

Improving Pasture Quality for Animal and Ultimately Human Nutrition and Health *by Ben Mead.*

Ben Mead N.Sch

Pengreep
Ponsanooth
Truro
Cornwall
TR3 7JH

Tel 01209 861114

Fax 01872 870789

Mob 07974 931242

Email bmead@lynherdairies.co.uk

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Executive Summary

You Are What You Eat has become a well-worn catchphrase of late, entering the nation's psyche to the extent that, besides becoming a best seller, the book of the same name and TV show recently topped the list of most loaned work of non-fiction in UK libraries.

The burgeoning interest, from both population and government, into what we eat walks hand-in-hand with a widening concern over the provenance, safety and supply chain of our food, and its effects on society as well as the wider environment as a whole.

Coverage of these topics rises not just in the daily broadcast media and press, but in other books that have hit the best seller lists, notably Felicity Lawrence's *Not on the Label*, Eric Schlosser's *Fast Food Nation* and Michael Pollan's *Omnivore's Dilemma*.

My report revisits this familiar territory, but from the altered angle of *You Are What You Ate*, or maybe *UR?U88* for the text generation for whom much of the content may well prove of even greater import during their lifetime.

It begins by looking at how what our livestock eats impacts upon their health, production and longevity. It delves back down the food chain into how the plants that livestock eat gain their nutrition and how soil is the very cradle of life on earth.

It questions whether many of our 'best agricultural practices' have excessively rocked this cradle, with increasingly observed on-farm phenomena that point to an underlying decline in overall health and longevity of crops and animals unless resort is made to regular and increasing applications of toxic rescue chemistry to salvage the harvest.

This is not intended as a nihilistic criticism of modern agriculture. It is a genuine attempt by a working farmer to enlighten other farmers disquieted at observing similar symptoms on their

own farms that a wealth of alternative options exists outside the paradigm of an increasingly industrialised and heavily fossil fuel-dependent version of agriculture.

It does not and cannot present a panacea. However it does offer signposts to the farmer with an enquiring mind to explore different roads that lead to a better destination than the one many of us have presently ended up in.

It does this by seeking out alternative sources of agricultural knowledge, visiting other farmers around the world who had reached similar conclusions and used this knowledge successfully as an antidote to many of the issues that were threatening their own health, often both personal as well as financial.

It became clear during my travels that much of the developed world's agricultural industry is close to running on empty. As one Australian farmer and fellow Nuffield Scholar memorably put it: 'We have two options. Whinge. Or change.'

This report is about change. Change for the better.

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My wife Catherine and three boys

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To Charles Walters Jr, the journalist and editor with the vision to found Acres USA, and fearlessly inspire, inform and give a voice and confidence to scientists and farmers seeking ways to farm by methods that needn't cost us the earth in the process.

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Lastly, and certainly not least, to James Baker who looked after the girls in the herd so well and in his inimitably calm and relaxed way while I was away travelling the globe.

Introduction

Together with my wife Catherine, I'm an owner and director of Pengreep Farm Ltd, a family farm in West Cornwall to which we returned after working in advertising and journalism in London. The farm comprises two main enterprises: a 130 cow pasture-fed dairy herd and a value-adding cheese-making business which produces 200 tonnes of handmade speciality farmhouse cheese per year. This is made from our own milk as well as additional supplies from other local dairy farms. The best known cheese in our product range is Cornish Yarg, of which we are the sole producers.

Our herd has been entirely grass-fed since 1994, following study trips I made to Ireland, New Zealand and other low-cost grazing practitioners around the world. The initial decision to go totally grass fed was twofold: Primarily economics, but since cows evolved as a grass-eating animal, I reasoned this was both what it was best adapted to do as well as the safest way to feed cows post-BSE.

Grass quantity measurement and budgeting in terms of kilograms of dry matter was the central tenet of my new farming practice. Quality control was little more sophisticated than trying to keep plentiful leafy green swards in front of the cows. Various attempts were made at informed mineral supplementation, based around forage and soil analyses, although the back-up support from UK labs, consultants and vets was limited, confusing, frequently contradictory and often biased toward the use of expensive products. My only conclusion was that the more I found out, the less I realised I and everybody else advising me really knew about the subject.

One of the features regularly noted by farmers who switch from a dairying system driven by high milk yield to one that focuses on grazing is improvement in herd health. This was certainly my experience.

However, as I increasingly pushed with a nitrogen-fuelled drive to increase stocking rates and thus litres per hectare as an antidote to a declining milk price, I began to observe subtle declines in my herd's health status. Since the herd was closed and no changes had been made to the diet I began to search for a possible explanation of the underlying causes and the possibility of how the herd's 'unchanged' diet might have changed in some way.

During the course of this research I discovered Acres USA magazine and its large library of eco-agricultural books and back issues. This huge resource shed the first real light on many of the issues that were increasingly concerning me in my own herd management, with detailed scientific and farmer evidence to support my own observations and provide practical solutions that appeared to work.

Attendance at my first Acres USA conference in Minneapolis in 2004 entitled: Food as Medicine, Farm as Healer vividly redefined agriculture as the noble art it was and still can be, the cornerstone underpinning the health and wealth of nations. It also brought into sharp focus the ways in which I felt I needed to adjust the direction in which I pursued my personal farming as a responsible denizen of the planet.

A Nuffield scholarship was a vital stepping stone in pursuit of this ideal, both opening more doors as well as affording the luxury to explore the farms, offices and labs firsthand of both the thinkers and the doers at the forefront of a more ecologically sustainable as well as financially viable agriculture that wasn't so dependent on cheap fossil fuel inputs.

Outline of study tour

I visited three countries on my study tour:

1. The United States.

Much of the research, publications and specialist consultants are based in the US. America's rapid slide down the world health rankings also fuels a small but growing band of concerned consumers voting with their dollars in seeking an alternative menu to a heavily processed and industrialised diet which is increasingly linked to obesity and ill-health.

2. Australia.

Australian soils feature both extreme mineral excesses and deficits. Combined with low world market farm commodity prices but rising input costs, Australian farmers need enormous ingenuity and skill in overcoming these hurdles to turn a profit and survive.

3. New Zealand.

The leading practitioners of grass-based dairying, I visited to attend a three day workshop in biological farming, meet other pasture-based farmers using eco-agricultural practices in a similar farming set-up that I could benchmark against my own in the UK.

My 18 months of study began with what proved to be a painful 'unlearning' of much of my existing agricultural knowledge as I re-educated myself on the fundamental biological and chemical principles of sustainable agricultural methods, largely via books, conference audio tapes and networking with contacts I'd made through AcresUSA.

In addition I also sent soil samples from my farm to specialist soil laboratories abroad for more detailed analysis and consultancy advice than was available in the UK.

While I knew that I wanted to study a grass-related topic, as this initial research progressed, it became clear that the essence of what I was concentrating my effort upon, what really interested me the most and also had huge potential financial benefit to myself and other grassland managers could be distilled into:

Pasture quality, and how it affects livestock and ultimately human health

The subtext to this study was: You are what you eat ... but how do you know or trust the true nutritional quality of the food that you or your animals are eating?

This study's aim is to look at sustainable eco-agricultural methods of growing genuine quality forage for grazing animals, how it can improve yield and nutritional quality of output yet lower costs through animal health and fertiliser savings.

Emphasis will be placed on the use of simple, low cost, on-farm tests as guidance to help achieve the balanced soil fertility that is fundamental to growing food of true nutritional distinction.

Some of the insights I gained during my initial research were instrumental in defining my topic and its relevance to current agricultural practice. These included:

- The realisation that my past assessment of pasture quality (and that of most other graziers I've known over the years) was far too subjective and narrow based on limited visual criteria that were highly selective and ignored many vital clues that I had either failed to observe or dismissed as irrelevant.
- Most of the knowledge I used for growing grass for my entirely grass-fed herd was based on vested interest-funded or conducted research, with inevitable bias.
- MAFF and The Royal Society of Chemistry research shows massive mineral depletion in fruit and veg over a survey period of 1940-1991. Both our food today, as well as that of our animals, is less nutritious than before WWII.
- Animal production, health and disease resistance is intricately tied into forage mineral content, which can be traced back to soil mineral balance supporting a dense network of beneficial soil microbial activity.

- Many so-called 'best agricultural practices' I had employed upset this delicate and dynamic equilibrium, with negative effects on the production and health of flora and fauna both above and below ground e.g. anthelmintic wormers, fertiliser choice, cultivation techniques, herbicide use, reseeding choices and practices etc.

- Healthy soil is an essential precursor to plant and animal health, and by both logical and proven extension, human health as well.

- The declining grass, legume and herb species diversity in my pastures was detrimental to herd health and production. It also increased susceptibility to drought and other extreme weather conditions.

- By improving my observation skills and 'learning to read the farm' better hitherto unforeseen opportunities emerge to increase profits through further cost reduction combined with increased income potential via both raised production and quality of output providing the potential to obtain premium prices.

- Grasses possess the greatest ability to sequester carbon dioxide, one of the main greenhouse gases, yet can require one of the lowest energy inputs of all agricultural crops. We shouldn't just hug trees but embrace grass as well!

- Water and energy usage combined with global warming, our carbon footprint and health and global pandemic concerns are the great threats and opportunities of the 21st century for agriculture, mankind and the planet.

The corollary of much of this reading and research is that intelligent management of pasture-based farming clearly has a valuable contribution to make, at very low cost, towards substantial mitigation of all of these grave 21st century afflictions.

The key investment required is in the creation of a major attitude shift and knowledge upgrade of the farmer rather than spending on expensive fixed capital assets.

The potential of the health benefits attached offer the ultimate gift horse USP for the marketing of products that can demonstrate such provenance. In these times of consumer self(ish?)-interest this seems a far superior sales proposition than simply using pretty landscape maintenance as justification for higher farm prices. Such a pitch might resonate well with second home-owning affluent purchasers, but hardly strikes a chord with the urban masses that make up both the bulk of the food market and the patient numbers of the NHS, many of whose ailments can be traced back to a root cause of declining nutrient density and complexity in the food chain being detrimental to their dietary requirements.

While this all looked good on paper, the real purpose of my travelling was to visit farms and farmers as well as their mentors and advisors to see whether the ideas and practices all stacked up where it counts, in the field, their livestock and indeed their own health. The plan was to examine firsthand whether these ideas really worked, learn the practical application techniques from the people actually making them work and then transpose these methods onto my own farm to bring health benefits to my fields, animals and family and the wider community within the sphere of influence of our farm ... the wildlife, our employees and our customers and consumers of our produce.

Travel and study summary

I spent almost 14 weeks continuously travelling between early November 2005 and late February 2006 ... one of the many benefits a block calving herd affords. Inevitably I was only able to visit farms at a single point in the seasons; however my travel to the Southern Hemisphere enabled me to see summer production while my American visits looked at the other challenge of weathering the winter.

