



April 18, 2020

Fellow Connoisseurs of Food Raised in Sunshine,

As it's a different world for all of us this season, my thoughts at the onset of this situation were to take the newsletter off the table, skipping it entirely this season. And what a coincidence when I later recognized this decision actually looked a teeny-tiny bit like *the easy way out* - I mean - what are the odds!?

My early concern was that the publishing of this newsletter amidst such a crisis would give the impression that I was tone-deaf to the obvious priority in everyone's lives. Yet as more time past, I started to sense a need to concurrently stay in touch with reality. This is after all, a situation which feels surreal - as if we're all extra's involved in the making of some far-fetched Sci-fi screenplay. Pinching ourselves, we're reminded that this surreal feeling is indeed a real feeling.

Yet integral to this reality, and in spite of the obstacle at hand, the natural world moves on with indifference. We - our society - can't skip a season, riding it out watching Netflix. We can't eat our seed corn. We have to produce new food. This thought crosses my mind as I once again witness the seasonal renewal magically transforming brown to green. Tic toc...we have to do this now. At the same time, the visions now etched in all our brains - of row after row of empty supermarket shelves - invokes in each one of us a similar reality. We can't let Priority #1 suck all the air out of the room when Priority #2 - FOOD - is essential to winning the fight against Priority #1!

Oh but how inattentive of me to have misrepresented this new triage of life's essentials. Based on documented evidence from sea-to-shining-sea, our priorities are: #1 Covid; #2 Toilet Paper; #3 Food. Don't know about you, but I never saw that one coming. Learning something new about humanity every day!

That's it for my monologue. Queue the band before we break for commercial, as I tell you what's in store for the rest of the show. So please *stay tuned* to Farming in the Key of Life, where we'll talk about: The how's and why's of making-hay-when-the-darn-sun-doesn't-shine-nearly-long-enough; Butchershop Red-ling; Solar goes Underground - A Deep Dive into Regenerative Fertility with Special Guests Ricky & Rosey Rhizobium; Hit 'n Miss Engines; Shavings from the Homefront - Family update.

Ps. This is a nuts-and-bolts edition put together on short notice with just enough editing (hopefully) to keep me from looking foolish! English teachers: Please do not mail a corrected and graded copy. (Yes, this has actually happened!) I already know it could be better! I claim official immunity from all grammatical infractions under the statute known as the *Jack of many trades and master of none!*

Reminiscent's from the Rear View Mirror

More often than not, our management decisions have gravitated to become a default to the lesser of evils - this as excessive precipitation has induced substantial adaptation upon most all fronts. Hence, pastures have thrived amidst abundant precipitation while at the same time livestock and farm equipment impose consequential damage to plant roots and soil structure. The ability to make dry hay requires at least three days without rain. However, equipment cannot be driven on saturated soils without accepting damage. As such, the dry-out period expands this rain-free window to a week or more.



In context, *dry hay* doesn't just describe hay that hasn't been rained on. Dry hay describes just one of three methods used for storing forage. These methods are: Haylage; Baleage; Dry Hay. The general target moisture percentages for each method are 60%, 50% and 15%, respectively. When forage is first cut, it's moisture level is typically around 75%. Armed with this knowledge, it is now easier for you to recognize the influence that time and weather impose upon each respective process. Haylage, being picked up off the field at 60%, requires a 15% moisture reduction whereas Dry Hay's target of 15% will require moisture to be reduced by 60%. Risk is commensurate to the drying time required for each method. The primary risk factor is of course the impending weather.

Whereas the concern that rain will fall on cut forage remains the primary concern, rain is far from being the exclusive risk factor. Sunshine, air temperature, humidity, dew point, wind, soil temperature and soil moisture all combine to influence drying times.

Haylage, with it's targeted 60% moisture level, often allows forage to be picked up one day after cutting. Haylage is picked up with a chopper which cuts the forage into smaller pieces. These chopped pieces are blown into chopper boxes, then dumped and packed in bunkers or blown into silos or silage bag, all of which depend upon anaerobic microbial activity to produce and preserve as a fermented forage. Haylage is primarily used by dairy farms as this ensiled forage is just one ingredient of many for dairy mixed rations.

Baleage relies upon this same anaerobic process, however without the chopper or silo. The un-chopped forage is picked up with a baler outfitted for handling wet forage. Because this method does not chop the forage into smaller pieces, the targeted 50% moisture level requires slightly more drying time than haylage. Even so, baleage can quite often be picked up the day after cutting. These bales must then be individually wrapped or line wrapped in plastic within 24 hours in order to create the anaerobic conditions necessary for fermentation.

Dry Hay typically requires the cut forage to dry in the field for 2-3 days or more to reach the targeted 15% moisture level. During this time, sunshine, heat, low humidity and a nice breeze are a necessity. If baled slightly wet, this method will produce moldy, dusty, unpalatable low quality hay. Crossing a moisture threshold with this method will lead to spontaneous combustion which almost always burns a barn to it's foundation.

Every one of these methods carries it's own list of assets and liabilities. First, all methods require a tractor, (preferably two tractors), discbine for cutting, tedder to facilitate drying, rake to form a windrow and baler to form a bale. Even buying used, this line of equipment can easily reach \$100K, although the tractors, representing half of this expense, are utilized diversely. All methods are first wrapped with net wrap, requiring a \$180/roll product capable of wrapping about 180 bales. The cost of twine is considerably less, however whereas the heavy bale must revolve 2-3 times to apply netwrap, twine wrapping requires nine or more revolutions. Each one of these revolutions is occurring as both the tractor and baler are operating under full load...and as the next storm front moves ever closer on the western horizon. Time reduction equates to substantial risk mitigation. It's not the 9:00 pm June sunset that limits baling. It's the 7:00 pm dew point that becomes the showstopper. That extra hour consumed sitting motionless, as a dozen revolutions of twine were applied, would have gone a long way in allowing all the hay to be picked up if it were net wrapped with only two revolutions.

