairie Agricole De La Maison Rustique, 1926), p. 135, p. 861 – 2.

interior malfunctions. That theory had been discredited by the end of the 19th century as agriculture acknowledged the existence of bacteria and fungi through the work of Pasteur, Koch, et al. As a consequence, most all consideration of the role of environmental factors as root causes was relegated to a minor role. There were, however, a number of investigators who, although acknowledging the new pathogenic theories about the function of microorganisms, still credited the influence of the growing conditions. They contended that microorganisms could only incite disease when the host plant had previously been rendered susceptible by unfavorable environmental conditions (e.g. poor soil, excess moisture, insufficient air, low temperature, etc.)

H. Marshall Ward (1854-1906) and Paul Sorauer (1839-1916) were the leading proponents of these ideas that came to be referred to as the Predisposition Theory. Predisposition can be defined as the tendency of non-genetic conditions, acting before infection, to determine the susceptibility of plants. This is a varying degree of resistance or susceptibility dependent upon external causes. In his essay *The Nature of Disease* (1905) Sorauer wrote that "for the production of a parasitic disease the presence of the parasite alone is not determinative but the constitution of the host organism is also a determining factor . . . That condition of a living creature which we are accustomed to term 'healthy', without being able as yet to define it, is one such restricting limit which the parasite under normal conditions is not able to overcome."[17] Ward in his Croonian Lecture of 1890 effectively summed up the predispositionists' case.

[17] Paul Sorauer, *Handbuch Der Pflanzenkrankheiten*. (Berlin: P. Parey, 1905).

"Disease is the outcome of a want of balance in the struggle for existence just as truly as normal life is the result of a different poising of the factors of existence."[18] It is a tribute to Ward's perceptive thinking on this subject that 85 years later Baker and Cook in their *Biological Control of Plant Pathogens* stated the same idea in almost identical terms: "The occurrence of a plant disease thus indicates that some aspect of the biological balance is not in equilibrium."[19]

In 1938, Von H. Thiem, a German researcher, discussed the existence of both an absolute and a relative immunity to pests. The former he called genetic immunity and the latter pheno-immunity. He considered plants to be genetically immune when their resistance is such that a specific pest will never propagate and develop on them. Pheno-immune plants, on the other hand, are those whose degree of resistance is influenced by outside factors. If the resistance of a pheno-immune plant is to be maintained then cultural conditions such as soil type, fertilization, moisture and so forth must be carefully considered. Thiem even contended that monoculture, long considered a causative factor of insect multiplication, would present no problem if proper cultural practices succeeded in assuring the pheno-resistance of the crop.[20]

H. Marshall Ward's influence reentered the natural farming discussion in 1940 with the publication of Sir Albert Howard's *An Agricultural Testament*. It

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[18] H. Marshall Ward, *On Some Relations Between Host And Parasite In Certain Diseases Of Plants*. Croonian Lecture. (London: Proc. R. Soc. Vol. XLVII, 1890), pp. 303 – 433.
[19] Kenneth F. Baker and R. James Cook, *Biological Control of Plant Pathogens*. (San Francisco: W. H. Freeman, 1974).
[20] Von H. Thiem, "Uber Bedingungen der Massenvermehrung von Insekten." (Berlin-Dahlem: Abr.Physiol. Angew. Entomol. 5:3, 1938), pp. 229 – 55.

turns out that when Howard was engaged in graduate work at Cambridge from 1896 to 1898, H. Marshall Ward was his major professor. Howard's wife acknowledged that Ward was the one who introduced Howard to the Predisposition idea.[21] Howard incorporated the concept into his own pursuit of a natural agriculture and stated emphatically in *An Agricultural Testament* that "insects and fungi are not the real cause of plant diseases but only attack unsuitable varieties or crops imperfectly grown. Their true role is that of censors for pointing out the crops that are improperly nourished."[22]

The third theme in this discussion, the effect of the soil quality and the growing conditions on the resulting nutritional quality of the produce, had a less scientifically respectable but nonetheless a long and enthusiastic parentage. The obscure names of Charles Northen, Julius Hensel, Albert Carter Savage, Sampson Morgan, Royal Lee and Weston Price all surface in the course of a thorough search of old sources. Their major concern was that if the full compliment of minerals was not present in the soil, the nutritional quality of the food and the subsequent health of the consumer would be diminished. The general suggestions for improving soil mineral availability ranged from growing deep rooting green manure crops that would bring minerals up from lower soil layers to supplying soil minerals by spreading the finely ground rock dust that