During that period I had the privilege of spending time with a wide and diverse variety of individuals and organisations involved in the production and marketing of eco-agriculture based food. These included:

- Farmers: over 30 of some of the best farmers I have ever witnessed in over 20 years of farming, bearing a variety of classification, including Biodynamic, Biological, Organic, 'Beyond Organic (!)', Fusion as well as Conventional farmers. Some of these exemplar practitioners were so far above the excellent rating of standard benchmarking procedures as to be almost unbelievable had I not personally trod their land, shook their hand and generously been allowed to peer into every nook and cranny of their operations.
- Farm advisors: I interviewed a wide variety of farm advisors that included holistic vets, soil consultants, animal nutraceutical specialists, journalists, GPs, holistic management advisors, naturopaths, government scientists, fertiliser and biological agricultural input manufacturers, compost tea brewers, food supplement producers, herbalists, agronomists, applied biologists, hair analysis chemists and entrepreneurs marketing farm produce on a health pitch.

- Health food chain personnel: I also visited two organic slaughterhouses, various health food supermarkets and cafes, raw milk bottlers and dairy product makers, food co-ops and farm shops which sold food with the double emphasis of great taste and beneficial to your health in my quest for as much variety of information on my subject as possible (and to avoid the almost unavoidable scourge of fast food and GM produce while on the road in the US).

I also gained much information from other sources besides. These included:

- Conferences: I attended three three-day conferences in 2005 of the Missouri Forage and Grazing Council, AcresUSA and The Weston Price Foundation, variously covering principles and techniques for growing nutrient dense food and its role in promoting human health and vitality as well as disease prevention.
- Workshops: For more in depth knowledge and detail I also enrolled as a student in Neal Kinsey's Advanced Soil Fertility Workshop and Dr Arden Andersen's Soil Management Course, both intensive residential three day soil science workshops.

In late 2006 I attended my third AcresUSA conference as well as Jerry Brunetti's one day pre-conference advanced learning course entitled: Food as Medicine. Diet As The Ultimate Key to Health & Healing. I'm somewhat uncomfortable that in the process of this travelling I took 14 plane

flights and put another 12,000 miles on hire cars, a carbon footprint that I hope to totally offset with the changes I now have the knowledge to plan and execute on my farm.

My findings

Rather than pen a chronological travel diary of every farm and individual that I visited, it became clear, when reviewing all the information I gathered, that wherever in the world these farmers were, they all focussed on at least one of three key areas.

It was notable that the best pasture results were achieved where all three elements were effectively managed in combination to produce synergy.

These elements were:

- 1. Soil Chemistry**
- 2. Pasture Species Diversity**
- 3. Soil Micro Flora and Fauna**

1. Soil Chemistry

The more-on philosophy

Farmers are well aware of the link between chemistry and crop growth, having used the NPK system for the last 100 years. Perhaps what they are not so aware of is the fact that the system's progenitor and originator of The Law of The Minimum, Justus von Liebig continued his research, swiftly concluding that he had published an over-simplistic model which didn't take account of other minerals and trace elements essential to growth, health, reproduction and plant nutrition.

Adoption of the NPK system has been of great benefit to the fertiliser industry as a marketing tool for its products. However, the benefit to farmers, food consumers and the environment is increasingly questionable.

Artificial N will undeniably paint a farm green and increase volume of grass grown to create a visual perception of lush fertility, encouraging the 'more-on' approach many farmers have adopted: If a little is good, more must be better.

Unfortunately, quantity and visual appeal is no measure of pasture quality; animals given free choice will avoid high N grass. Its damaging effects on the digestion and health of ruminants through increasing blood urea nitrogen (funny protein) as well as the soil humus and wider environment are increasingly questioned and widely documented from both within and outside the veterinary and scientific community. Andre Voisin, the French scientist and grazing pioneer, discovering the Law of the Maximum, demonstrated that an excess or imbalance of one material could be just as harmful to production through the agency of locking up other essential minerals present in the soil.

So it's not surprising that studies as well as farmer experience show declining nitrogen efficiency, with use per tonne yield increasing significantly over time.² Coupled with its manufacture being voraciously energy hungry, and its use burning up soil humus, its cost/benefit return will look increasingly less attractive as its negative carbon footprint becomes more widely accounted for and rising prices further erode farm profit, both directly and indirectly.

The sharp focus in agriculture over the last 70 years on N P & K has meant the balance of other minerals in the soil being largely overlooked. However, large numbers of government-published food quality studies in the US and Europe verify 30-60%, even 80% in some cases, declines in the selenium, zinc, cobalt, manganese, magnesium and calcium and other mineral content of fruit and veg.

1. Soil Chemistry

Why do minerals matter?

Minerals are the basis of plant, animal and human health. Two times Nobel Laureate Dr Linus Pauling stated that, in terms of human health: 'One could trace every sickness, every disease and every ailment to a mineral deficiency.' There is considerable further evidence of this to be found in the publications of Andre Voisin, William Albrecht, Weston A Price and Sir Albert Howard to name just a few eminent but highly respected scientists working in this area. (Booklist in Appendix)

Consideration of just a tiny fraction of the roles that the aforementioned declining soil minerals play in life processes within the more familiar milieu of agriculture underlines the importance of our detailed attention to ensuring their provision.

Selenium is important for reproduction, healthy muscles and growth and shedding of afterbirth postpartum. Zinc is necessary for moisture absorption in plants and fertility and hoof strength in animals. Cobalt is essential for healthy bone development and the health of red blood cells and the synthesis of Vitamin B12 as well as supporting nitrogen-fixing rhizobium and other soil bacteria.

Manganese affects seed germination, speed of growth and stalk strength in crops. Research from the US reported in AcresUSA 1992 showed that a lack of manganese allied to a shortfall of copper, cobalt and iodine predisposes animals and humans to *Brucella abortus* infections and also TB and Johne's Disease. It's also worthy to note that the work of the late Mark Purdey³ raised important questions about the role of manganese in BSE and CJD, with very high local levels being involved in all animal TSE and human CJD clusters around the world.

As most livestock farmers know, magnesium deficiencies produce grass tetany as it's tied in to nervous behaviour, as well as mastitis, arthritis, warts, soft teeth and bone deformation. It also holds the soil together and is an essential

component of chlorophyll and involved in photosynthesis. Calcium is required for nervous and muscular systems, normal heart function and blood coagulation. It is probably best known as a vital component for bone growth but is also often referred to as 'the trucker of minerals' for its role in transporting all the other minerals into the body of both plants and animals.

Two excellent sources of recent farmer-friendly information about the role of the minerals from an agricultural viewpoint are Neal Kinsey's book *Hands On Agronomy* and Pat Coleby's book *Healthy Cattle Naturally*, both of whom I was lucky enough to spend time with on my travels.

Clearly, for anyone involved in the breeding, growth and reproduction of livestock and crops, missing or inadequate supplies of raw materials vital to these life processes will directly impact on the yield, quality and overall profitability of their own enterprise.

The indirect costs of negative global perception, loss of morale and market confidence and counter measures brought in on the British meat industry post-BSE and Foot and Mouth, are difficult to quantify but an undeniable and huge drain on the industry.

Many farmers experience firsthand the well-recorded trends of falling livestock longevity and fertility, increasing levels of mastitis, TB, lameness and both the threat and reality of pandemic diseases such as Foot and Mouth and Avian Flu and the call for increasing vaccination programmes. On the arable side, declining crop quality parameters of reduced proteins, declining bushel weights and keeping quality, increasing moulds and mycotoxins and weed burdens all mirror declining and imbalanced levels of minerals in the soil and its subsequent inability to provide full nutrition leading to declining quality, disease burden and yield disappointment, which all siphon profit off the bottom line.

1. Soil Chemistry

What can we do as farmers?

The initial step in overcoming any problem lies in recognition that the problem exists in the first place. As farmers we also have to realise that, just because our neighbours might share the same problem, it's no excuse to be complacent in trying to determine the root cause in an effort to devise an effective solution.

Whether farmers are in denial or simply ignorant of the issue is a point of debate. Most soil testing in the UK, for those that do it, simply covers pH, P & K and occasionally magnesium. Wider soil macro and micronutrition is glaringly absent on agricultural educational establishment curricula, this dearth of knowledge often embarrassingly manifested in the condition of crops and animals sometimes witnessed at open days.

Government fertiliser best practice guidelines covered in RB209 concentrates on NPK fertilisation, with an acknowledgement of the contribution of one or two other elements such as sulphur and magnesium and a nod towards the importance of trace elements. Yet this fertiliser 'bible' offers no guidance on how to get these other important minerals correct. Nor does it give any hint of how N, P & K from different raw material sources behave in remarkably different ways with dramatically differing effects on soil ecology.

But as any thinking farmer who has successfully 'cured' livestock infertility and parasite problems with a copper bolus would contend, a more sophisticated soil analysis beyond N, P, K and pH should be called for in at least attempting to deduce why copper was inadequate in home-grown forage in the first place? Was it simply not there or might it perhaps be locked-up and unavailable due to an excess or shortage of other minerals?

The Albrecht option

William A Albrecht is considered by many as the pre-eminent soil scientist of the 20th century. His published scientific papers spanned the years 1918 to 1974 and all are just as valid today, if indeed not more so, than when first published. All emphasised the fundamental necessity of feeding plants, animals and human beings through ministration to the soil itself, correcting deficiencies of diet at their point of origin – that is, in soils a scientific measurement found wanting.

If you cannot measure you cannot manage. Relevant, representative soil mineral tests are the key raw data on which to judge the health and growth potential a soil can bestow, as well as what inputs to use to bring the base saturation of minerals into balance for optimum plant and subsequent animal nutrition.

It is also fundamental to the recycling of nutrients removed in the harvesting process. This is the only way to ensure that our food supply is sustainable rather than extractive and of finite lifespan, a major consideration given world population growth forecasts.

Albrecht used lab tests that measured nitrogen, sulphates, phosphates, calcium, magnesium, potassium, sodium, cobalt, boron, iron, manganese, copper, zinc and molybdenum as well as total exchange capacity, pH and humus content. Albrecht defined the aim of achieving soil balance as: 'The supply of what is deficient to correct what is in excess.'

Defining the optimum levels or balance of minerals was what much of his research was devoted to, although he modestly described his process as: 'Simply studying and learning what Nature did which had never before been recorded.' Thus his basis for unravelling the riddle of true nutritional fertility was based on an almost forensic analysis of many different soils from all over the world where either extremes of productivity and health or the opposites of sickness and failure were expressed in crops, animals and even humans.