The cost of a wrapper falls between \$25K - \$35K. A \$90 roll of plastic will wrap just 20 bales. All this plastic must then find its way to a recycler. The silage option required to handle high moisture hay adds several thousand dollars to the baler expense as well as requiring higher tractor horsepower. A bale squeeze loader attachment is required (as opposed to a tradition bale spear) in order to move bales to storage without penetrating the plastic.

But these aforementioned price tag liabilities don't take into consideration the justification inherent to the purchase. Most obvious is the greatly increased odds that quality hay will be made within an increasingly narrow window of time. This proclamation of quality is also recognized by the cattle. Whereas we have indeed made some dry hay to which the cattle have demonstrated great pleasure in consuming, the easily recognized fact is that, when the cattle are given a choice between dry hay and baleage, they will always devour the fermented hay before feeling forced to consume the dry hay. Unlike dry hay, with baleage there is almost no sorting, which results in unfavorable



hay being pulled out and trampled. They eat it all. Furthermore, any bale wrapped in plastic is not subject to aerial and ground moisture resulting in near zero waste. While the net wrapped hay does shed some water (all this hay is staged outdoors), several inches of the outer layers as well as 6-8" of the bottom are all waterlogged waste. Given that these areas represent the widest diameter of the bale, on a percent basis, this loss is substantial. The wetter the season, the greater these losses. Only a few years ago, I was putting a sharp pencil to the concern of mitigating these outdoor storage related losses with the intent of building a hay shed. This was before this successive seasonal track record which now threatens our ability to make hay. This is a paradigm shift which now transcends previous concerns. Wrapping bales is now a necessity. Wrapping resolves many of the concerns associated with storing hay outdoors.

Make our Hay or Hire a Custom Operator? Many farm experts state explicitly that farms such as ours are too small to justify the equipment costs. This all makes logical sense when viewed exclusively from an analyst's desk. Yet consider this reality when viewed directly from the field: In 2019, nobody was able to find a window of time to make hay until early July. Nobody. Worse yet, when that first window opened, it opened with the knowledge that it would be short-lived. EVERYBODY had to make their hay all at the same time. In fact, because I had not yet bought a wrapper, I had made arrangements with a custom operator to wrap our hay. I made this arrangement in early June, when both parties assumed there would be reasonable opportunity forthcoming. By early July, it's not that all bets were off, as I could still get our bales wrapped...but get in line. High moisture hay needs to be wrapped within 24 hours - at the latest.



So... All of this was addressed in great detail as a backdrop to validate this statement: The conditions necessary for making dry hay are no longer realistic.

This is especially true of 1st crop, which is harvested in late spring when excessive rains are most prevalent. Adding to this concern is the realization that 60-70% of seasonal stockpile is made from the 1st cut. This problem has led to an extreme shortage of hay throughout the Midwest. The cost to winter-feed grassfed cattle is now three times the expense of a few years ago. As most horse owners are not tethered to a business mind set, the equine segment of the hay market has driven prices beyond the sustainable reach of any farm operating as a business. Without the ability to make all of our own hay, we will not be in the beef business much longer. Yet we made a substantial land and grazing infrastructure investment in 2012...so the beat goes on.

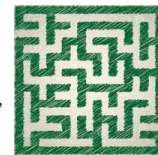
To this end, we've cut the size of our herd almost in half to be in sync with the volume of hay we can make ourselves (as well as to match limited butcher availability. More on this later). We have also retooled our haying equipment to allow the option of making Baleage. We were lucky to find a used wrapper only a few miles from home. We will also need to invest in a grabber attachment, as plastic cannot be penetrated by spear attachments. Fortunately, our baler was built as a silage model. Even so, anxiety will plague me until I know all the equipment can handle the added weight. The 50% moisture level means half the weight of every blade of forage is water, greatly increasing bale weights which will force me to make smaller bales in order to keep weights in a range my equipment can handle. All expensive trade-offs, however not nearly as expensive as putting a full week of labor and depreciation into cutting, tedding and raking *dry hay* - only to lose it all on the final day to a rogue thunderstorm.

Pastured Chicken (aka meat birds) continues this year roughly within the same window of time. This decision continues utilizing the Goldilocks method of management as we seek out the window of time which is neither too hot nor too cold for these birds. As mentioned in past newsletters, the move we made several years ago to the deep-bedded day-shelters (as opposed to the portable shelters) remains as the only reason we're still providing Pastured Chicken. The birds now remain high and dry on the deep-bedded packs amidst this pattern of excessive precipitation. Wet chickens with their skin in frequent contact with cold, saturated soils is a recipe for disaster and failure. Feeling lucky that we dodged this bullet. Even so, servicing these four larger shelters throughout so much rain added many hours to the labor timecard. We were also forced to accept pasture damage from our UTV and tractor traffic. Mud Season... unfortunately it's not just March and November anymore. This reality is a genuine game-changer to which we will continue to struggle through as we engineer new ways to adapt.



The backdrop to a great deal of all of these adaptations is centered upon our ability to utilize wet pastures without causing substantial damage. We have had success, however this success has not come without added expense. Over the winter months, our only means of dealing with excessive, unfrozen moisture is to throw money on the ground to elevate the livestock, money being expressed through unprecedented volumes of bedding and the labor required to disperse. The summer pasture damage mitigation plan is less a hemorrhage of materials as it is labor. Within the past three seasons, we have not been able to complete one full rotation through all the paddocks as our grazing layout was designed.

Of course, efficiency is integral to any successfully designed system. As such, a paddock adjacent to today's grazing is always destined to be tomorrow's grazing. There's no longer any assurance of this. Soil types are diverse. Topography influences soil types. A 30 second downpour can take an already questionable paddock out of play for a week or more. This forces me off the grid. I am no longer able to simply wind up a pasture break wire to let the cattle pass behind me onto fresh grass. Instead, I have to build temporary lanes guiding the cattle to the permanent center lane which then allows me to direct cattle to a wider choice of paddocks. Usually this means moving them uphill. As such, a grazing master plan is now an amalgamation of the two week weather forecast and how this forecast *feels* as I push my boots into each successive paddock in my plan. It is the recognition in which I tell myself that, if I don't use this low ground now, accepting minor damage, I will not be able to use it at all next week amidst more rain. Ultimately, as I try to run a future video clip in my head, I must create a two week plan that will zig and zag the herd, with each successive zig and zag gradually moving the cattle towards high ground precisely when more rain arrives.