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[21] Louise E. Howard, *Sir Albert Howard In India*. (London: Faber and Faber, 1953), p. 162.
[22] Howard, op. cit., p. 161

was generally available as a waste product of the rock crushing industry. A number of reasonably respectable reviews of natural mineral sources were written in response to growing interest, but it was the actual awareness of mineral deficiencies affecting people and livestock that finally brought attention to the issue.

Dr. E. C. Auchter, then chief of the Bureau of Plant Industry of the USDA, wrote a lead article for Science magazine in 1939 entitled, *The Interrelation of Soils and Plant, Animal and Human Nutrition*. He stated that up to then we had neglected "the interrelationship between the physical well being of man and the factors in the soil that affect the composition and development of plants." Whereas the previous focus had been only on large yields "we ought to give more attention to producing crops of the highest *nutritional* quality for man and animals . . . if conditions of lowered health exist in part because of low quality plant or animal products produced on deficient soils, then the plant, animal and soils investigators have a challenge and responsibility that can not be shirked." In a subsequent article he concluded that, "the unfolding of this relationship may conceivably revolutionize agricultural theory and practice and profoundly change our ideas on the advancement of human welfare."[23]

Ten years later, Paul Sears of Yale in an address to the Ohio State Medical Association mentioned his thoughts on the subject. He discussed

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[23] E. C. Auchter, The Interrelation Of Soils And Plant, Animal And Human Nutrition, *Science*, 89, 2315, 1939, pp. 421-427.

groups representing the "growing popular interest in the relation of Soil to Health . . . The main tenet of such groups is that, by promoting the normal biological processes in the soil and returning all possible organic matter to the soil, healthy plants, livestock, and human beings will be produced. At times some of the more enthusiastic over-do things . . . But they are, in general, on the track of a very important truth."[24] Almost simultaneously, as reported in the Washington Post on October 26, 1949, the counter-forces were making the opposite case. Elmer Nelson, head of the Food and Drug Administration division of nutrition, testifying in a court case said, "It is wholly unscientific to state that a well-fed body is more able to resist disease than a less well-fed body. My overall opinion is that there hasn't been enough experimentation to prove dietary deficiencies make one more susceptible to disease."[25]

The introductory discussion above presents some background for the three strains of thought that coalesced into a new biologically based concept of agriculture in the 1940s.

1) Soil fertility can be maintained and increased to optimum levels by means of green plants, organic matter and natural inputs such as limestone and other finely ground rock powders.

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[24] Cited in *Soil, Food And Health,* edited by Jonathan Forman. (Columbus, Ohio: Friends of the Land, 1948), pp. 40 -41.

[25] Cited in *Empty Harvest*, Bernard Jensen and Mark Anderson. (Garden City Park, New York: Avery Publishing Group Inc, 1990), pp. 40-42.

2) The plant vigor resulting from doing # 1 correctly renders plants resistant to pests and diseases.

3) The plant quality resulting from doing # 1 correctly provides the most nutritious possible food for maintaining man and his animals in bounteous health.

All three begin with and depend upon how the soil is treated. But in the best agrarian tradition the fertility of that crucial soil factor is not a function of purchased industrial products. It evolves from intelligent human interaction with the living processes of the earth itself. These are processes that are intrinsic to any soil maintained with organic matter. They are what the earth does.

Detractors have often misrepresented a biologically based agriculture as if it is nothing but the substitution of purchased organic inputs for purchased chemical inputs. Even if there were evidence to document the rationale for a substitution philosophy, it would lose on the grounds of economics alone. Both bone meal and dried blood, for example, two popular “organic” fertilizers, are prohibitively expensive on a farm scale. Furthermore, such substitution thinking is not pertinent to the actual objective of a biological agriculture – namely the development of sustainable, farm-generated systems for maintaining soil fertility. The concern is not the substitution of one fertilizer for another but rather the long-range practical and economic viability of farming practices. Supplies of blood and bone meal are no more assured than are supplies of chemical

fertilizers that derive from finite and dwindling resources. Agricultural systems that rely on inputs from either source cannot be depended upon over the long term. What can be depended upon, however, is a system that bases fertility maintenance on proven cultural practices with the addition of locally available waste products.

