Foreword by Glen Atkinson

I would express this first paragraph slightly differently to Hugh, and feel it appropriate to make this comment so as not to confuse the reader with other material presented on this Garuda Biodynamics site.

"In nature *oxygen* brings life, *carbon* provides the building blocks, ***Hydrogen*** gives the spark, *lime* and *silica* make the mortar and ***Sulphur*** gives us the moisture. But only *nitrogen* **enacts** the master plan. Nitrogen is first and foremost of all anions, a triple negative atom. Unlike the positively charged, self-centered, fat calcium or the dull, triple positive, doughy aluminium, nitrogen has its extremely sensitive perceptions open to the universe and is the vehicle of awareness, our connection to the **planets**. Thus nitrogen is the carrier of the astrality, the awareness and intelligence in nature.

Nitrogen
The Carrier of Awareness

By Hugh Lovel

In nature *oxygen* brings life, *carbon* provides the building blocks, *sulfur* gives the spark, *lime* and *silica* make the mortar and *hydrogen* gives us the moisture. But only *nitrogen* carries the master plan. Nitrogen is first and foremost of all anions, a triple negative atom. Unlike the positively charged, self-centered, fat calcium or the dull, triple positive, doughy aluminium, nitrogen has its extremely sensitive perceptions open to the universe and is the vehicle of awareness, our connection to the stars. Thus nitrogen is the carrier of the astrality, the awareness and intelligence in nature.

When we are born as individuals we each have a unique nitrogen signature stamped upon the assembly of our proteins and replication of our DNA. We take up our nitrogen via our digestion, breaking down foreign proteins into amino acids, and from these amino acids we build up our own proteins with our architectural identity stamped upon them. So our character is built. Everyone is a bit different, and our immune system is our means of maintaining our personal integrity.

The same is true of a farm. It develops its own nitrogen-amino-protein character. A farm's nitrogen-fixing microbes take in nitrogen and build up proteins according to their unique stamp. Soil animals eat them and transform this into *their* unique organization. Plants absorbing these tiny critters' digestive products get an even more enhanced nitrogen organization. Ever the farm's plants and animals, and ultimately the people that eat them, take it round after round higher. If we short circuit this grand schema and bring nitrogen in from elsewhere, we water down this enhancement. Composts, compost teas and other nitrogen containing biologicals should not be used as sources of nitrogen, but rather *as means of increasing nitrogen fixing capacity*.

Worst is applying nitrogen as crude chemical salts which, when concentrated, suppress or even kill the soil microbes responsible for nitrogen fixation. But even manures, seaweed extracts and other biologicals have to be integrated into the farm's unique identity. Instead of getting nitrogen from elsewhere, what we *most* want to do is to get nitrogen cycling fully and rapidly within the biology of each farm. This makes the most out of enhancement. On any given farm the more we increase the density of plants and animals, large and small, the more we ensure enhancement. This is our guide to achieving quality.

Of course, building soil biology is the road we should have traveled all along. The great nineteenth century chemical pioneer, Justus von Liebig, sometimes known as the father of agricultural chemistry for his introduction of potassium nitrate and phosphoric acid, protested that there was [obviously] more to the picture than the simple addition to soils of a few chemical salts. Industry didn't listen and tried to present this abuse of chemistry as scientific. But there is nothing scientific about thinking our nutrients must be soluble when that means they will wash away or build up as salt deposits where fields aren't exactly flooded by rain. Although past practice and industrial propaganda condition us not to ask the right questions, an innocent child would be apt to query, "Daddy, don't we want our fertilizers to be *insoluble* but *available*?"

Up until the Chemical Ag era *soil biology* maintained insoluble but available nutrient supplies. Generally crop residues and manures were recycled where they did the most good in maintaining soil biology, and the experience of older folks guided most people in this regard. Then as steel and

mechanical horsepower allowed cultivation to be more thoroughly death dealing, soil biology faltered in face of the onslaught, and chemical industries were quick to supply the first of many fixes. Since then farmers have been like the lady who swallowed the fly—and then swallowed a spider to catch the fly, a mouse to catch the spider, a rat to catch the mouse, a cat to catch the rat, and so on with each correction becoming a bigger problem without ever addressing the cause. With soil fumigation and genetic modification today's technological fixes have taken on a weird science fiction aura, as though Darth Vader is coming to the *rescue*. This is a criticism of applying knowledge without wisdom, and using single facts in isolation without any awareness of the plot. It does not help that we are using nitrogen in its crudest and rudest forms rather than more complex and integrated ones, as nitrogen is the vehicle for our awareness. We might each ask ourselves, where do we get the nitrogen in our diets?

It is easy to see that anything held within the cell walls of living organisms will not salt out or wash away. The issue of addressing the true shortcomings of farm fertility programs is one of how to keep the land's biology on a roll. Life and living organisms are active. When they stand still, they either hibernate or die. With death their nutrients are released and if these are not taken up by something else living in the soil they either salt out or leach.

Balanced and complete biological fertilizer programmes commonly get soil biology rolling again, but winning once does not necessarily mean the whole campaign will succeed. How do we *keep* the restoration of soil biology going like a snowball picking up speed down a hill? The quick kill mentality that got us where we are is much like the 'quick draw' gunslinger mistakenly pulling the trigger before his gun leaves his holster—with a result we've all heard about. Any time we kill in agriculture we need to be sure it profits the overall life and biology of the farm—killing to feed and not killing to waste. It is not cultivation or the occasional use of a chemical that got us in trouble, but the inappropriate use of these things whenever we lost the plot. Nowhere in agriculture has this affected us more than with nitrogen.