Internal to this has been the inability to clean out the winter paddocks to make compost. I did capitalize on a one week period in fall which was dry enough to allow spreading before being shutdown for the season once again by persistent rains.

On a more positive note, the late October soil structure at our acreage up the road was firm enough to allow us to rotationally graze the carry-over cattle and the newly weaned calves right up to within a week of Christmas. The tradeoff required more additional labor on the timecard as the "easy water" was no longer an option. I call it the easy water because on the eve of the first killing frost, I have to blow out several thousand feet of waterlines - a project in-and-of-itself. Without these lines effortlessly carrying water out to the far reaches of the farm, if I am to keep cattle moving on a rotation, I must truck hundreds of gallons a day across the fields. Had to get creative several times, reconstructing temporary fencelines when things became a bit too wet to risk burying a tractor but the hay savings and feed quality provided the incentive. This lucky stretch of agreeable weather is the reason we were able to make it through this winter on our own hay supply.



Another positive note has been in relation to reduced predation upon both the layering flock and meat birds. Raccoon, opossum and coyote predation were all greatly reduced last season - so much so that I'm now concerned about the health of these wild animals. The aerial predation inflicted by hawks, owls and now eagles continues as our number one threat, albeit at levels reduced from previous seasons. The Great Horned Owl threat has moved to the status of public enemy #1. To a large degree, this occurred because 2019 started out with our south fields under water. This prevented my usual presence in these fields located right up against the marsh... where the raptors like to build their brood nests. Without my usual activities in this area, they made themselves at home, expecting - and actually implementing - the family training and dining plan centered upon their perceived menu listing our succulent organic chicken as their main entrée. This in turn required a religious devotion in adapting to the daily sunrise/sunset times. Open and close the chickens just a few minutes too early or too late assures that arrival will find the casualties associated with that error.

True Story - Mother Nature Whips Me the Bird This past fall I was doing repair work inside a henhouse. As I was inside for some time, I apparently remained undetected by a passing Cooper's Hawk. (As a side note, I have never witnessed this breed of hawk make a successful kill. It appears they get the itch but refrain from making the kill as they recognize that their potential prey is a bit too large for them. Or maybe they just like to antagonize, showing off their Top Gun skills as they dive in like high speed missiles.) Nevertheless, an inopportune moment, noticing the tell-fear instantly spreading through the flock. I looked up and to my horror, witnessed a pulling out of it's high speed dive only 30 seconds, I suppose if a camera were upon me, my posture would have suggested I was thinking "no big deal... the hawk will see me and change it's course"... but it didn't. I say this hoping for your full confidence that I am not embellishing. First, understand that the dive speed of these hawks can exceed 120 mph. At the last split second, I realized the hawk had pulled out right at the level of my face. Feeling this laser dot on my snozzola, I instinctively dropped my tools, yelled and hit the deck. I do recall that it was my vocalizations that created the last second diversion as the hawk was greatly alarmed - as if it had not seen me. Had the hens not warned me, I do believe the story would have become a teaser on the national news, where just before the commercial break, the anchor declares "When we come back, you won't believe what surgeons removed from a Wisconsin farmer's temporal lobe." Seriously. It could not have been any closer without actually striking me. The air pressure and close sounds of the hawk's wings all hit me. The hawk almost certainly would have died. It would be interesting to learn from a Physics teacher, what the acceleration forces would equate to as this two pound bird struck my head at 120 mph. (Nevermind. Now that I wrote this out, I guess I don't need a Physics teacher anymore!)



Butcher Shop Update Unfortunately, capacity and resultant backlogs have gotten worse. Butchers are raising their prices at will. Reservations are needed a year in advance. A pattern of redlining is now surfacing. The trend is to limit the number of animals that can be scheduled for single day. Whereas we had previously invested and structured our harvest dates upon the reasonable efficiencies inherent to the load capabilities of a standard heavy duty pickup truck, we are now being forced to accept less than half of this reasonable potential. As such, my request to schedule 12 head of cattle is immediately shot down to a maximum of 4. They will allow me to schedule 4 more head each successive week, but not 12 head on the same day.



Here are the ramifications of this monumental trend: Our method of farming utilizes neither a confinement nor a feedlot. Our cattle are rotationally grazed. Our hogs roam freely in large outdoor paddocks. Whereas confinements and feedlots are structured to simultaneously function as both a feeding and handling facility, a farm which raises livestock outdoors in a less constrained environment must commit time and energy to move livestock to a sort and load area.

In this light, it is accurate to state that conventionally-raised livestock sleep, eat and eliminate wastes in the same environment that our livestock inhabit for just a few hours of sorting and loading. We can't just swing a few gates, pressure a few select animals against a myriad of steel partitions into a chute and head down the road to the butcher. We have to plan the location and rotation of our cattle weeks in advance. Our most distant pasture paddocks would require the cattle to walk almost a half mile to reach our loading area. Planning ahead allows us to zig and zag the daily rotations such that, on the day prior to loading, the cattle are either very close to the load area, or at the minimum, directly adjacent to our permanent laneways which allow efficient, direct access to the load area.

Unlike cattle held in confined space in routine close proximity to humans, pastured beef cattle develop a wild, independent mind set. Moving a wild herd of cattle is always a risky, spontaneous endeavor in which patience and experience are a handler's primary virtues. This, coupled with sturdy facilities at key pressure points usually enables a successful move. Yet regardless of facilities, it is during the sorting of a wild, pastured herd, that damage to facilities and potential bodily harm to the handlers reach an apex. Once we have given the herd time to settle down, it is easier and safer to divert 12 candidates into the trailer than the new redlined limit of 4. More to the point, when we are limited to just 4 head, we are forced to repeat the entire process two more times, effectively tripling our expenses and risk of injury. Successfully moving the herd to the load area represents 80% of this labor and risk.