Among those cultural practices I include:

- Crop Rotation –Firmin Bear of Rutgers stated that a well-planned crop rotation was worth 75% of everything else the farmer did.
- Green Manures –Deep rooting legumes not only fix nitrogen, penetrate hardpan and greatly increase soil aeration but also bring up new mineral supplies from the lower depths of the soil.
- Compost Making – Of all the support systems for the biological farm none is more fortuitous than the world's best soil amendment, compost, which can be made for free on the farm from what grows thereabout.
- Mixed Stocking – Raising animals and crops on the same farm has both symbiotic and practical benefits. The crop residues feed the animals and the animal manures feed the soil.
- Ley Farming – The fertility of land plowed up for row crops after 3 to 4 years in grass/clover pasture is practically that of virgin soil because of the enormous amount of plant fiber added by the perennial plant roots.

- Undersowing – Establishing a green manure crop underneath the growing cash crop can often double organic matter production in the course of the year without any effect on the cash crop.
- Rock Powders – The slow, measured availability to plants of mineral amendments (calcium, phosphorus, potassium, etc.) added to the soil as ground rock powders mimics the availability from natural soil particles.
- Enhancing Biodiversity – This includes practices such as growing a wide range of crops, sowing pastures with many different forbs in addition to grasses and legumes, carrying a mixture of livestock, establishing hedgerows for wildlife habitat, and so forth. The more components involved, the more stable the system.

These practices are pieces of a management program by which biological farmers successfully nurture natural soil processes to meet human needs in food and fiber without in any way overwhelming those processes and causing them to malfunction. The best biological farmers follow a pattern at odds with the pattern of chemical agriculture. The chemical/industrial mindset focuses on the symptom of a problem and devises expensive products in order to palliate that symptom. The biological/agrarian mindset focuses on the cause of the problem and looks to manage natural processes in such a way as to correct the cause. Biological farmers use the natural fertility-enhancing practices mentioned above to correct the cause of low soil fertility rather than attempting to treat the symptoms (poor yields, poor quality) by purchasing chemical stimulants. The

same pattern applies to pest problems. By improving soil fertility, avoiding mineral imbalance, providing for adequate water drainage and air flow, and growing suitable varieties biological farmers avoid the plant stress that causes pest problems, thus correcting the cause rather than treating the symptoms--insects and diseases--with pesticides. The aim of biological agriculture is to cultivate ease and order rather than battle futilely against disease and disorder.

But, can you really farm that way? Can a successful agriculture be conducted by simply combining the known effects of natural processes with the management provided by intelligent human understanding of how to nourish those processes? If such an agriculture can work and could be made universal, then this new agriculture would be truly sustainable and have the power to transform the world. Back in 1967 when I began farming none of us paid attention to whether agricultural science (as opposed to agricultural tradition) approved of our approach. We started farming with compost and cultural practices because the ideas made sense and, lo and behold, they worked. Alternative agricultural research today is showing that we were pretty astute. Studies are appearing almost too fast to read them all.

For example, the importance of soil organic matter is more appreciated every day even though it “is arguably the most complex and least understood

component of soils."[26] Bioactive humic substances produced by earthworms in compost have been found to enhance root growth and availability of nutrients "by mechanisms that are not yet clear" because "relatively little attention has been paid."[27] Work with composts has determined their ability to control plant diseases through initiating in the plant what Harry Hoitink of Ohio State calls 'Systemic Acquired Resistance.'[28] T. C. R White has explained how the effect of stressful growing conditions "upsets the metabolism of the plant in such a way as to increase the availability of nitrogen in its tissues" which increases "survival and abundance of herbivores feeding on those tissues" even though "these physiological changes may often not be sufficient to produce visible signs of stress in the plant."[29] Non-genetic tolerance to stress is a form of "induced resistance dependent on environmental factors" and an approach "that only a limited number of

researchers have tried to define."[30] But even genetic resistance makes no difference if negative growing conditions inhibit the expression of the genes. In USDA research to determine why tomatoes growing in mulch of vetch green manure were more disease resistant and longer lived than identical tomatoes