The result of his research was that he was able to repeat these results in both lab and field trials. These extensive studies with growing plants and animals substantiated his contention that declining soil fertility, due to a lack of organic material, major elements and trace minerals – or a marked imbalance in these nutrients – was responsible for poor crops and in turn for pathological conditions in animals fed deficient feeds from such soils. Obviously mankind is no exception.

1. Soil Chemistry

Practical implementation of a focussed soil balancing programme

Farmer's son Neal Kinsey studied under Dr Albrecht at the University of Missouri and has himself been described as: 'Knowing soils like an old salt knows the sea'. He has many clients around the world and after reading his book, speaking to a number of farmers using his programmes as well as having met him, I sent soil samples from my own farm as well as enrolling in one of his three day advanced soil courses in Albrecht methods whilst in the US.

On the basis of laboratory analysis of my field samples (see appendix for example), Kinsey was able to describe over the phone with uncanny accuracy and detail which were my best performing fields, the types of weeds and even the susceptibilities of my animals to particular ailments despite never having set foot on my farm.

More importantly, the field printouts gave me detailed instructions of what minerals and trace elements to apply to bring the soil back into optimum balance for forage and animal production and health.

In conversations with Kinsey I was able to custom build a field-by-field remedial soil fertility programme. This took into account the availability of local, unbranded but good quality commodity straight materials of specific provenance, as well as my budget and timescale. Attendance of his Advanced Fertility Soil Workshop also gave insight into the complex set of interacting chemical reactions and the number-crunching to calculate the quantities of materials required to achieve the desired, balanced soil chemistry outcome.

This is a very different approach to my previous and generally standard practice of simply phoning around the fertiliser merchant for the cheapest source of N P & K with little or no understanding of the products that I was buying, their source or method of production (or possible undeclared contaminants) and the faith that with a standardised NPK rating they would all perform in a specified and similar manner.

The sobering fact is that while the same NPK-rated products will test equally in lab assays, their behaviour and performance in the soil – where it really counts – is often remarkably different. In many cases, notably Triple Superphosphate and Muriate of Potash, these effects are positively harmful to the soil microbial organisms responsible for the symbiotic relationships that build fertility, crop vigour and disease resistance.

In addition, Kinsey's advice also specified boron, cobalt and iron sulphate for certain fields as deficiencies requiring supplementation. Copper lock-ups on other fields were reflected in fertility and parasite issues of specific animal groups reared on those areas.

1. Soil Chemistry

Does it work on real farms?

I visited a number of farmer-owned farms in the US and Australia that had been using Albrecht programmes to see for myself how these had been carried out and how effective they were.

In Missouri, I visited Jerry Fry, an ex-USAF pilot at his organic, pasture-fed beef ranch. Meticulous in his record keeping, he showed me through the details of his soil analysis and subsequent five year programme of remedial mineral applications. Photographs and walking the farm showed how the land had transformed from a weed-infested, low quality and low production farm to one that was now high quality pasture without weeds in just five years, enabling him to calve, fatten and sell high quality, organic pasture fed beef at a premium.

This was especially impressive given Jerry had neither years of agricultural experience under his belt nor resorted to toxic chemicals or artificial fertilisers. What he did have was an enquiring mind, a well chosen, extensive and well-thumbed library covering both the technical and philosophical angles of agriculture, coupled with a clear and determined goal of farming sustainably without chemicals or preconceptions.

With this resource base he had developed a well-defined, simple strategy to get to his goal, and possessed the military discipline to execute it to exacting standards. Jerry's pasture and livestock results were convincing proof that Albrecht methods worked effectively when the protocols were followed as directed.

This was further underlined by visiting the family dairy farm of Dale and Ruth Carter 20 miles up the road. Dale was considering an Albrecht-based programme. His soil type was almost identical to that of Jerry Fry's farm before remineralisation. Walking his acres highlighted the symptoms of a soil dominated by magnesium excess typical of the area: tight soil structures that were sticky in the wet, dried out, cracked and didn't retain moisture in the summer and suffered high populations of prickly weeds and grasses that were prone to insect attack. This had been further compounded by the use of cheaper, locally quarried dolomitic limestone material adding further magnesium. His cattle needed substantial supplementation and medicinal intervention to achieve decent levels of youngstock growth as well as adult production and fertility on this unbalanced soil.

One of the interesting features of the Albrecht approach is the same rules apply across the world. I visited Paul Mason's farm near Wellington in New South Wales. He runs an impressive one man show over 4200 acres, although he did admit to having: 'a bloke who helps out for one to two weeks a year' when he's busy! He runs 1400 beef cattle which he buys in as 300kg steers and grows 3000 acres of grain.

He'd always been interested in soils as he used a Brookside consultant in the past and confessed to: 'Reading Kinsey's book several times although I didn't understand it ...' He began using Kinsey and the Albrecht methods in 1994. The farm has low calcium, excessive potassium levels of up to 14% and high magnesium. 'When I started out calcium levels were 35% and magnesium 16%.

There was a wool depression on and no money. I told Neal I couldn't afford to spend the sort of cash necessary to raise the fertility up to excellent levels in one hit so I suggested I'd give it my best shot and come back if I started getting results on lower levels of input'.



(left)

The Carter Family farm shows weeds typical of a magnesium-dominated Missouri soil. Jerry Fry's organic pasture became weed free and highly productive following Albrecht methods adoption

1. Soil Chemistry

The results were very encouraging. Finishing times for the cattle decreased from 15 months down to 12 months. There was a 2% carcass weight increase and better grading at the abattoir. Paul was able to increase the stock numbers up from 1000 to 1400 head because the pastures were so much better and he was gaining an extra \$35 per carcass because of the improved grading quality.

On inspection in the paddock, his Hereford and Angus cattle certainly lived up to expectation and, in spite of the increased stocking rate, Paul remarked that his cattle were both healthier and only required drenching once a year whereas before remineralisation they required three to four treatments a year. Some farmers nearby had to worm monthly.

Vet Colin Trengove, a partner in APAL, a soil testing lab set up with three other farmers to provide Albrecht method analysis in Australia confirms similar results in South Australia where he works: 'Where soils are in balance the farming seems so easy! Insects and weed problems disappear, lucerne pastures last 10-15 years instead of five and animal health problems are limited.

But where soils are badly out of balance the animals display poor growth rates, disease, gastric problems, mastitis, lameness, sudden death and lowered immune system function. I use a combination of soil tests with animal tissue, blood and liver biopsies on problem farms to create an immediate animal rescue plan as well as provide a longer term overall solution via a soil remedial programme.'

Back on Paul Mason's farm, on the cropping side Paul reported considerable benefits too. 'My turning point was when I won Best Wheat Crop Cup. I pulled a soil sample from the paddock where the winning wheat was grown and the analysis figures came back with all the Albrecht magic numbers. That's when it really clicked for me.' Besides his award-winning crop there are other benefits as well. Crop yields have risen and: 'Weeds are no longer a problem, relative to what they were'. As soil calcium levels rose and the soil became more friable he's also found he can work the ground faster because there's less drag on his gear, reducing fuel, wearing parts replacement and cultivation time. Quite important given his workload and low staffing levels!

Overall Paul reckons to have seen a 200% increase in productivity off his fields as a result of his soil remediation programme. I also observed that although there had been no significant rain on this farm for two years, the paddocks were noticeably greener and carried more stock than neighbouring farms. There was also considerably more biodiversity, fantastic dung beetle activity and no smell or flies.

Clearly Paul has demonstrated Albrecht methods work very well, generating dramatic quality and quantity gains both directly and indirectly with many costs cut and income raised, even under harsh conditions. He does confess that he hasn't sat down to do the sums so: 'I don't know whether I'm better off yet'. My intuition was that here was a business that was profitable in its own right. But apply triple bottom line accounting with the observation that year-on-year organic matter was steadily increasing rather than declining and here was an exceptional farmer demonstrating that, far from being mutually exclusive, highly efficient, large scale, quality food production can go hand-in-hand with genuine, long term sustainability and enhancement of its immediate environment.



(above)

Healthy Herefords on Paul Mason's farm despite two year drought, seen in neighbouring brown fields on rhs horizon

1. Soil Chemistry

Limitations and alternatives to the Albrecht approach

This is not a quick fix and patience is a necessary ingredient: 'Some paddocks I've been working on for 10 years to get right but many people want too much too soon and they'll put so much on they'll either kill a crop dead or grow the worst crop of their life. The hardest part with Albrecht is prioritising which excess or deficit on the farm to address first. In my case the most startling result I've had here is from getting the calcium closer to balance. I used to farm on heavy black soils which were very magnesium-dominated and it was much harder and slower to get the results I get here. Having seen some of the soils in South Australia they'd be better off selling up and moving to better land'.

This is a critical point that any farmer contemplating soil remediation using the Albrecht system needs to address. It was graphically explained to me by Adrian Lawrie of Lawrie and Co when I visited him in Adelaide, South Australia. Adrian was a highly experienced hands-on broadacre farmer who now runs a biological farming supplies company with his wife and daughters, providing education, consultancy and associated farm inputs for large scale biological farming. His company have put together a truly excellent handbook called *Soil's Alive*, a 'by farmers, for farmers' practical manual for the understanding and practical application of Biological Farming that covers mineral, microbe, plant and pest management in one handy volume.

'Neal Kinsey came to Australia and I attended one of his soil seminars in Albrecht methods,' explains Adrian. 'We had the soil analysis results of a local farm and he was going through the remedial inputs. Due to the combination of the extreme excesses of the soils in this part of Australia, the high cost of purchasing and shipping in the large quantities of remedial materials and the low value of the land, back of an envelope calculations showed that land purchased for \$250/acre

required \$650 of material to bring it into Albrecht's ideal balance!'

While this might be economically feasible for a high value vineyard or similar operation on a small number of acres, for the majority of farmers growing large acreages of grain or beef for a commodity market it's a non-starter; the figures are simply too far adrift.

Admittedly this is an extreme example unlikely to apply to UK soils where excesses and deficits are not so pronounced, remedial materials are cheaper and land prices are significantly higher. However, extremes can often be overcome by a different approach.

One of the alternatives to using Albrecht principles where extreme soil excesses and deficits and cost of remedial inputs mean the economics don't stack up is to opt for the Reams' methods.

Dr Carey Reams was also a scientist working in the area of growing crops with the emphasis on health and nutrition, developing the Reams' Theory of Ionisation. Using the Morgan Extract solution method (a different methodology to Albrecht's lab assays), his soil tests charted the same macro and microelements, but also gave a measure of what was available as well as unavailable to the plant.