Easier for anyone to envision are the added expenses this redlining imposes upon the expenses associated with the truck, trailer, travel and unload times. Our truck and trailer is capable of safely and efficiently transporting 12 head of beef. We paid for this capacity. The trailer will now be 67% empty. The fuel cost difference to operate the truck under the lighter load is trivial. The travel time required to haul 12 head takes no longer than the redlined quantity of 4. Upon arrival at the butcher, often the farmer must wait in queue, then strategically position the trailer for unload, requiring almost the same with 12 head as with 4. Using Lake Geneva as an example, the 45 mile round trip time required to load, transport, unload, return and unhitch has been 2.5 hours. Commercial rates for this job would fall into the \$125 minimum category plus time spent waiting in queue and unloading.



Why are butchers now imposing these redlines? Their schedules are booked a year in advance. They have raised their prices at will with little if any noticeable effect on backlog. DATCP regulations have had the effect of discouraging addition capacity. Some failed dairy farms have converted to raising local beef. A disproportionate percentage of current capacity is filled by hobbyists. To this last point, there is less concern for the inefficiencies of transporting small redundant loads of livestock when a hobbyist neither earns their living from livestock activities nor functions in the business mind set of expected profitability. The butcher's schedule would likely remain in backlog even if all full time farmer's were removed from demand. As such, the butchers are able to pick and choose to their advantage. Appears to be Supply & Demand Economics 101. If you or I were in their shoes, we'd probably do the same.

At the heart of this lies DATCP regulations which are indifferent to the sizing and capacity of food processing facilities, effectively disincentivizing both existing capacity enhancements as well as new entrepreneurial startups.



Ironically: *Get big or get out?* We got ourselves big enough to haul 12 beef or 25 hogs to the butcher in one trailer...yet now we're being squeezed to get small- which slowly bleeds us out.

The Evolution of Solar Energy on the Farm - Above and Below Ground

Food raised in sunshine... That's what it's all about for the vast majority of supporters of this farm and it isn't all that hard to understand why. Many people understand that sunshine never works alone. Sunshine on the backs of livestock provides a visible assurance of food being metabolized amidst fresh air and cleanliness. Sunshine represents the proverbial aggregate which is truly greater than the sum of all its parts.

It's easy enough to see the light, sense the heat and feel the perpetual movement of air across a pasture. Less tangible yet still appreciated by many, is the peace-of-mind obtained simply by knowing the food we are feeding our families has grown to fruition in a naturally clean environment - an environment impossible to replicate without direct exposure to sunlight.

These attributes all represent the low-hanging fruit associated with food raised in sunshine. We need only to subject our senses to witness their benefits. But we humans have always been prejudicial to the less glamorous attributes of sunshine - attributes which cannot be readily witnessed by any of our five senses.

Internal to this aggregate of food raised in sunshine exists two primary influences which, even though largely invisible to the naked eye, are essential to plant growth, disease prevention and fertility. In the context associated with solar energy on the farm, it is impossible to talk about one without the other. These silent, unglamorous attributes represent the tag-team consisting of *photosynthesis* and the *soil food web*. It is because of this unglamorous, silent symbiosis between sunshine, terranean and subterranean biology that the growth of food is made possible without the application of fossil-fuel fertility, herbicides and pesticides.

Yes, we understand that people support our farm largely for the taste, health and symbiosis inherent within a local economy. But truth be told, our farm was not founded upon these more glamorous, tangible, marketable aspects. Taste, essential omega-3's, high nutrient density, food safety concerns mitigated by paradigm, methods readily validated by the consumer, a farm setting pleasing to the senses and perhaps above all, the peace-of-mind derived from all of the above - these are the primary reasons most people support perennial pasture-based farming. Odd as it may sound, these wonderful attributes were not the center dot of our crosshairs. But they certainly have always been recognized in the slightly fuzzy near backdrop above and behind the crosshairs.

Anyone familiar with Upton Sinclair's early 1900's expose' of our country's meat processing plants is likely familiar with his sentiments as he responded to public outcry. Sinclair famously proclaimed that he *aimed at the public's heart, and by accident hit it in the stomach*. Perhaps a college level Marketing Psychology course could be built upon this premise.

We've always been aiming for the heart strings, knowing full well that marketing to the stomach was mandatory. It is a stroke of luck in that the collateral effects of our original intentions have allowed a means to elevate this farm into a viable business. Our primary founding objective has been, and continues to be, centered upon developing and implementing a sustainable, regenerative farming paradigm. First and foremost, the energy inputs necessary to allow regenerative fertility must be derived from the symbiosis between photosynthesis, plants and soil microbes. Photovoltaics, wind energy, passive solar, geothermal earth buffering, superinsulation, energy efficiency, livestock diversity, managed grazing, perennial planting, organic principles - these attributes all represent a means to this end - an end associated with the recognition that it is the microbial life in the soil which holds the keys capable of unlocking regenerative fertility.

Why does it matter - now - after all these years? Because now more than ever, a spotlight is needed to illuminate the consequences inherent to a society gravitating towards a plant-based diet while at the same time indifferent or intolerant towards the primary influence of Climate Change. Combining these two trends, we feed the fire, compounding and accelerating the use of petro-fertility and carbon emissions - these emissions not just from smoke stacks and fracking wells, but equally so, by the oxidation of soil carbon- the carbon essential to the organic matter integral to healthy soil.

Biological or Chemical - these are the only two methods we have for providing the fertility necessary to sustain 8 billion human-beings. The biological method is dependent upon the earth's natural systems to biologically create regenerative fertility. The chemical method relies upon finite fossil fuels, carcinogenic chemicals and high levels of processing as a means of fertilizing, protecting and creating the foods our society will consume if we continue down this path away from animal based agriculture. This pathway represents a paradoxical twist within the context of sustainability, that being personified as... *The Impossibility of the Impossible Burger*.



Without further adieu - let's now follow the sunshine into the less glamorous - less marketable side of regenerative farming. Sound the horn. We're diving underground to envision how the natural, regenerative fertility system works. But before we dive, let's whip up a picnic basket lunch - something we can use to feed the animals, drawing them in closer for observation.