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[26] Fred Magdoff and Ray R. Weil, *Soil Organic Matter In Sustainable Agriculture*. (Boca Raton, Florida: CRC Press, 2004), p. 3.
[27] Luciano Pasqualoto Canellas et al, "Humic Acids Isolated from Earthworm Compost Enhance Root Elongation, Lateral Root Emergence, and Plasma Membrane H^+-ATPase Activity in Maize Roots," *Plant Physiol*, 130, 2002, pp. 1951-1957.
[28] Harry A. J. Hoitink, and P.C. Fahy. "Basics for the control of soil-borne plant pathogens with composts," *Annual Review of Phytopathology*, 24, 1986, pp. 93-114.
[29] T. C. R. White, "The abundance of invertebrate herbivores in relation to the availability of nitrogen in stressed food plants," Oecologia, 63, 1984, pp. 90-105.
[30] Eliot W. Coleman and Richard L. Ridgeway, *Role of Stress Tolerance in Integrated Pest Management*. In Sustainable Food Systems, edited by Dietrich Knorr. (Westport, Connecticut: AVI Publishing Company, 1983), p. 127.

with black plastic mulch, Kumar et al. found that the genes for longevity and resistance were not 'turning on' in the sections without the vetch mulch.[31]

Nutritionists to their dismay have found what they call "dilution effects" in Green Revolution type crops. Breeding programs aimed to produce high yielding cultivars combined with intensive chemical fertilization to push yields still higher have resulted in vegetable and grain crops that do not have their full nutritional complement because of inability of their limited root systems to absorb sufficient of the minor nutrients. The result is a "hidden hunger" caused by trace element deficiencies in those who consume such foods. The recent study by Brian Halweil, *Still No Free Lunch*,[32] presents a very complete picture of the relationship between plant breeding, high chemical fertilizer use, the nutritional quality of the resultant produce and the new interest in pursuing such research. Other forward thinking scientists around the world are beginning to investigate biological issues, and they are finding the system that biological farmers have been creating for the past 120 years, this alternate agricultural reality, is as good as they have claimed it to be.

How could these ideas have been so obvious, so logically presented, and yet so consistently ignored by the majority of agricultural scientists? Let me

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[31] Vinod Kumar et al, "An alternative agriculture system is defined by a distinct expression profile of select gene transcripts and proteins," PNAS, 101, 29, 2004, pp. 10535-10540.

[32] Brian Halweil, *Still No Free Lunch*. (Boulder, Colorado: The Organic Center, 2004).

explain it metaphorically. Imagine, if you will, an enormous tapestry hanging from the ceiling of a grand hall. The tapestry depicts the natural world in all its elegance. Subsoil and topsoil, plowed fields and green pastures, prairies and forests, valleys and mountains, sea and sky are all crisply represented. There are creatures large and small, birds and fishes, bacteria and fungi, predator and prey and the dynamic balances between them. You can also see farmers interacting with that living world. And you notice that the more they have harmonized their agricultural practices with the patterns so clearly delineated in the tapestry, the more successful they are.

From where you stand on the front side of that tapestry, you don't find too many others with you. There is, however, a great buzz of noise coming from the other side. When you walk way down to the far end of the hall and peer around the corner you can then see the tapestry's reverse side. With its stray colors and loose threads it gives only a vague picture of what is truly represented. What you find there are enormous crowds of people actively trying to decipher what they see and trying to solve problems that only exist on the backside of the tapestry. They have no idea that there is a front side and, when you mention it, you can tell they don't believe you. From where they stand the vagueness of the tapestry has convinced them that Nature is incompetent and needs a great deal of help from mankind to straighten her out.

The problem isn't that these people are ignorant. On the contrary many of them are brilliant. Their leading scientific disciplines such as Discordant Thread Theory and Random Color Hypothesis are highly respected and extensively researched. The university Department of Untrimmed Ends enrolls many student applicants, eager to make careers in the field. A multitude of learned disquisitions are published in numerous scholarly journals. Huge industrial complexes have arisen in concert with their line of thinking and countless tons of stimulating and controlling substances are produced every year. The backsiders are convinced that as long as they keep expending enormous effort to compensate for Nature's flaws, all will be well.