Broadly speaking, both approaches draw from the same underlying principles. But whereas Albrecht concentrated on feeding the soil, Reams' advice gave farmers soil remedial information as well as an additional option to supply necessary missing plant nutrients via foliar feeding at the appropriate stage in the plant growth cycle that they were required. This is often the more financially viable option, particularly where soil excesses/deficiencies are extreme, though it is also a more management intensive option requiring greater monitoring, skill and understanding as well as timeliness of application.

1. Soil Chemistry

There is no doubt both programmes are effective on the evidence I saw. Choice is both a matter of individual personal preference, management skills and funds available, as well as an assessment of the limiting factors of the soil types of the individual farm and the proximity and cost of suitable remedial materials.

Most of the principles and knowledge that Albrecht and Reams based their programmes upon overlapped. Many of the farmers I visited were aware of both approaches. Some stuck rigidly to one or other school of thought, but there was also a considerable degree of mixing and matching from both disciplines, often to the greatest effect.

Veterinarian Dr Dan Skow and Wendell Owens of International Ag Labs in Fairmont, Minnesota are the leading advisors on Reams' methods, with Dr Skow having studied under Carey Reams and been entrusted with all his papers, audiotapes and notebooks when he died, as well as having authored the book *Mainline Agriculture for Century 21*.

As Wendell Owens succinctly summed up when I visited: 'With base saturation (Albrecht) methods, if you're driving in the middle of the road you'll be OK ... but if you're near the edges you'll be upside down in the ditches!'

The key objective behind achieving balanced soil chemistry is that it allows the creation of the optimum physical structure within the soil. The ideal textbook soil is made up of 25% air, 25% water, 5% organic matter and 45% minerals. This effectively builds the best environment for beneficial soil organisms to multiply and thrive, symbiotically releasing insoluble soil nutrients into plant-usable forms and building soil organic matter as a by-product. Plants are also aided in developing larger, deeper root systems that access more water and nutrition to develop better nutrient density and yield as a result of improved soil friability and pore spaces created by the chemistry and biology in tandem.

Another important contribution Carey Reams made to the art and science of producing nutrient dense crops was the development of the refractometer, with Bob Pike of Pike Agri Lab Supplies Inc, as a measuring device that growers could use as a rapid and inexpensive crop tester.

An indispensable tool in fruit and viticulture farming, it works by measuring the percentage of dissolved sugars, or brix, in the sap of a plant. The governing principle is that plants' ability to generate sugar is as a direct consequence of the quality and quantity, or lack of, the nutrients they require that are available to them. The better the nutrition available from the soil (or, as in some cases described earlier, provided as a foliar spray at the appropriate time by the farmer), the more complex the carbohydrates the plant can manufacture. This not only supplies better quality nutrition to animals further up the food chain that evolved to consume those plants as one of their sources of food, but also builds in disease/pest resistance as an added bonus to the plant.

The refractometer has great potential as a tool for measuring pasture quality through the agency of sap squeezed from grass. Indeed, there was a vogue for using it in silage-making to decide if grass sugar levels were sufficient to ensure fast fermentation by fuelling the acid-producing lactobacillus strains essential to preservation and minimal quality loss of the pickled grass, before actually mowing the grass.

While the refractometer is a valuable instrument to the advanced pasture farmer, it should only be regarded as one item in a specialist tool chest. It has a role in quality appraisal of pasture but its use before the fundamentals of soil chemistry balance have been addressed and rectified can be a disheartening exercise. Its principle function is not as a means of creating quality pasture, but rather of being a precision tool to fine tune a good pasture to one that is truly excellent since high brix will not result until this has been done.

Jon Frank at International AgLabs has been experimenting further with the refractometer, using it to measure brix in milk as well as plants. He has found that, with his own milking goats, the higher the brix of the forage fed, the higher the brix levels in the resultant milk produced from that forage. There is an undeniable link between flavour and brix levels in fruit and veg, and he confirmed that this same feature applies in milk: The higher the brix, the better the taste. Clearly for those selling milk or milk products direct to consumers the ability to increase brix, and flavour as a consequence, can only have a beneficial effect on consumer satisfaction and consequent demand.

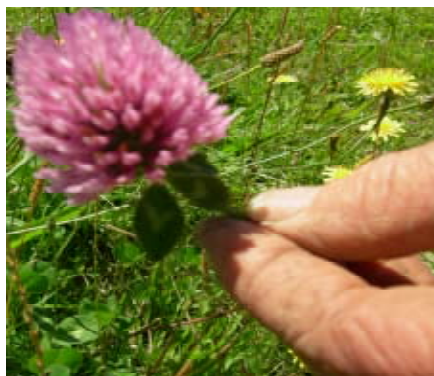
2. The importance of pasture plant species diversity

Building a more robust and bountiful soil food web

As any good retailer knows the wider and better the range of goods offered, the greater the numbers and social mix of shoppers likely to be enticed into the shop and therefore the greater the chance of the tills ringing up sales to make the enterprise prosper.

The purpose of encouraging agricultural biodiversity is to create a similar effect to that of the successful shopkeeper. Thus by creating, maintaining and even enhancing the range of conditions that foster diversity of species we can similarly make food production prosper by drawing in beneficial organisms that enhance both the growth and quality of the food produced. Such beneficial organisms would include micro organisms in the soil, pest predators, crop pollinators and crop residue shredders, for example.

Biodiversity is something farmers are continually being asked to enhance. The reasons are less well explained, and often in narrow frames of reference to small numbers of rare bird species. This is hard for many farmers to swallow, given plenty feel their own survival chances deserve a higher ranking on any endangered species' list. A cynical predisposition to milk biodiversity solely for the grant aid it proffers is created, and low self esteem is fostered within an industry that feels under appreciated for its contribution to one of society's most fundamental needs, food.



(above)

Classic pasture diversity at Ron & Bev Smith's inspirational organic dairy farm in Gippsland

Yet broadening biodiversity can pay handsome dividends over and above grant aid if applied with appropriate knowledge and intelligence, contributing to both harvest quantity and quality.

Plant species diversity has a vital role in creating this overall biodiversity increase. Just as balancing soil chemistry helps build and enhance the physical soil structure and environment most conducive to thriving soil ecology, broader plant diversity adds a dramatic multiplier effect to the soil food web.

It does so by adding depth, dimension and range into the habitat and food supply, both in its canopy and its root system rhizosphere. It turns farming from a single dimensional affair into something more three dimensional. So the conditions for greater numbers and varieties of macro and micro organisms to mutually live and thrive together in self-supporting self-sufficiency to create a sum greater than the whole are created. Thus vital tasks like pollination, carbon cycling, pest predation, amino acid and vitamin synthesis etc which we take for granted – yet have major financial bottom line implications – are carried out free-of-charge for us to the mutual benefit of all but the bad guys.

This symbiosis creates powerful synergies that result in both enhanced quantity and all-important quality of whatever crop or livestock the farmer harvests off the land.

Biodiversity also buffers these harvests from the greatest leveller of all in agricultural income, the climate. Survival chances in extremes increase the wider the range of adaptive powers within the species base, a feature well illustrated by the fact that high diversity hedgerows rarely suffer the effects of drought when everything around them is burning to a crisp. We overlook this low cost, indeed self-liquidating, insurance against the increasing uncertainty of climate change at our peril.

2. The importance of pasture plant species diversity

Why should we worry about soil diversity?

There are literally millions of different beneficial soil flora and fauna, which all have an unwaged yet valuable input to building soil fertility and growing nutrient dense food.

If we assist in the (re)creation and maintenance of an environment for them to thrive we all gain mutual benefit. However systematically destroying their habitats, justifying our actions with the battleground polemics of Winning the War on Weeds, Fighting to End World Hunger, Stamp Out Disease and such like, creates such collateral damage to our allies they can often no longer collaborate meaningfully to mutual benefit.

To illustrate, the nitrogen fixing power of clover and other leguminous plants is probably the most widely known beneficial symbiotic relationship in agricultural circles. This has the potential to provide 80% of a grass crop's nitrogen needs totally free of charge from the atmosphere, yet few of us do much to really nurture this free lunch bonanza. Indeed, in the indecent scramble for haste and efficiency, we often inadvertently do more to prevent it through physical and chemical abuse of soils leading to greater compaction and the vicious downward spiral that this sets in motion.

Since the precursor to nitrogen fixation is infection of the root hair by nitrogen-fixing bacteria to create the nodule, unless our farming practice fosters an environment conducive to nitrogen-fixing bacteria, as well as nurturing and maintaining the dynamic equilibrium conducive to other beneficial soil organisms, we can kiss goodbye to free nitrogen. Instead we can expect to provide it year in, year out, as an

increasingly costly purchased input, with its huge negative carbon footprint and pollution implications, until such time as we redress the balance.

So just how bad is it, Doc?

Just as global warming deniers increasingly concede that evidence is becoming overwhelming, there is much factual documentation that soil microbial activity is declining. Lab tests of farm soils show low microbial activity as the rule rather than the exception, confirmed less scientifically by the frequent 'lifeless' smell or lack of nose as well as low earthworm populations when field soils are dug with a spade.

Rhizobium bacteria seed inoculants are increasingly required to get legumes to fix nitrogen in worthwhile quantity. Thatch build-up frequently observed in many pastures indicates a lack of carbon cycling fungi and bacteria, which is a likely contributing factor towards explaining the UK's latest carbon soil audits showing accelerated and worrying declines in soil carbon levels over the last 25 years. ⁴

2. The importance of pasture plant species diversity

Why has plant species diversity declined?

With industrial agricultural methods predilected foremost on yield quantity, harvesting efficiency and economies of scale, species selection and breeding have become predominantly focussed on outright yield and uniformity. Important benefits that lower yielding species bestow, such as flavour, palatability, nutrient content, animal fattening or milk production ability and drought/disease resistance are increasingly overlooked because of some inconvenience factor.

The result has been a gradual whittling away of older native open-pollinated deep-rooting but lower yielding pasture species and herbs once ubiquitous in much pre-war livestock grazing. Thus species-rich pastures have been replaced by a virtual monoculture comprising of a limited handful of 'new, improved' but shallow-rooted hybrid ryegrasses which seed company marketing spiel suggests are superior; a lure many farmers, myself included, have often gullibly swallowed hook, line and sinker.

This 'superiority' is based around narrow selection criteria inexorably driven by the mechanised forage silage-making culture dominating UK livestock husbandry. It has also become self-perpetuating; good silage is made before grass goes to seed. Its succession of haymaking combined with zealous topping of grazing pastures means less viable seed falls onto the fields to ensure species survival in following years, thus farmers trot back to merchants to purchase more hybrid seed developed from an ever-diminishing gene pool.

The ploughing up and chemical dosing of former grazing land to grow forage crops like maize further hastened old pasture species destruction. In addition, many new forage crop varieties exhibit high

dependency and expensive taste for artificial inputs to perform but traditional varieties display the opposite trait, often suppressed by use of these same inputs, speeding their decline and disappearance.