Pull out your mixing bowl. Measure out 6 molecules of atmospheric CO₂ and 12 molecules of H₂O. Dump everything in your bowl. Stir lightly to prevent CO₂ from reentering atmosphere. Nuke mixture 2 minutes in backyard Solarwave oven. Burp lid to allow newly created oxygen *waste product* to escape into atmosphere. Remove from oven. Pour newly created sugars immediately onto humus plates. Ring dinner bell. Each ounce serves over 1 billion soil microbes.

Not exactly the way photosynthesis works you say?! Okay, so it's true that you don't need to ring the dinner bell - the microbes will find it - and I neglected to mention that this whole process doesn't need you, your mixing bowl or your Solarwave oven. (Hope you didn't run out and try to buy one as they're probably hard to find!)

Of course the entirety of this seemingly magical conversion of sunlight, atmospheric carbon and water into glucose occurs internal to every chloroplast-laden biological *solar panel* found on earth. But...this baits us into believing it's a *walk-away-and-let-the-natural-process-do-it's-thing* - sort of deal...and you'd be right - if only we humans were not so adept at undermining the natural conditions necessary to take this process to fruition.

First questions to ask are *why the heck are plants involved in this production of sugar anyway and what's in it for them?* Good question and glad you asked this! After all, once the sugar is synthesized within the chloroplast's of the leaves, the end product is pumped underground to the roots where it is more or less put on display - not all that much different from the lady at the grocery store teasing you in to try a free morsel on a toothpick. Why doesn't the plant just feed itself with these sugars? Why must these sugars be processed by animals in order for the plant to thrive? And the anticlimactic answer: Unfortunately this isn't the way the natural world works either above or below ground. The natural world does not function within the bounds of human logic.

Now back to that morsel on a toothpick analogy as this is indeed the intent of the plant - to tease and lure animals to the bait. These photosynthesized sugars ooze off the plant's root hairs, luring microbes like the allure of bacon or fresh baked bread attracts people. And again, just like up here in the world of humanity, the plant has positioned it's billboards and dangled it's wares along the busiest highways and intersections. In the subterranean world, these busy highways are located amidst the highest densities of organic matter, every micro-strand functioning as a microbial superhighway.

Like human marketing, this plant is targeting a niche consumer. The plant knows that not every microbe will be interested in the fine print arrangement it is offering. The plant has spent all it's marketing capital hoping to lure in only those microbes who are willing to do a little work in exchange for food. Of course, just like humanity, some microbes pull to the curb, read the sign that says "Work Here for this Food", look both ways to see if anyone is watching, then proceed to gorge on the free food, speeding off without providing the work. Because the plant expended energy producing the food they stole yet failed to enroll the workers necessary to replenish and maintain it's manufacturing equipment - the plant must now pick up roots and move to a more ethical neighborhood. But of course I'm just messing with ya. That doesn't happen. It is an understatement to state that the natural world is lacking in compassion. The natural world is indeed ruthless. When soil bacteria are not available to perform their work, the plant turns yellow and ultimately dies.

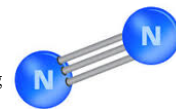
But - if the plant can hang on long enough in spite of freeloaders stealing many of it's samples, soon, the targeted customer ultimately arrives. Who is this targeted customer? For the fun of it, and to put a face on the influential animal, I'll call them Ricky & Rosey Rhizobium, who just happened to be speeding by in their VW Microbus when Rosey, riding shotgun, yelled over to Ricky "take da next exit der sugarbuns, dey got one'a dem der all ya can eat buffets where Rhizobium's like us can stoned on sugar as long as we're willin' to put in some work after the hangover." It's a little known fact that Rhizobium's are typically of Yupper stock.



What kind of work is performed in exchange for a free meal of photosynthetic sugar? The short answer is: *nitrogen-fixation*. Rhizobium's and a host of other symbiotic bacterial species possess an enzyme which allows them to unlock the bonds of N₂, effectively converting - fixing - this atmospheric nitrogen into plant usable forms such as ammonium. Yes, you read that right: Little tiny microscopic organisms can accomplish the same incredibly difficult molecular breakdown as lightning and the incredibly energy dependent and powerful Haber-Bosch process. Before we proceed any further, let's first remind ourselves of nitrogen's back-story.



Nitrogen is essential to amino acids, proteins, DNA and the production of chlorophyll in plants. In other words, the building blocks of life, cellular metabolism and photosynthesis can not occur without the presence of nitrogen. Pretty darn big deal, this nitrogen character. Yet as sadistic as it appears on the Grand Scale of things, even though 78% of the air in our midst is comprised of nitrogen, the triple bonds which hold this essential, ubiquitous molecule together make nitrogen extremely difficult to isolate. If you find yourself making a comparison to dying of thirst while floating aimlessly in a salt-laden ocean, you're thinking in the right groove.



So just how much energy is required to bust atmospheric nitrogen's triple bonds? The extreme energy associated with lightning remains as the only natural atmospheric phenomenon capable of this task. Prior to Haber-Bosch, most all of the nitrogen utilized to create the building blocks of every cell within every plant and animal that ever existed on this planet - was "fixed" utilizing the symbiotic food-for-work relationship which I characterized with Ricky & Rosey Rhizobium. Conversely, Haber-Bosch represents the industrial production of ammonium where nitrogen molecules must be extracted - fixed - from the atmosphere, requiring substantial consumption of coal-derived electricity and natural gas as the raw material necessary for it's carbon and hydrogen molecules.

At this point in the story, we understand the basic premise of biological nitrogen fixation. We recognize solar energy being transformed and transported underground. We recognize a symbiotic relationship between plants which barter their sugars in exchange for highly specialized work performed by specific bacteria. This symbiotic relationship is literally - LITERALLY - (sorry!) responsible for providing the exclusive source of of a raw material fundamental to the creation of every living cell of every plant and animal on this planet.

With this thought in mind, it feels like the right moment to take a philosophical detour allowing us to digest and ponder any ramifications that may or may not be inherent to this total transformation from biological to industrial nitrogen fixation (Haber-Bosch) which began in earnest after WWII.

We are told that in all of human history, 108 billion human-beings have walked this planet. Within this totality of all humanity, the 103 billion human-beings living before WWII were metabolically created and nourished from conception to death - with nitrogen derived from each generation's contemporary, regenerative, biological energy expenditures. The people living after WWII represent an abrupt and unprecedented classification of humanity: 5 billion human-beings metabolically created and nourished from conception to death - with nitrogen derived through the consumption and combustion of ancient deposits of coal and natural gas.