However, when you step back to the front side of the tapestry, there are no flaws to be seen. You wonder if those backside people prove ecologist Frank Egler's statement, "Nature is not more complicated than we think – Nature is more complicated than we can think." But that is obviously not the case on the front side. As you study the front side more thoroughly you begin to see the patterns involved. You notice that the agricultural practices of the front side farmers are designed to harmonize with the directions in which the natural world wants to go anyway. You notice how those practices have been selected to enhance the systems with which they interact. This is a biological agriculture and it will continue as long as the earth abides.

I can imagine three simple explanations for why the inhabitants of the backside of the tapestry fail to comprehend the existence of a different reality, for why they cannot imagine a world where soil preparation using compost and green manures and rock minerals creates high yields of vigorous plants that do not need the protection of pesticides and fungicides. There seems to be great difficulty in comprehending what I call a *plant-positive* approach (strengthening the plant through optimum growing conditions) as opposed to the conventional *pest-negative* approach (killing the pest). As Benjamin Walsh stated back in 1866 in *The Practical Entomologist*, "Let a man profess to have discovered some new Patent Powder Pimperlimplimp, a single pinch of which being thrown into each corner of a field will kill every bug throughout its whole extent, and people will listen to him with attention and respect. But tell them of any simple common-sense plan, based upon correct scientific principles, to check and keep within reasonable bounds the insect foes of the farmer, and they will laugh you to scorn."[33]

The first explanation is the lack of a word. There is no word in our popular vocabulary to describe *plant-positive* thinking. We all know what the Department of Plant Pathology concerns itself with. But does any university have the antonymic Department of Plant _____? What would the word be? Euology (from the Greek eu – good) or Sanology (from the Latin san – health) might be

[33] Benjamin D. Walsh, The Practical Entomologist. (Philadelphia: Entomological Society of Philadelphia, 1866).

suggested as possible new words. Or possibly call it the Department of Plant Phylactotrophy? (Phylact – protect, troph – nourish.) What if all the Land Grant schools had a Department of Eucrasiotrophic Agriculture? (Eu – good; crasio – constitution; trophic – nourishing.) What if we lived in a world where we had the expectation of healthy plants rather than pest-ridden plants? What if the Department of Phytostenics (phyto – plant, sten – strength) published research explaining how plant health had to be subverted through mistaken cultural practices before pests could dominate? That would be a different world. But the fact remains that it is difficult for most people to comprehend a concept so novel that their language has never had scientific words to define it.

The second explanation is that humans cannot imagine a world where they are not in charge. As a biological farmer, I work in partnership with Nature, and I'm a very junior partner. Given the limited amount of hard knowledge available, I often refer to my management as "competent ignorance" and I find that a very apt description. But my level of trust in the design of the natural world and willingness to be guided by it is discomforting to those who think we should exercise total power over Nature. Colwell is most emphatic on this point: "But though part of Nature, man's unique function . . . lies in controlling and transforming the natural world, not piously seeking its guidance. How profoundly we believe this today. How could we help but believe it; the entire edifice of our civilization is built upon it. The Baconian conception of science as control over

nature is not only an intellectual presupposition of ours, it is a deeply implanted emotional attitude as well."[34]

The third explanation goes back to the beginning of the industrial revolution when the money world began to replace the non-money world. At that point what would have been seen as the great benefit of a biological production system, minimal need for purchased inputs, suddenly would come to be seen as its defect. In an industrially dominated money economy the processes by which biological agriculture produces food are inherently subversive because they are self-resourced through that partnership with the natural world noted above. By self-resourced I mean that for those participating in biological agriculture, the majority of the inputs are coming from within the farm. Thus, biological farmers who take full advantage of the earth's contributions do not need to purchase industry's products. The aforementioned Cyril Hopkins was fully aware of that reality in 1912 when he wrote in a University of Illinois agricultural circular; "The real question is, shall the farmer pay ten times as much as he ought to pay for food to enrich his soil? Shall he buy nitrogen at 45 to 50 cents a pound when the air above every acre contains 70 million pounds of free nitrogen?"[35]

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[34] Thomas. B. Colwell, Jr., *Some implications of the ecological revolution for the construction of value*. In Human Values and Natural Science, edited by E. Lazlo and J. B. Wilbur. (New York: Gordon and Breach, 1970), p. 247.
[35] Hopkins, (1912) op.cit.