There is a strong case for thinking grazier farmers to re-evaluate seed choice and pasture management from a similar viewpoint as the more enlightened are increasingly questioning the suitability of their animals' genetics to perform on grazed grass.

The increasing omnipotence and growth of global corporate agribusiness with powerful, controlling interests in seed development and biotechnology looks set to further winnow out variety and choice as mergers and acquisitions pare away independent alternatives.

Copyright-protected seeds with built-in, brand-specific herbicide-resistance are the focus of massive research and funding. The objective is to ensure that once the farmer has chosen the seed variety, he has no option other than to purchase a specific manufacturer's herbicide product. Aside from such biotechnological handcuffing conferring a new variant serfdom back onto farmers, eye-watering investment costs will inevitably limit seed variety development and choice while the use of broad-spectrum herbicides will further deplete remaining native seed stocks germinating from soil seed banks.

This has become symptomatic of an industrial agriculture protocol. It is concerning to note that similar narrow selection criteria has been taking place not just in other seed selection, but animal genetics too. The Atlas of Food ⁵ highlights the quickening pace and sheer loss of agricultural biodiversity across the world; the US alone has lost a staggering 97% of its original fruit and veg varieties and large numbers of domestic animal breeds.

Biodiversity has been the cornerstone of Nature's highly successful insurance policy to ensure survival in the event of disease or natural disaster. In pursuing a strategy of efficiency, man is dismantling this security net by ruthlessly weeding out vast numbers of apparently underperforming species in the quest for volume, cheap food and profits. However, this culling of diversity inevitably comes at a cost of inbreeding greater overall vulnerability into the food chain.

While increasing lack of disease resistance might be good news in the short term for shareholders of global pesticide and biotech companies, it is becoming a very real threat to overall food supplies. These risks are further heightened by increased global mobility of goods, people and animals. Recent Foot & Mouth, Avian Bird Flu and Sudden Oak Disease outbreaks provide a wake up call for anybody still half asleep to the implications.

2. The importance of pasture plant species diversity

Positive effects of pasture diversity on grazing behaviour and intake

Any observant stockman should notice that cows, when given the option, will often graze old pasture species and herbs in preference to nitrogen-fuelled hybrid ryegrass. Due to its difficulty and high cost, little if any work is done on palatability testing with the actual animals new grass varieties will be consumed by. Compare and contrast this with the extensive test marketing of new food products for human consumers.

Yet careful observation of the cow at pasture shows a most discerning diner, displaying clear indications of preference which must be based on palatability since the distraction of packaging and advertising cuts no ice in the bovine marketplace. I have watched my own cows seeking out with great precision specific herbs and plants in the hedgerows with the nose of a connoisseur.

I have noticed too, individual's preferences for harvesting specific berries, fruits, leaves and buds out of the bushes at different times of the year. I have watched well-fed cows being brought in for milking deliberately stop to eat seemingly unpalatable thistles and stinging nettles at the same spot on several successive days indicating a positively selected dietary addition. This was not casual, but a deliberate behaviour pattern, with discerning organoleptic perusal the match of any cheese grader or fine wine taster.

Neither is this sloppy new age thinking. Albrecht and Andre Voisin always maintained that the cow was a genuine biochemist and gourmet rolled into one ... an idea that sounds preposterous to many, yet bears further examination.

Animal nutraceutical specialist Jerry Brunetti was one of the first people to shed light for me on some of the relevant science behind these phenomena I had observed firsthand. He had written a series of articles in AcresUSA magazine⁶, as well as given papers at the AcresUSA conferences over the years, alerting livestock farmers to the powerful medicinal properties of pasture plants that can enhance animal health and production by inclusion in the ruminant diet.

Brunetti's knowledge draws on a vast wealth of documented literature spanning botany, chemistry, biology, veterinary science, agriculture, herbalism and folklore as well as 27 years of observation, trial and experience gained formulating preparations for animal use.

2. The importance of pasture plant species diversity

Why should livestock get access to these species diverse pastures?

Since many of these phytochemicals can only be synthesised by plants, the essential fatty acids for example, the only way that livestock (and we as rumen-less humans), higher up the biotic pyramid, stand any chance of availing of many of these natural and powerfully beneficial dietary ingredients is by consuming the produce of animals that have both a diet rich in these compounds and the biological mechanism to both extract and incorporate them into a form in which we can then assimilate via our own diet.

Quality raw materials are fundamental to both the building blocks and maintenance of long life and wellbeing throughout the ecosystem. Health and expression of full genetic potential begins with the very first link in the food chain and relies on that quality being maintained and passed on down each link in the chain. This is not just about avoiding weak links, but forging stronger links right the way through the chain.

Besides visiting Jerry at his property in Pennsylvania, I met a number of farmers whose on-farm experiences concur with my own; not only are many of these natural herbs production boosters but also health remedies the equal of, and often better than the arsenal of modern synthetic prescription pharmaceuticals, in some cases acting faster, better and with less adverse side effects. To add icing to the cake they cost a fraction of the branded products, have no withdrawal periods and, given access to them, the patient is an intuitive and proficient self-medicator too!

Perhaps this is not so surprising. The ancestry of modern pharmacology can often, quite literally, be traced back to roots and other plant extracts or isolates. But as a simple paper chromatogram of plant extracts will show, they contain far more compounds beside just the active ingredient pharmaceutical companies today seek to recreate synthetically in order to patent, brand and corner a market.

It is these extra ingredients that are thought to work in conjunction with the main active ingredient to deliver synergy and better overall healing. This is because they buffer the toxicity of certain isolates, preventing harmful side effects in both the animal and the environment following use because, being natural products, nature has a mechanism to break them down into harmless by-products, unlike synthetics.

These phytochemicals can not only boost milk production and growth and provide cures for animal illnesses, but also provide prophylactic control in the prevention of animal sickness in the first place; clearly the most preferential and satisfying route to herd health.

2. The importance of pasture plant species diversity

Creating healing fields on farm

This can be achieved relatively easily by growing wide ranges of suitable plants on farm and allowing animals free access to them by, for example, incorporating them into pasture or planting them along cattle track fence lines. I saw this on a number of farms in Australia and New Zealand with comfrey, flax, alder, elder, willows, chicory, yarrow, burnet, alsike, lucerne, sweet clovers and similar adding both aesthetic appeal as well as wildlife habitat, shelter and shade advantages besides.

On several organic farms I visited down under, farmers were creating medicinal paddocks, with close to 70 types of medicinal herb available. The cure rates for sick animals when put into this grazing was, several claimed, both better, faster and cheaper than when they had relied on mainstream veterinary medication before their organic conversion.

Obviously such claims can be difficult to verify, but inspection of all these herds showed obvious and superior health and vitality within the stock, corroborated by excellent fertility and longevity. On Ron and Bev Smith's organic dairy farm in Gippsland a high number of cows had completed more than 12 lactations with every sign of plenty more fruitful years ahead. The vet had not visited for three and a half years ... and that was to put down the 13year old pet rabbit because Ron didn't have the heart to break its neck!

Clearly these were not animals denied treatment on grounds of costs but ones where the environment created on the farm by the farmer's efforts and sensitivity prevented the conditions requiring treatment in the first place. One Australian Nuffield Scholar I visited put a cash perspective onto it. Terry and Pauline Hehir converted from an output driven high input dairy system to organics. As the conversion progressed, vets bills' fell from a high of Aus\$35,000 to just \$1000pa on

the 650 cow organic/Biodynamic dairy herd. With soil and pasture remediation kicking in and soils loosening up they no longer had to: 'soil test with a hammer and bucket of water', and animal health and production improved spectacularly. For the first time in his farming career, Terry grumbled, paying tax was becoming an issue.

History is littered with examples of animals' ability to self medicate. Perhaps one of the best known and most controversial instances was the Hoxsey⁷ cancer cure herb elixir. This was based on a recipe devised by recording the herbs eaten by a horse afflicted with a cancerous tumour which dissolved when turned loose onto native pasture rangelands. Many human cancer survivors gave much of the credit for their cure to this treatment.



(left)

Plant diversity builds health, fertility, long life, beauty and profitability into Gavin Fisher's farm eco-system

2. The importance of pasture plant species diversity

Towards a scientific proof

While it is easy to dismiss such stories, and there are plenty of scientists and doctors that do, it is undeniable that different herbs and weeds contain many and varied phyto-chemical compounds within their leaves, roots, stems and seeds. While we still do not know what many of the properties of these phytochemicals are, there are also ones that that we do, and medical science has made use of them. A well-known example being salicylic acid, which is the main component of aspirin, the healing powers of which the Native Americans knew when they sourced it from willows as a cure for illnesses long before Bayer produced a commercially branded pill from a chemical isolate.

Dr James Duke's Phytochemical and Ethnobotanical Database (www.ars-grin.gov/duke) is a rather more powerful, USDA-funded analytical tool shedding light on the sheer numbers and potential benefits one can obtain from pasture and plant biodiversity encouraged on your farm. Using chicory and plantain as examples, because these are highly relished and preferentially grazed by livestock (in spite of the slight bitterness of chicory) each herb comes up with over 80 recorded phytochemical compounds and minerals, including salicylic acid, ascorbic acid, tryptophan, betacarotene, boron, calcium, linoleic and alpha-linolenic acids in significant quantities.

Science barely scratches the surface as to the full benefit payload components such as these can bring, a task hindered by prevailing reductionist scientific methods making it virtually impossible to measure the complex multi-factorial combinations that creates the synergy leading to the greatest benefits accrual and toxicity buffering.

However, in a simplistic attempt to illustrate the interactive, inter-reliant and synergistic nature of an ecosystem, take the example from above looking at a tiny fraction of the content of plantain and chicory being added to a pasture. Boron increases tryptophan. Tryptophan is an essential amino acid and higher quality protein. Tryptophan is also similar to indolacetic acid, which is a natural growth hormone for plants, so increases forage yield. What this highly simplified analysis hints at is how the inclusion of chicory and plantain creates part of a complex mechanism to increase both quantity and quality of pasture through synergy. Because tryptophan is an essential amino acid, i.e. animals can't synthesise it, but it is an important requisite to building the highest quality meat protein, its omission or shortage will preclude production of the very highest quality, top grading stock with maximum nutrient density status for the end consumer.

Ironically, for those who reach for the spray can at the sight of a weed, the nutritional density of various herbs and weeds often surpasses even the best alfalfa and ryegrass we work so hard and pay so dear to grow, quite literally blowing them into the weeds.⁸

As Dr Duke's botanical database highlights, many are surprisingly high in quality protein, have excellent digestibility/energy quotients as well as tremendous capability of mobilising and concentrating macro and micro-elements either via their deep rooting abilities or capacity to absorb from the atmosphere.