I'm not pretending that I can get my arms around this to grasp the ramifications of this seismic change. I don't see the evidence that we've even recognized this reality much less studied it's effects. Following instinct, I'll throw more fodder onto the philosophical table.

Within the 75 year span in which the 5 billion Haber-Bosch humans have lived, the vast majority of our Earth's oil and gas deposits have been depleted. This is the recognition that immense 100 million year old carbon deposits have largely been consumed in less than 100 years by human-beings representing less than 5% of all the humanity ever to have walked our Earth. The rapidity of this near depletion represents a regenerative ratio of 1,000,000:1 - that is to say one million years to produce 1 year's consumption. Greatly exasperating this disparity lies the fact that these carbon deposits had previously been physically and chemically locked deep underground. These carbon deposits were integral to the balance of an ancient carbon/photosynthetic cycle. It is within a 100 year period - a split second in geologic time - in which these deposits of highly dense carbon were oxidized - burned - effectively transferring these vast deposits of ancient carbon directly into our atmosphere, instantly overwhelming our contemporary carbon/photosynthetic cycle.

Now that the table is heaped with philosophical fodder, let's return to our journey underground, throwing some heat into the philosophical compost with this statement put forth by industry agronomists:

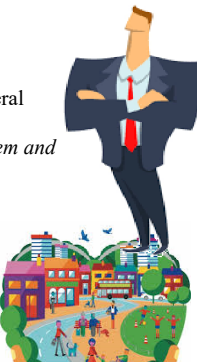
Nitrogen is nitrogen...the plant doesn't know the difference.

Modern day agronomist's have been known to admonish organic-minded thinkers with this snarky quip. It's always thrown into a back-and-forth debate as "scientific", "academic", "factual" with a follow-up drop-the-mic-gotcha gesture. Why? Because the statement is accurate. The plant doesn't know the difference. But don't throw in the towel just yet.

The Age of Specialists

In Silent Spring, Rachel Carson succinctly illuminated the collateral effects of paradigm paralysis with one prescient statement:
We live in an era of specialists, each of whom sees his own problem and is unaware of or intolerant to the larger frame in which it fits.

The coal and natural gas of Haber-Bosch is as integral to modern agronomy as racing gas is to NASCAR. Agronomy is hyper-focused on the *plant* with indifference to soil biology. To agronomy, NPK is "plant food". Agronomy's NPK is mined, processed and trucked to the farm. Many forms are injurious to soil biology. Some are fatal. It's not intentional harm as much as the conflation of indifference and ignorance. Feeding the plant directly provides yield. It works - *with indifference to collateral implications*. Agronomy is about *feeding* the world, not *saving* the world.



Conversely, the organic, regenerative-minded farmer understands that the natural biological process doesn't feed the plant directly. In nature, **soil microbes always eat first**. A regenerative farmer has to feed the microbes the nourishment which allows them to thrive and do the work they've evolved to perform within the soil food web. A regenerative farmer recognizes adequate fertility is locked within the soil's organic matter. A healthy community of soil organisms are required to unlock this fertility, making a vast array of nutrients to become available in plant-ready form.

Needless to say - the biological process is bad news to the fertilizer salesman. But now necessary to say: It's not all just about nitrogen-fixation. Borrowing from the political line: *It's the organic matter, stupid!* (I'm not calling anybody stupid. But I suppose I am behaving a bit like a stupid politician!)

High quality organic matter is complex, containing an essentially diverse variety of decomposing carbon necessary for the cellular proliferation of life for a vast multitude of species, each dependent upon the availability of these variations of organic matter. Unlike human society, where our energy is piped and wired from a distant source and we drive from our dwelling to a distant supermarket, organic matter is integral within the sand/silt/clay composite. Perhaps the best human visualization is to think of the soil blend of sand, silt and clay particles as bare bones and foundation. Picture the concrete walls of a parking structure, the clay and gravel bed of a dry aqueduct or the empty shelves of hoarded supermarket. Organic matter puts the food on the bare shelf, the life and energy into the otherwise bare foundational infrastructure. Organic matter turns the bare concrete parking structure into a comfortable, hospitable dwelling. Organic matter becomes the carpeting, drapes, wall paper, comforter, shelter and pantry. Organic matter allows the energy source to be available where it is consumed as essential metabolic energy. Organic matter represents the bookends of life - where new life enters and death becomes integral to replenishment. Organic matter is the life blood and carbon fuel of the soil food web society.

A diverse array of bacteria, fungi, protozoa, nematodes, earthworms, insects, ants, moles, ground dwelling birds and many others all interact to form the soil food web community. Populations measured in trillions represented by thousands of species coalesce to create this community, each member performing an influential role either via their occupational, municipal-type activities or their role as food source for larger carnivorous members. Any loss or gain of any species is detrimental to maintaining societal balance and sustenance. A healthy community is imperative for creating and maintaining healthy levels of microbial diversity and the organic matter this microbial community is dependent upon.



Why should we be concerned with this microbial society? Because a well-balanced, diverse array of soil microbes is capable of converting and storing photosynthetic solar carbon energy into plant-usable fertility while at the same time preventing the discharge of CO₂ into the atmosphere by storing this as carbon-rich organic matter.

Dragging tillage tools through this soil food web creates the same effect below ground as tornado does above ground. It is the size and stringy shape of fungi that make them most susceptible to tillage. When the ideal 1:1 ratio of bacteria to fungi is damaged by tillage, bacteria populations proliferate to a point that a former asset transforms into a rogue liability. The exchange of carbon between the plant and microbes is diminished. Soil pathogens amplify. Like the tornado traveling through a highly populated urban setting, the aftermath of a tillage touchdown brings normal life to a halt. The dead are carried away. Manufacturing stops. Rogue elements proliferate and prey upon the victims. Societal law and order ceases to exist. Areas - neighborhoods - within the living space of organic matter become increasingly blighted.