That may explain why so few people are aware of the simple ways by which perceptive farmers have learned to successfully satisfy human needs for food and fiber within the framework of Nature's biological realities. By being self-resourced, biological agriculture offers no foothold for industry, resulting in no advertising, no research and development, no buzz, no audience. If everyone can grow bounteous yields of vigorous plants that are free of pests by using homemade compost and age-old biological techniques, there is no market for fungicides or pesticides or anhydrous ammonia. If a concept cannot be commodified, that is to say if it isn't dependent upon the purchase of industrial products, industry is antagonistic and the idea gets short shrift in our commercially dominated economy.

But maybe the problem is that we just don't believe any of this is possible. What? Farmers can grow broccoli without green worms? Livestock can be raised without antibiotics? Dream on! But I have come to these conclusions and can suggest these radical ideas because of what I see happening on my farm every day. We often jokingly refer to our farm as the National Empirical Research Station. When scientific evidence is lacking, practical experience is all we have to go on. And the facts are right in front of my eyes while I am cultivating or transplanting or tilling or mending fences. I see that the biologically based agriculture I have practiced for the past forty years really works. When I have done my job as a farmer correctly, when I have optimized the biology of crop production by maintaining soil organic matter,

improving soil aeration and mineral balance and providing adequate moisture, when I have paid close attention to enhancing natural processes, there is no down side. The livestock are in full health. There are no green worms on the broccoli. There are no root maggots in the onions. The yield and the quality of my farm products are consistently exceptional without any need for industrial products. And, in addition, we are not responsible for creating a dead zone in the Gulf of Maine through excess runoff. That is the daily reality of a successful biological farm. Could it be that we the people have been conned into ignoring a whole other way of farming by a limited worldview that has never allowed us to consider non-commodifiable options?

Cartoonist Al Capp penned one of the best (and most entertaining) depictions of the difficulty of being a self-resourced community in a commodified world. In September of 1948 he introduced his readers to a new character in his Li'l Abner comic strip - the Shmoo.[36] Shmoos are affectionate little livestock that look like chubby bowling pins with short legs.[37] Shmoos need no upkeep, multiply at will, and happily supply all manner of staple foods, such as milk, butter, eggs, and meat, to the inhabitants of Capp's fictional Appalachian village of Dogpatch. When Capp's hero Li'l Abner Yokum first discovers the Shmoos, their guardian warns him off. "Shmoos, mah boy – is th' GREATEST MENACE TO HOOMANITY TH'WORLD HAS EVER KNOWN."

[36] Al Capp, *The Short Life And Happy Times Of The Shmoo*. (Woodstock & New York: The Overlook Press, 2002).
[37] See page 32 of this document.

“Thass becuz they is so BAD?” Li’l Abner asks him. “No stupid,” he replies. “Its because they’re so GOOD! . . . There are enough shmoos to supply EVERYBODY ON EARTH with ALL they can eat – FOREVER! And there’s NO CATCH! Shmoos don’t eat anything, but multiply rapidly! - OH, THIS IS A BLACK DAY FOR YOU, YOUNG YOKUM – AND FOR ALL HUMANITY!” The saga eventually ends and the world returns to normal when the craven industrialist, J. Roaringham Fatback, fully aware of the commercial dangers of such a situation, hires exterminators to wipe out the shmoos. When a few shmoos survive and again multiply, the U.S. Government itself sends out its own extermination squads.

In an article for *Cosmopolitan* magazine in June 1949, Capp wrote about how he got the idea of the Shmoo. He might just as well have been writing about biological agriculture. “I was driving from New York City to my farm in New Hampshire. The top of my car was down, and on either side of me I could see the lush and lovely New England countryside . . . It was the good earth at its generous summertime best, offering gifts to all. And the thought that came to me was this: Here we have this great and good and generous thing – the Earth. It’s eager to give us everything we need. All we have to do is just let it alone, just be happy with it.”