Clearly, introducing greater plant species diversity offers the prospect of broadening man's agricultural activity from a rather narrow stratum, one dimensional, spoon-feeding operation into an exciting, three dimensional process drawing from a profoundly deeper resource pool of appreciably greater variety and self-sustainability.

2. The importance of pasture plant species diversity

Home grown versus bought in stock minerals

Many good stock farmers do their best to make up mineral shortfalls expressed as an observable symptom in their animals by giving stock access to mineral tubs etc. This can be effective, but is both costly and, unless steps are taken to adjust the soil chemistry to obviate the cause of the symptom in the first place, has simply created an ongoing additional cost that will forever suck profit until the underlying cause is rectified.

Supplementation is a hit and miss affair too. Fast, simple, cheap, meaningful animal tests for deficiency are not available in the UK, though cattle hair analysis has proven of worth in Australia (see later) in building up a long term picture. Just as with the soil, feeding minerals to animals in excess can result in as many problems as a deficiency, a point to bear in mind since many manufacturers add molasses to enhance palatability and intake of their products, which often contain synthetic rather than natural origin ingredients.

Soil rectification is my preferred route. As minerals are essential in plant biochemistry to create vitamins, enzymes, essential amino acids etc you get these as an all-important bonus when you take the soil route too. Excising these important nutritional constituents out of the plant food loop inevitably leads to weaker links that can only lead to dilution of nutrient density further up the food chain.

More insight into the benefit of providing natural, home-grown nutritional ingredients versus synthetic ones came when I visited Standard Process, one of the original US whole foods supplement manufacturers, as part of my research into how to grow quality into crops through soil fertility methods. Founded in 1929 by

Dr Royal Lee, a dentist and inventor, Dr Lee was a man who believed that nutrition held the key to health, and devoted much of his life to researching and manufacturing food supplements that provided the nutritional elements missing or destroyed by the increasingly industrialised food production and processing methods employed by the multinational food giants.

One of his inventions was the Endocardiograph, the precursor of the Acoustic Cardiograph (ACG). This recorded audible and inaudible heart sounds converting them to a printed record. His discovery that patients given naturally-derived food supplements produced a smooth ACG trace versus a rather jagged trace for those on synthetic supplements was instrumental to his company purchasing land and farming its own crops as the source of highest quality raw materials for its products, which numerous healthcare professionals I spoke to considered to be some of the most effective on the market.

2. The importance of pasture plant species diversity

The market opportunity for increased nutrient density food products derived from herbal pastures

Functional foods have become one of the fastest growing sectors of the food industry, fuelled by both increasing consumer awareness of the link between diet and health and the eagerness of food manufacturers to invest because of high value-adding opportunity in static or declining traditional food and drink markets.⁹

To illustrate, consumers are gaining increasing awareness of the benefits of omega 3 fatty acids, so manufacturers and retailers highlight products high in omega 3 such as fish and olive oil. There is evidence linking grass-fed meat and milk with higher levels of omega 3 and the all important omega 3: omega 6 ratio than similar animals with limited or no access to pasture. This has led to increasing research into how to boost levels in products derived from animals with less or non-existent access to grass via dietary additives (all branded and expensive) to enable the consumer to home in on a now recognised perceived health benefit.

Yet Dr Duke's botanical database provides a key for the savvy farmer to find the richest sources of natural ingredient building blocks for a raft of health-promoting food constituents, like omega 3 and conjugated linoleic acid, in cheaply grown, perennial herbs which cattle display an intuitive ability to seek out and preferentially graze.

Indeed, so great is their desire to consume the omega 3-rich seeds of flax plants that one farmer reported his cattle not only jumped to reach the seedpods, but were not put off by the

bitter tasting outer pod, because they instinctively knew that inside was where the rich omega 3 oils resided.

Ian Mills, owner of the Ballanee Pedigree Aberdeen Angus herd in Victoria, is another outstanding Australian organic pasture-fed beef farmer. His farm and herd displayed quite exceptional multi-faceted implementation of biological farming methods and he recounted his initial supplying of a local butcher with his animals. The customer response and desire to repeat purchase every time one of his animals hit the butcher's slab was so pronounced he sent meat samples off to the lab for analysis. The results that came back showed he had achieved the holy grail of a 1:1 ratio of omega 3: omega 6 fatty acids. High diversity herbal pastures were a cornerstone of his production system.

This was not an isolated incident.

I witnessed something similar in America when joining holistic vet Will Winter, who advises the Thousand Hills Cattle Company¹⁰ on their organic 100% grass-fed beef rearing programme, on a customer sampling exercise in Kowalski's, a Stateside supermarket health food chain. I watched as shoppers not only declared it the best beef they had tasted in years, but voted with their dollars, emptying a cabinet chock-full of premium beef in just a little under three hours flat.

As Will Winter is quick to point out, typical grain-fed feedlot beef in America has an Omega 3: Omega 6 ratio of between 1:17 to 1:21. This significant imbalance is considered the root cause of inflammatory and coronary heart diseases, fuelling huge demand for anti-cholesterol statin drugs in the US.



(left) Holistic veterinarian Will Winter gets up close with 100% grass-fed beef shoppers

2. The importance of pasture plant species diversity

Practical implementation of pasture diversity

Two of the most useful farmer friendly agricultural primers on the subject were written by Englishman Newman Turner back in the 1950s. Fertility Farming and Fertility Pastures detail his experiments with herbal leys and are an excellent source of useful information and guidance. Several British seed suppliers will mix Newman Turner leys, and I have incorporated many of these herbs into my own pastures by various means that include scratching into existing pastures with tined rakes and using cattle to trample them in in preference to mechanical means. Several farmers in Australia stated that they preferred the older varieties of seed, suggesting that newer varieties are dependent on nitrogen and chemicals, bearing out similar observations that I have made on trial plots in the UK. David Clayfield, near Mount Gambier, South Australia told me he got better performance out of \$2 seeds when applied with biological stimulants than he did out of \$30 new varieties, a statement given credibility by the notable health and productivity of the 500 dairy heifers he was contract rearing on 20year old stands of lucerne.

Turner's books document many of the medicinal benefits considered earlier under the phytochemical analysis as well as high palatability of individual herbs, which include worming properties (plantain), mineral and vitamin providers (chicory), chickweed (kidney tonic +vitamin C source) cleavers (blood purifier) to include just a few. Much of this information can be further researched in the numerous herbal medical guides referenced in the book list.

As Turner realised, herbs and weeds are also a low cost source of supplying missing topsoil minerals when mown and mulched, or returned as manure after having passed through a grazing animal's digestive tract.

They can also be used as a diagnostic tool for building up a picture of farm soil mineral and microbiological status. Where an individual weed species proliferates and takes over, swamping out other plants and reducing diversity, there is often an underlying and highly specific soil condition that has enabled one plant to thrive and caused others to recede. Knowledge of what these conditions are can therefore convey useful decision making data to guide the informed and aware farmer in making the necessary tweaks to re-establish the diversity-favouring balance. However tempting it might be, recourse to the sprayer merely serves to shoot the messenger. As many have experienced to their cost, the weeds soon return; the spray hasn't altered the underlying conditions which permitted the weed to dominate in the first place, and so the next generation springs up to mock and maybe eventually mutate into an herbicide-resistant variety.

There are numerous books that explain these principles and how to control excesses without recourse to toxic chemistry. Ones I have found helpful are listed in the reference pages, although *Weeds and Why They Grow* by Jay L. McCaman is perhaps one of the easiest to use reference works. It gives the common and scientific name of each weed as well as a chart tabulating the 12 mineral excess/deficits they like best with another 11 soil conditions such as levels of humus, porosity, bacteria, drainage, hard pans etc which combine to create the conditions where a normally benign individual species required for the benefits of plant diversity takes over to excessively dominate and overrun a formerly rich, diverse sward.

The retreat of the formerly diverse sward has occurred not because the dominant weed has taken over but more as a result of the conditions or terrain changing in such a way that it has become the only species that can survive this new terrain or soil condition that has emerged from the loss of former equilibrium. Re-establish the balance and diversity should begin to re-establish.

2. The importance of pasture plant species diversity

Reading your farm

The importance of all this is that it enables you to, as Jerry Brunetti puts it: 'Read the farm better, building up a picture of what's going on'. Dr Dan Skow's version is that it helps farmers: 'See what they are looking at.'

Acquiring this observation skill is vital to becoming a better, more aware farmer and can reduce dependency on slower and expensive third party lab testing programmes. Jerry Brunetti illustrates: 'Everything is connected. If you're putting out free access minerals and you see the cows come in one day and really punish the dolomitic limestone you think, are they after the calcium or the magnesium? Well, the weeds that are growing in the pasture may give you a clue because some will indicate low calcium or high magnesium for example. Likewise, if they're eating mustard family plants, that suggests they need sulphur. You can cross check this with your soil analysis and they usually correlate. Of course, another alternative would be to put out magnesium oxide, ground limestone flour or sulphur for the cows to free choice. As with selecting herbs, they usually show a definite preference for whatever it is their metabolic processes are short of at the time.'

Global implications of pasture diversity

Like it or not, agriculture is one of the biggest producers of greenhouse gases (GHGs)¹¹. It also has the capability to act as a massive carbon sink through its effect on the carbon cycle. A study published by William Holmberg of the EPA in America indicated that building the organic content of farmlands by: just one tenth of one percent each year can offset all the carbon dioxide released into the atmosphere from burning fossil fuels. So not only is agriculture part of the problem, but if we

so turn our minds to it, we can also be a significant part of the solution.¹²

Maintaining varied green cover on soils at all times reduces moisture and carbon loss, prevents overheating and is vital to high levels of carbon sequestration and nutrient cycling, acting as a sink for GHGs. Greater plant diversity increases this ability to remove higher volumes of these gases from a state where their excesses cause harm to one where the increase of soil carbon, or humus, is beneficial to water conservation and growing higher quality nutrient dense food – a classic win win situation.¹³

The benefits of encouraging greater biodiversity can further be illustrated by the simple example of the humble dung beetle. Its ability to rapidly bury animal manure, a potent source of methane GHG, where it can be quickly rendered down by hungry soil microbes and recycled into high quality plant food is another welcome benefit in addition to those of helping control fly and parasite populations and improving soil drainage and aeration.

The most comprehensive strategy to tackle global warming logically combines not only boosting removal of excess GHGs already in circulation, but also minimisation of man-made production as well. The aim is to re-establish this dynamic equilibrium, in much the same way as Albrecht protocols target balanced base mineral saturation in the soil or James Lovelock so elegantly describes in his Gaia books.