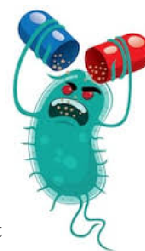
Haber-Bosch nitrogen and mineralized salts immediately follow tillage, effectively subjecting the remaining soil organisms to a second severe storm amidst the cleanup. Haber-Bosch nitrogen, in ammonium form, acts similar to a helicopter drop of food into a storm ravaged area. The twist unique to soil microbes is revealed as these soil bacteria gorge on this freely available nitrogen. For the same innate reasons that our above ground livestock instinctively regulate their mineral intake, this dietary overdose of ammonium nitrogen compels the microbes to seek a carbonaceous dietary source to balance this metabolically critical ratio. The microbes readily find this carbon directly amongst them ----- within the soil's organic matter.



As microbial behavior is revealed exclusively through evolutionary pragmatics with no human variant of logic, (not that we always use logical thinking ourselves) the microbes continue their feeding frenzy with indifference to supply. Dumb, fat and happy, they metabolize and proliferate at maximum capacity. One single microbe is capable of reproducing 10 billion offspring in just one day. In short time, these Haber-Bosch derived populations of microbes have consumed substantial volumes of carbonaceous organic matter - literally consuming their means of sustenance. As famine quickly follows, entire cities die in droves, the carbon in their billions and trillions of bodies gassing into the atmosphere.

Any life remaining in the soil, be it bacteria, fungi, nematodes, earthworms and many more, are next subjected to a third storm with the application of herbicides and pesticides, killing off even more life.

The remnants of life that remains after these three successive storms is known to adapt, evolving into what humans call superbugs - soil life which has developed a tolerance to agronomy's herbicides, fungicides and pesticides. This in turn induces the agronomist and farmer to apply more chemical, develop stronger chemicals and develop genetically modified seeds resistant to specific pests, pesticides and herbicides. In this lens, industrial technology is hooked into a cycle in which industry is perpetually chasing biology's tail, with each new product only buying short time before being subjected to the biological response.



The aftermath of these successive storms, repeated year after year is akin to the visible aftermath of nuclear war. The loss of soil life and organic matter decreases the space between the inanimate soil particles resulting in compaction and greatly reduced ability to hold water, in turn resulting in an increased frequency of flooding and runoff of nutrients into rivers, lakes and aquifers.

The industrial method of agriculture does indeed feed the world. Yet beyond a shadow of any and all doubt, the technology associated with this objective accomplishes this mission with blinders on all who willfully or blissfully participate. We look straight ahead at the yield, with blinders obstructing our view of open pit mountaintop mining, the fracking of natural gas, the dispersion of chemicals across vast swaths of land and the geopolitical, geoenvironmental and geosocial ramifications induced by all of the above. In what way are we different than the soil microbes who illogically deplete their only means of sustenance when we are painting ourselves into a corner - a dead end. We continue to do so because the worst of these ramifications are not yet severely affecting us.

It is said that modern fertility is good for the father and bad for the son. Logic can indeed be socially rationalized through the vice of selfishness.

Presenting a brief introspection into the inner workings of an invisible subterranean process is challenging. Intangible + Unglamorous = Unmarketable. (Boooring!)

Yet I hope to have impressed the extreme importance this process imposes upon our lives and our society - present and future. I hope to have nudged you closer to my crosshairs - the recognition that the implications associated with the energy expenditure required to produce the food essential for nourishing your family - is worthy of it's role as the *primary* pinpoint attribute in the center of those crosshairs. This fertility conundrum of Chemical vs Biological can and should be viewed as the keystone attribute. All other attributes - positive and negative - cascade directly off this critical decision.

This is the back story to what I've referred to as *Farming in the Key of Life*. Regardless of methodology, farming represents an intimate relationship with nature. Our actions can either be performed with intent to resonate in harmony with nature, or conversely, with off-key indifference to the choir in our midst.

In the bigger picture we follow this aberrant pitch to find the source of it's amplification. That source is represented by a word which our society will defend with religious zeal, such that all blasphemies will be subject to society's inquisition.

It was none other than Winston Churchill who ingeniously conflated blasphemy with orthodoxy when he stated *Democracy is the worst form of government, except for all the others*. As one molecule of free-market Capitalism is super-glued to every molecule of Democracy, the two become one. Unlike a critique of most anything else in life other than religion, any critique of Capitalism automatically indicts the accuser as a Socialist or Communist. It's as if a dirty baby has to be thrown out with the bath water - we're not allowed to clean it up or even make mention that it might be a dirty baby. We need to see past this as nothing other than the adolescent thought process that it is. Capitalism has flaws which can and must be fixed, lest those super-glue bonds lose their adhesion to Democracy.

All a bit worldly for a small farm publication but necessary to recognize as modern agronomy's selfish indifference is no worse than most other aspects of our current system. Our entire economic system is centered upon an underlying antagonist: Competitive markets operate with indifference to any collateral effects imposed on society. As such, each competitive free market player must be prepared to participate to the lowest cost methodology the market will demand. The winner will be the low cost producer. That producer will have found the sweet spot which is *almost, but not quite fatal*. If one producer isn't willing to flirt with fatality, that producer is driven from the market by someone else who is. Because sticker price drives our market, farming in the key of life is viewed as little more than virtue. This mischaracterizing of regenerative fertility as anything other than *essential* has placed our future ability to feed ourselves upon a crumbling foundation.

Still feeling the need to throw in an alternative analogous idea I've had bouncing around in my head for quite a while. It's a bit more tangible, slightly more glamorous (for some) so perhaps a bit more interesting to follow. This analogy steers your thinking, less so in the way of the microbial players, but more so in the way of energy storage within organic matter and the soil food web as the aggregate.



This analogous mechanism is known colloquially as the Hit and Miss engine popular in the first half of the last century. For those of you who've never attended a tractor show, Fall Harvest Days, threshere, or just walked right past the old tractor tent at your local county fair, copy and paste this YouTube link into your browser: <https://www.youtube.com/watch?v=Z5X0blh2Up8>

You'll see that continuous energy remains available for use even though the fuel necessary to create that energy is only being introduced via short *hits* - firings - of fuel. That single short expense of energy is transferred into the inertia of a heavy flywheel. Even though the engineering minds out there might cringe at the redundancy I created when chaining "heavy" to "flywheel", this association dependent upon storing energy within the inertia of a heavy, moving mass is imperative to the analogy.