Granted, we the people are happy with a generous earth but those commercial interests selling palliatives for a stingy earth are not. Logically they

fear they have nothing to sell to those who eschew their products. However, if they studied the needs of biological farmers they would discover a demand that I know exists for consultation and analytical services in lieu of products. Biological farmers could benefit enormously from improved soil biology tests, plant tissue analyses, livestock health and metabolic analyses, computerized crop rotation programs, and the like. The development of a range of services enabling the biological farmers to better keep their fingers on the pulse of these natural systems could be a whole new and positive direction for agricultural science.

But as it stands now, agricultural science lost its authenticity years ago under the influence of the chemical/industrial mindset and now finds itself perpetually etherized in the confused world on the backside of the tapestry. Ever ignorant of Nature's elegance it comes up with backside products like methyl bromide and genetically modified plants. Agricultural science has become a tragic character not unlike the one portrayed in T. S. Eliot's poem, *The Love Song of J. Alfred Prufrock*. "At times, indeed, almost ridiculous. Almost, at times, the Fool." In my mind's eye I can picture Mother Nature, "settling a pillow by her head" while contemplating agricultural science's misunderstanding of the "overwhelming question" and saying, "That is not it at all. That is not what I meant, at all." Biological agriculture has dared to "disturb the universe" in its search for a better way to farm. Its success has created a solid foundation for

the superiority of agriculture over industry and a secure future for the agrarian dream.

Eliot Coleman
Harborside, Maine
September 2010

ADDENDUM:

The English ruralist H. J. (Harold John) Massingham, 1888 – 1952, was an astute observer of the natural world and the author of over 30 works of rural appreciation. The following quote from Massingham's *Field Fellowship* (1942) has no place in the body of my essay but I wished to include it here nevertheless if for no other reason than to bring Massingham to the attention of American agrarian scholars.

"In a noble book written in 1940 by Lord Northbourne (himself a farmer), called *Look to the Land*, it is written, 'Is farming merely a necessary drudgery, to be mechanized so as to employ a minimum of people, to be standardized and run in ever bigger units, to be judged by cost accountancy alone? Or is the only alternative to national decay to make farming something real for every man and near to him in his life, and something in which personal care and possibly even poetic fancy count for more than mechanical efficiency?' In other words is farming a craft or is it a business? Is it a way of life or a mode of money-making; is quantity a superior aim to quality, production to fertility and are the things of the spirit totally detached from purely material factors? Or, to put it in another way, is the reason why *quantitative* farming is being everywhere proved a failure that these *sentimental* elements like craftsmanship, love of the land, human harmony with biological rhythms, traditional skill, cultivation by human labor, *personal care* and individual treatment have been carefully segregated out of it like the wheat-germ from our modern white bread?

If modern materialism had not blinded the human vision of reality, the answer would be obvious enough. Nature is a series of biological rhythms, interactions and interdependencies, which are essentially non-mechanical because the stage on which they operate, is that of life. The naked soil shares the gift of life with the wool-wrapped sheep. That is why the earth, when

overdriven or exploited or speeded up or subjected to the business methods of an industry, refuses to be so maltreated by going either sick or sterile. The statement needs no argument because that is precisely what is happening and has happened. In the days when agriculture was the central craft surrounded by satellite ones, these things did not happen or were of rare occurrence for the simple reason that man fitted his own life into those rhythms and adapted them to his needs. Such rhythms are timeless and from this the truth is derived, as Lord Northbourne points out, the natural conservatism of the farmer and his right suspicion of changes introduced by the town, whose mechanical activities are severed from the ordered cycles of the earth. If men can be forced and regimented to sacrifice their spiritual inheritance in order to serve the machine, nature and the earth cannot and will not any more than the winds of heaven can be controlled by pistons and levers. The earth demands the labor of a true man, not the gyrations of a senseless machine, in order to give of her best, and thus quality in farming, as malnutrition has shown us to our bitter cost, must forever take precedence of quantity. Farming as a craft can never be old-fashioned or superseded since it is dependent upon doing things in the right way and at the right time and not in the wrong way and the fastest time as a passing economic fashion based on predatory relations with nature demands. Where fertility is the master of production and quality of quantity as subsistence farming fosters, there need be no fears as to the health of man or the bounty of earth."

H. J. Massingham, Field Fellowship. (London: Chapman and Hall, 1942), pp, 170 – 171

THE SHMOO

"Confound it, Gruenblatt. Without proper scientific and other clinical disciplines, you're still talking theory."