The ability of permanent, diverse herbal leys to fertilise, remediate soil chemistry and maintain health and productivity at high levels offers great potential to reduce our dependency on alternative fossil fuel-derived fertilisers, pesticides and medicines. The improvements they bring to soil structure through aeration and soil chemistry balance improves yield, and reduces the horsepower and frequency needed to carry out cultivation, further reducing carbon emissions.

Gavin and Sharon Fisher's extraordinary farm in New Zealand was perhaps the most outstanding embodiment of what a farmer who thinks outside the box can achieve when applying these principles to a regular dairy farm. Their land was a true masterpiece of vitality and stimulation at every turn and it financially stacked up better than most: double the district average profit on half the district average acreage, with no purchased inputs for five years and yet measurably increasing levels of soil carbon or organic matter and overall biodiversity.

It was a true oasis of genuine sustainability in a farming area where the advance early warning indicators of trouble ahead caused by different protocol intensive dairy systems were beginning to express themselves in the environment. Like many ambitious Waikato farmers Gavin had considered the option to sell the farm or use it as leverage to acquire more acres in the South Island, where his dollars would have bought a much bigger farm. Bucking the trend, as always, he'd decided to stay put. 'The way we looked at it, we are making a very good living on a farm that's half the district average size. That leaves an opportunity for another family to make a good living too. Why bother to get bigger?'

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The simple carbon accounting assessment of measuring the increase or decline in organic matter was one the more advanced biological farmers I met viewed as a key performance indicator ... get this right and much else falls into place besides. Indeed, as they refined and shared their methods through local discussion groups, many found that as more of the principles were put in place and beginning to perform, synergy was created, accelerating annual organic matter increases, in some cases claiming over an inch of topsoil gained per year. A note of real optimism in a world where many modern agricultural methods have done much to hasten the pace of humus destruction and eventual desertification of land.

The jury is very much out on the overall effectiveness planting trees are as a means of carbon sequestration and valid off-setting. Since Co₂ is heavier than air it tends to accumulate in higher concentrations in the canopy of pasture rather than trees and so grass has the ability to capture greater quantities. What the net carbon gain is following the grazing cycle is the subject of debate, research and inevitably great variability. But what these individual farmers were demonstrating was that when the right environment is created, their farms were clearly acting as a measurable positive carbon sinks, evidenced by year on year net gains in increased soil carbon levels experienced, and all this as a bonus to high levels of output of exceptional quality, nutrient-dense food.

On the evidence I saw, pasture species clearly have a huge potential not only to reduce carbon footprint in agriculture, but also to boost production and health of all that consume them as well as maintain and enhance the environment. As Jerry Brunetti contends: 'Food can be medicine. Therefore the farm has the power to be healer. So where do you want to get your health from? The farm or the pharmacy?'



(left)

Gavin Fisher shows how pasture diversity builds humus and retains water even in extreme heat summer conditions

3. Increasing soil flora and fauna

The two previous sections of this report have highlighted various practical methods the farmer can employ in reinstating soil conditions that support a soil food web that teems with beneficial microbiological life and has the power to be self-sustaining.

However, in soils where species' populations and varieties of beneficial bacteria and fungi have declined to very low levels or become dormant or even extinct as a result of previous agricultural practice, it can be highly beneficial to reintroduce them. In effect this re-colonises the soil, helping to catalyse such vital processes as carbon, nitrogen and water cycling as a beneficial side effect.

There are various means of doing this, the best known of which is by applying compost. Compost can have drawbacks. In some cases, notably where there might be a potassium borderline excess for example, it can upset the soil chemistry balance further, creating trace mineral lock-ups that set in train the conditions for the debilitating cycle for poor crop and animal performance. It also requires considerable materials handling capacity.

Compost tea making is a technique whereby beneficial bacteria and fungi are extracted from small quantities of very high quality compost, and then encouraged to rapidly grow and multiply in a process that produces a super-enriched brew of these microorganisms. This liquid can then easily be applied to soil or crops via sprayers, irrigation, misters etc.

It has farmer-familiar similarities to making silage inoculant or yoghurt, for example, and in basic form, has been around since Roman times. Biodynamic farmers started using a similar process with some of their liquid preparation applications. However, it is only more recently, with the research of, notably, Dr Elaine Ingham and Soil Food Web Inc ¹⁴ resulting in techniques for measuring quality, that the doors to more consistent quality, larger scale brewing have been opened, advancing its application beyond horticulture into field scale agriculture.

Many of the more advanced pasture farmers in all the countries I visited were using compost teas. There were different approaches taken, however. Some bought sprayer-ready mixes. Others bought ready-made branded concentrate, using brewing units on farm to add volume before application. Various pioneers built on the principles, innovating and developing both their own brewing systems and gathering free local ingredients to make high quality compost from which to source the necessary bacteria and fungi as feedstock for their extracts and brews.

Ben Dowling, a crop agronomist with a degree in Applied Biology is definitely in the latter camp. He started making compost extracts as a sideline to tap his university training in a more environmentally sensitive manner, offering high quality compost extracts as an additional option to chemical sprays for his broadacre farmer clients. The results were so encouraging that a third of his income now comes from his Microfarm Pty offshoot, and as word of the effectiveness of his brews spreads among the local farming community, he believes it has potential to generate close to 100% of his revenue: 'Potato grower clients were getting 15-20% higher premium grade pack outs and getting the deep red colour back into Pontiac, even in a monoculture,' he explained. News like that spreads fast in the agricultural community.

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He's pragmatic about his extracts' capabilities: 'Sometimes you have no other option than to use a pesticide; your crop will simply be wiped out if you don't. But even in such a case, following with an extract brew can lessen the collateral damage done by the pesticide taking out beneficial organisms as well as the harmful one'. This was a view endorsed by farmers Adrian Lawrie and David Clayfield, making and selling similar preparations, who described this practice of chemical and biological techniques rather appropriately as Fusion Farming.

In essence the techniques help to build a more varied and complex network of beneficial microorganisms and hence soil food web. While balancing soil chemistry and increasing pasture diversity creates a habitat that can support greater numbers and variety of organisms that will bring benefits such as disease resistance, increased synthesis and variety of proteins, carbohydrates, enzymes, vitamins and so on, this will not happen if the microorganisms are not present. A classic chicken and egg debate does the rounds as to which comes first, but the realistic and logical answer is that you really need to attend to both factors if you want to reap the best results in the shortest time.

As mentioned, a number of the guiding principles owe a debt to biodynamic methods. Some of the farmers gave acknowledgement to this fact, routinely incorporating other biodynamic practices

such as BD preparations, Flowform water treatments and lunar cycle planting into their brewing. A usefully down-to-earth book that sheds more light on what more mainstream farmers would probably consider rather esoteric practices is *Grasp the Nettle* by New Zealand farmer Peter Proctor.

Compost extract brewing is a potential subject for a whole Nuffield report in its own right. As the photo shows, you don't need a huge amount of space or equipment to experiment and make brews. Ben's equipment was self-built, using aquaculture and sewage treatment aeration equipment and tanks. Many other brewers were using cast off milk vats and good old agricultural ingenuity. Time, a decent microscope, an open and enquiring mind plus a predisposition to share and exchange information with like-minded individuals seemed to be prime requirements behind those who achieved the best results.

Two golden rules also appeared cardinal for successful results. Firstly, you categorically must have excellent compost as feedstock for extracting microbes. Without sufficient numbers of beneficial microbes to extract it's a waste of time going into the brewing cycle. Rubbish in, rubbish out. Secondly, it's vital to massively aerate. Beneficial bacteria and fungi are aerobic; lack of sufficient oxygen will kill them, turning the brew anaerobic and possibly harmful.

The final consideration is that, to get the best results, you should be aware of, and preferably address, any major underlying soil chemistry imbalance and should be aiming to increase plant diversity in association with your overall farm improvement plan.



(left)

Ben Dowling at his Microfarm premises. High quality compost is made in outdoor bins using native bush litter, abattoir paunch, worm casts and liquid seaweed, cuttlefish and fish oils. Inside, aerated tanks multiply bacteria and fungi, producing non-toxic sprayer-ready liquid. There was no smell or flies, despite high temperatures. His garden was full of delicious, nutrient dense organic fruit & veg

3. Increasing soil flora and fauna

The need to adopt a holistic management approach

One theme that I hope has emerged in the forgoing discussions is how even basic farm management decisions made with best intentioned good faith and prevailing wisdom of the time, may result in unforeseen longer term consequences limiting future sustainability of the entity. There is clearly a need to create a management framework that considers the interrelating cause and effects of our everyday farm decision making into an overall sustainable and long term future plan.

In the same way that cheap credit deals are made to look so attractive the temptation is to ignore the inconvenient truth that debt eventually must be paid off, we are ill advised to discount the reality that we can only rob our soil of nutrients, diversity and beneficial microorganisms for so long before the symbiosis and synergy evaporate and we are left with a devalued asset that no longer generates sufficient wealth to meet even its debt repayment.

Many modern agricultural practices exponentially exhaust the soil capital balance that underpins the basic solvency necessary for wealth creation via the agency of harvesting free sunlight energy, converting it into goods with monetary value.

‘There is no one way and no one answer to any problem, and never can be. There are millions of answers and potential solutions and these have to be worked out case by case, situation by situation by people who are driven by a desire for something better. Holistic Management merely empowers people to identify and to achieve what is best for them.’ So writes Allan Savory in his book *Holistic Management: A New Framework for Decision Making*.

The person who introduced me to this powerful, highly relevant and timely book was Nuffield Scholar and sheep and combinable crops farmer John Triall, who farms in family partnership with his father and wife Martine at Tuwina, New South Wales.

Ordinarily I would have discounted a visit to his farm since his entry in the Nuffield Who's Who indicated little in common with my own farming methods and direction. However, through the biological farming network I had heard of an extremely radical change in direction that John and Martine were putting into practice on their farm on a grand scale. There was also a sophisticated and highly evolved management plan that was drawing many different threads together simultaneously.

Technically John is a highly innovative crop farmer, designing and building much of his own tillage equipment with many novel features that had other farmers pitching up at his farm by the coachload in order to study his methods that pulled in above average yields.

In spite of the industry accolades, the realisation dawned on John that his business was of questionable sustainability. This was primarily down to his farming system's heavy thirst for fossil fuel-derived inputs of machinery diesel, fertilisers and chemicals. This last item alone had regularly been adding Aus\$250,000 to his costs, and his books showed a rising trend of fertiliser and spray inputs just to maintain yields.

In the short term he didn't like the volatility of fuel prices. The longer term prognosis of post peak oil fuel cost escalation, possible supply problems and his land's declining productivity was the more ominous writing on the wall that gave him sleepless nights. A separate nightmare was the increasing frequency of drought/flood cycles escalating the risk of payback wipe-out after the lion's share

of input cash had been irretrievably buried or sprayed into the ground or burnt into hydrocarbon emissions.