Of course, the sun doesn't shine all the time. The sun provides it's energy in short *hits*. Nighttime and cloudy days are analogous as the *miss*. This intermittent solar energy is transferred into the tremendous mass of the soil food web, acting as the *flywheel* of stored energy.

This biological solar energy storage represents something entirely different than the batteries and thermodynamic movements which typically come to mind when thinking of solar energy. Yes, the soil properties themselves - the sand, silt and clay - are indeed conducting, convecting and storing radiant solar energy. However, as seasonal variations induce this warmth, it is the soil food web that is awakened from dormancy.

Whereas the soil composite of sand, silt and clay can be thought of as the high rise housing and infrastructure to which this microbial population utilize for shelter, mobility, birthing centers and cemeteries, it is the organic matter content of this barren soil which serves a function much more difficult to correlate directly to any single aspect of infrastructure employed by humans. Organic matter seems to act like an edible veneer of infrastructure, perhaps akin to the aforementioned concrete parking structure coated with edible berries, greens and bacon bits hiding in the hollows. As soil microbes consume this veneer of food, they thrive, produce fertile wastes, proliferate, live a full life and ultimately die and decompose, all of these phases enhancing the energy stored within the soil food web.

These effects seem trivial until we are reminded that there are more than 8 billion microbes living and working within just a single teaspoon of soil. This is easily extrapolated to correlate to a single acre of soil. First, know that this extrapolation takes into account only the top 7" of soil as it is within this shallow layer that all of this aerobic activity occurs. Second, let's provide some boundaries so everyone can visualize one acre. I'm going to allow some fudge so that I can use an easily recognized example.

Lambeau Field uses the standard 160' x 300' field, so the Packers play on 1.1 acres. Actually, now that I think of it, Soldier Field might be a better, smaller example as the Bears need to play on a kiddie field as a handicap for their stats! (There goes all our Illinois support!) But I digress...



Now picture just the top 7" of the soil on a football field and envision four tons of living organisms - bacteria, fungi, arthropods, nematodes, earthworms - all moving, metabolizing, proliferating, storing carbon, unlocking and creating fertility. Science refers to this as biomass, hence my analogous use as a flywheel.

Interesting final thought on Hit 'n Miss: Envision a 21st Century variation employing high tech bearings and materials. Perhaps all movement would occur in a vacuum. Connect the high tech flywheel, not to a gas motor but to an electric motor wired to a bank of capacitors. Charge those capacitors with... PV. Almost but not quite perpetual energy?! Pie-in-the-literal-sky dreaming!

Shavings from the Homefront I'll continue to occasionally add these shavings as many of you who've supported this farm for so many years have literally watched our kids grow up.

Richie, our oldest, married Ashley last year here in Waterford. They reside a few miles west of Honey Lake in a nice fixer-upper ranch home they are perpetually improving. They've gutted and replaced all aspects in the kitchen, put on a new roof, remodeled both bathrooms, new flooring, new woodwork and a work and play area in the basement, all using the sweat equity method. Richie now has quite a few years as a project manager at Balistreri Environmental in Elkhorn. Ashley put her marketing degree to work at InPro in Muskego, the same place Michelle works. As both of their employers have been deemed essential, they both continue to remain actively employed, although like so many others, the duration of this Covid situation is proving this to perhaps become tenuous. For the time being, they are still doing fine.

Sheri, as I've reported last year was married here on the farm to Bryan in 2018. They live about 6 miles SW of Columbus. Bryan has since assumed all responsibilities on his family's home farm where they grow all the feed for their custom dairy heifer operation. He also has a seed business and trial run into hemp and CBD oil. The old farmhouse they are living in is currently in the midst of a full scale renovation. They have their own herd of cattle on their own place as well as the hemp project. Sheri is now the Behavioral Health Specialist for all of Care Wisconsin, managing cases throughout the state. Oh... And one other little thing: Sheri and Bryan have a new family member in the making! She's just starting to show now, due in August. They've chosen not to know the gender so don't ask because nobody knows! Sheri has been shown the old pics of Michelle's belly with Sheri inside. Headphones are stretched to the fullest extent for the finest stereo effect. And the song being played is, appropriately - the Eagles singing New Kid in Town. Sheri intends to carry on the tradition where yet another human-being enters the world already possessing 9 months seniority in the Eagles fan club.

Sarah graduated with her BA from UW Madison last May and was accepted that same year into UW Madison's Nursing program where she will study for two additional years. Late last summer, we moved her into a new apartment a few miles west of the main campus. Like everywhere, the Covid situation has now upended the best years of her schooling, ultimately moving the most challenging and interesting aspects (clinicals) into a much less interesting online format. Bummer, but as we all see in the news, these changes are trivial compared to what many others are going through so she's adapting - like everyone.

Michelle had been working from home two days a week prior to Covid but now has gone full time from home, with all the office tech set up for video conferencing and the like. When she's not working she's crafting!

Me - As my social connections continue to be primarily animalian of the non-human kind, it has occurred to me that I was into social distancing, when social distancing wasn't cool! Things are different? Huh?

In the bits and pieces of time found in between farm work, I've been adapting new technology to our farm's energy systems. We have four different systems providing power for the farm. Our battery-based systems are now utilizing lithium batteries repurposed from salvaged Chevy Volt's. I've also installed the same in our farm's UTV. The formerly larger 24 volt system has been separated into 24v and 48v systems. Wind turbine is 24v which pushed me into this split. We're also now heating all of our hot water with PV as well as an in floor radiant system also using PV produced hot water. Both electric cars continue to be fueled by sunshine. Those eggs I've been known to deliver to many of your homes were not only produced in sunshine, but also transported to your door in a vehicle which runs on sunshine. I will continue in earnest to selfishly deplete every photon of sunshine possible. As hard as I've tried, the sunshine returns again the next day. I'll have to try harder I guess!

Thanks for reading. Best to everyone in these challenging times.

Steve