Nitrogen is the most ephemeral element in nature. It not only leaches as bitter and unappetizing nitrates, nitrites and urea, but it also evapourates as rank ammonia and stinky, volatile amines. Because it is so easily lost, nitrogen is the biggest issue in fertility management. The evidence is in that well-run biodynamic farms, which never buy in any nitrogen, often equal or exceed the yields of farms continually 'topped off' with urea or anhydrous. How do they do it? Even more incomprehensible, some of these farms started on soils with almost no organic reserves. Yet they got their biology going almost like a bonfire and they've fed it and replenished it ever since even while selling products to the wider world. Usually at the outset they made some substantial biological inputs, but they didn't keep doing this. They used this priming of the pump, and then kept the well flowing.

I have seen large wheat fields in western Oklahoma where well-brewed compost teas with innoculants, humates and sea products took the place of anhydrous ammonia, the cheapest form of nitrogen fertilizer, at a third the cost. Yields were not only comparable, but salty, compacted areas were revived, and a premium price was obtained directly from millers without going through the grain trade. Crop quality was significantly improved. I've *not* seen it, but I've heard though Elaine Ingham that a similar turn-around was going on with large scale Idaho potato growers.

Critics of organic and biological farming have enjoyed pointing out that at twenty to fifty tons of compost per hectare per year there's not enough manure and compost in the world to supply agriculture, even if animal confinement cesspools were all scrupulously put to use. Good point, as long as one uses compost to supply nitrogen. We should use compost to provide *nitrogen fixing and cycling capacity*. This means making compost so it is balanced and rich in microorganisms which are self-organizing, reproductive and self-correcting, which NPK is not.

Maybe you've discovered that rebuilding soil biology and remineralizing soils is much cheaper than NPK programmes in the long term since inputs end up getting cheaper and cheaper instead of more and more spendy. But if you are still spending money on nitrogen you haven't rediscovered the plot. The overall nitrogen cycle is complex and it involves all 40,000 or so species of microorganisms in healthy, productive soils. They all need nitrogen to build their proteins and replicate their DNA.

We could say it starts with nitrogen fixing microbes, such as rhizobia and azotobacters. There are many players in the nitrogen fixing game—azospirilla, clostridia, algae, even endophytes that live within the tissues of grasses such as acetobacter in sugar cane. However, all use the same enzyme, nitrogenase, to break atmospheric nitrogen out of its bondage. With the help of iron and molybdenum this enzyme begins the process of unzipping the $N_2\uparrow$ molecule's triple bonds. But nitrogen is so reactive that this cannot proceed unless the nitrogen fixing microbe has biologically complexed calcium to feed into the breach.

Mycorrhizal fungi are amongst the most capable soil microbes for making calcium biological, so their role in nitrogen fixation should not be underestimated. A couple years back a soil

microbiologist won kudos for proving a strain of mycorrhizal fungi living on pine roots directly utilized nitrogen from certain azotobacters, but for the most part the soil is a teeming zoo of predation where nitrogen fixers and calcium activators are eaten and their amino acids and minerals excreted—only to be taken up again by other microorganisms which in their turn are eaten, etc. Some of the most primitive microbes on earth actually consume rocks and release their minerals, and this goes on up the food chain to earthworms. Earthworms also consume small bits of rock, which they use as gravel in their gizzards—like chickens—to grind their food up. Then they coat their tunnels with a calcium rich slime, and ultimately they eat the fungi that grow on this medium and spread its spoor wherever they go. Ants, as the master microbiologists of the soil, travel even further than earthworms and have been known to culture upwards of 30 or 40 different strains of microorganisms in their ant heaps. They seem to know which microbial species can break down even the worst toxic chemicals in soils and rejuvenate them. They are usually a benefit below ground where they aerate the roots of plants and cultivate beneficial microorganisms so they can pasture their aphids on the roots and milk these tender, fat creatures for their latex-rich juices.

The picture gets more and more complex the deeper we plumb its mysteries. For example, all plants give off root exudates, which supply the bulk of the renewable energy where the sun doesn't shine. But each plant gives off quite different mixes of carbohydrates and proteins at its roots and feeds a different community of microorganisms. Where crops such as wheat, corn or sugar cane really provide syrupy sweets for nitrogen fixing energy, legumes such as clovers, soybeans and lucerne give off stronger acids capable of unlocking the calcium nitrogen fixers so voraciously use. If we aren't rotating or undersowing our grassy crops with legumes the chances are our nitrogen fixation will fail because of lack of biological calcium. In general plant diversity is the key to unlocking nature's storehouse so our soil biology thrives and yields abundantly. For example, the high dandelion populations that can and sometimes do occur in third year lucerne bring potassium back into the biology of the topsoil, and far from being an undesirable weed, these are a favorite of livestock. Hemp makes potassium biological, and if we were allowed to grow it as a soil building cover crop it is the perfect rotation for potatoes, which need their potassium to be biological. Buckwheat does a very similar thing with phosphorus, leaving lots of readily available phosphorus in its wake and providing a small flush of available phosphorus for the sprouting roots of small seeded vegetables and herbs when it is used as a nurse crop and mowed after the second week.

In short, building our soil biology is the key to achieving self-sufficiency in agriculture, and this is particularly true when we look at the nitrogen picture. It makes all the difference in the world how we get our nitrogen, whether from the urea bag or from nature's grand schema via biological fixation and soil digestion. And the difference it makes to our personal awareness and intelligence and to our society as a whole cannot be over-emphasized.

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