With the help of the Holistic Resource Management model and advisors familiar in the techniques, John and Martine developed a unique, long term plan involving all the staff to reverse the declining fertility of their farm and create a truly sustainable organism that would continue to build fertility into future generations without heavy dependency on oil.

‘My philosophy is that eventually nothing should be brought onto the farm. It should all be self-generated by the biology,’ says John, nailing his colours firmly to the mast. As the programme develops and soil microbial activity returns the signs are highly encouraging. The chemical bill has dropped threefold to Aus\$80,000 and fertiliser costs on his sorghum crops have dropped from \$120/ha to \$35/ha and yields of 7.5t/ha have been maintained in spite of drought conditions.

One highly important contributor to this increasing fertility is the introduction of cattle to the property, in spite of the fact that many local farmers, other Nuffield scholars included, believe this to be sheer folly on this soil type. John has applied his mechanical inventiveness to developing a highly ingenious and permanent low cost fencing (\$750/km vs. usual \$3000/km) and portable water trough system sufficiently robust on this soft-soiled farm for 1000 head beef cattle herds. With the grazing cells being marked out on a 196ft grid he also retains the flexibility to tramline crops with a 40ft rig in the future

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The importance of the cattle is that they are used as self-replacing tools for rebuilding fertility, replacing the thirsty tractors and depreciating metal of yore. Almost all the pasture is regenerating naturally from the native species seed bank held within the soil, although John has drilled in some deep-rooting herbs like chicory to help in the processes of mineralization, aeration, drought resistance and soil anchorage. 'People say it looks scruffy in the transition period. Aside from the low cost, what we'll achieve through the native natural regeneration is those species best suited to local conditions and which build complexity into the soils until eventually they can support trees.

This has to evolve through succession. In the early stages you see a lot of first generation plants like burrs and other prickly plants which quickly grow on bare soil to establish cover and protect the earth from animals damaging the ground again while it heals.'

The cattle perform a vital role within the Voisin-style paddock grazing regime, trampling crop waste organic matter, seeds and manure all generated on-farm back into the ground, feeding the cycles of decay and regeneration within the soil to build better structure and fertility, cranking back into life an eco-system that runs directly off free solar power, rather than costly and finite fossil fuel supplies.

Allan Savory's book *Holistic Management* is an important 600plus page tome which covers in enormous and highly readable detail many of the principles that John and Martine have put into place on their farm. To summarize, it has helped them identify an impending problem of long term sustainability. It has enabled them to come up with a solution. They have applied this with the assumption that it could be wrong, so they have put a monitoring method in place that acts as an early warning system, enabling them to make revisions promptly, if necessary.

For John there is no doubt that adopting a Holistic Management strategy has been a turning point: 'For the first time ever in my life farming, I can see a future,' he told me. Endorsements from experienced outback Australian farmers don't come much stronger or direct than that. When I followed up a year after my visit, the enthusiasm coming down the phone was palpable. John confirmed a year end with the best profits he'd ever achieved in spite of a year that was down 65% on average annual rainfall.

This was no fluke but the result of careful planning and support which gave John the confidence to ignore the ridicule of his neighbours and step outside the safety and comfort of a more familiar style of farming that is beginning to show increasing signs of reaching both its sell-by date and its ability to deliver quality and continuity of supply.



(above)

John Triall has put his former arable farm into rehab, adopting Holistic Management techniques to regenerate soil fertility. He uses cattle, natural regeneration and deep rooting plants as tools to break its damaging addiction to oil, building an advanced, sustainable solar-powered eco-system in its place

3. Increasing soil flora and fauna

Is human health affected by food production methods?

Clearly this is an emotive and highly charged \$64,000 question that stimulates heated debate and widely differing opinion. It probably always will.

But there is no doubt, from what I have observed on my travels, that the environment created and methods used in food production contribute greatly to its potential for health-enhancing properties, as evidenced by the crops and livestock I witnessed. This was more than just visual too, being transferred to the kitchen and dining table. Eating quality, enhanced flavour and taste, as well as keeping quality and shelf life of food is similarly greater, with fruit and vegetables simply dehydrating rather than rotting, attracting insects or just plain going bad.

Where brix levels measured with a refractometer indicate true nutrient density excellence, (a shamefully below 1% occurrence in my own tests of considerable quantities of both organic and conventionally-grown fruit and veg sourced from the full range of UK food outlets) your taste buds literally shout quality and there is a strong, intuitive desire to eat your fill in the same way that Albrecht and Voisin observed animals, given free choice, seem to be able to select and preferentially graze forages that lab tests subsequently showed provided the highest nutrients density and range.

One of the strongest impressions I came away with from visiting many of the farms where biological farming methods were used in an holistic approach, was that health was not only apparent in the stock and crops. The whole environment including the wildlife and the farmers, their families and staff all buzzed with a positive energy and vitality sadly missing from too many involved in agriculture today. This energy was both balanced and contributing greatly to overall productivity.

It was noteworthy that a number of farmers I visited had sought out and adopted these methods of farming as a direct result of personal illness. Dr Marten Stapper, a senior agronomist with CSIRO, recounted the story of one farmer who, several years following his conversion to organic farming, began a programme of far infra-red saunas as part of a detoxification therapy in his illness recovery programme. The smell of 2-4D spray chemicals being sweated out of his body was a powerful reminder that toxic chemicals can get under your skin and rather too close for comfort. This subject has been explored further in James Fergusson's book *The Vitamin Murders* and for any farmer concerned about their exposure to pesticides it provides a useful background to testing the levels of specific chemicals harboured in their bodies as well how to remove them.

Today the shelves are laden with books that make the link between diet and human health and longevity, often with reference to Mediterranean and Hunza peoples who experienced above average health and longevity. Weston A Price's *Nutrition and Physical Degeneration* was one of the first and most groundbreaking books in respect to the modern diet. His work has been getting renewed interest, thanks to the efforts of the Weston Price Foundation¹⁵ in the US, a charity that aims to restore nutrient dense foods to the human diet through education, research and activism. This work is frequently used by US health food coops¹⁶, farm shops¹⁷ and raw milk bottlers¹⁸ and product makers¹⁹ as a source of consumer education in their marketing strategies.

Price was a Chicago dentist who, observing the increasing rates of dental decay and mouth overcrowding in his patients in the early 20th century, wanted to test the hypothesis that this was as a result of declining nutrient density in food brought about by the increasing industrialisation of its production and processing.

Since oral health is an important barometer of overall health there was an increased significance to this research.

What he found, via his study of certain isolated communities worldwide where processed foods were unavailable (a hard task to replicate these days), was highly diverse and often complex diets deeply ingrained in the culture that were exceptionally high in mineral density and which bestowed well above average health, fitness and longevity on its consumers. It was also significant that he found excellent dental formation and oral health in spite of the total absence of dentists let alone toothbrushes!

He also observed that when these same traditional diets were replaced by a modernised, processed Western diet, health and longevity declined rapidly. The next generation of once rudely healthy populations were beset with dental and general health problems, a fact vividly illustrated by the numerous photographs in his book.

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What is especially poignant about Price's findings is that they compellingly challenge many of the currently-held viewpoints and politically correct diets western society has adopted (low fat, low cholesterol, non dairy and wheat, soya alternatives etc). The Foundation's ongoing research and publications draw on the crucial importance of drawing distinction between the sometimes harmful, mutant versions that lurk within a generically-labelled group of food such as fats²⁰ (trans fat, hydrogenated, polyunsaturated etc) or milks(raw, pasteurised, grass-fed, breast vs formula vs soya, skimmed, homogenised etc), for example, and the provenance of the foods. It was interesting to note that Dr Price and Dr Royal Lee, the dentist and founder of Standard Process mentioned earlier were colleagues.

Sally Fallon, founder of the Weston Price Foundation, further explores the importance of preparation of many of these foods in her book *Nourishing Traditions*. This large volume draws heavily on Price's pioneering research, covering in specific and exhaustive detail which foods to eat and which to avoid, as well as the importance and science behind why correct preparation is necessary to derive maximum nutritional benefits. Such factors were clearly understood and handed down from generation to generation as an intrinsic part of the culture of all of the communities Price visited, in spite of their isolation and lack of what we might call proper education.

A good instance of this is the soaking and/or sprouting of grain which is important for neutralisation of the seed-protecting enzyme inhibitors which upset both animal and human digestion, producing rumen acidosis and wheat allergens, for example. Conversely, it highlights how processing using heat, pressure, irradiation, sterilisation, chemical reduction etc often destroys or diminishes the original nutrient content while natural processes like fermentation can preserve and even enhance the nutrition.

Dr Arden Andersen is a man in no doubt about the critical relevance of nutrient dense food to human health. Brought up on a Michigan dairy farm, he majored in Ag science and advises worldwide as a farm consultant, as well as publishing several books and study courses for farmers to whom growing nutrient dense food is paramount. His credentials for this were impeccable, including time spent in post-grad study with both Dr Dan Skow and Dr Phil Callahan. The latter an entomologist who's ground breaking work and books into paramagnetism, rock dusts and how insect pests avoid healthy crops but are drawn only to sick crops is essential reading for broadminded farmers searching for an understanding into the science of why biological farming methods have the power to deliver better quality and sustainability right the way through the food chain.

Dr Andersen later enrolled in medical school, graduating to practice medicine as a bonafide GP in a civilian family practice as well as a flight surgeon in the USAF, while still maintaining his links to the agricultural community. During the course of my Nuffield travels and studies I visited Dr Andersen at his surgery in Goshen, Indiana as well as heard him speak at three Acres USA conferences and attended one of his three-day soil management courses while in New Zealand.

Having spoken to both his medical and farming clients, besides applying techniques I have learned from him on my own farm, it is clear that many of his methods, while not mainstream, clearly work, and often with spectacular success where others have failed.

It is also clear that his application of holistic health management in both soil and human health disciplines draws on many overlapping principles of analysis and remediation via balancing of mineral excess or deficit. Thus the correction of a soil by the application of a specific mineral to react out another in excess can be mirrored by a similar process in which

intravenous nutritional therapies achieve similar ends in the human.

Further confirmation that many of the same principles are at work came when I visited Brett Lambert, chief chemist at SAFE (Sustainable Agriculture & Food Enterprises) Analytical Labs in Burleigh Heads on the Sunshine Coast in Australia. Brett had originally worked for Syngenta, looking into developing an alternative to the soil test for the huge outback cattle stations where sheer size of the properties made soil sampling, let alone the cost of remediation, a financial and practical non-starter.

Having experimented with animal blood sampling and liver biopsies, the perfection of a method of digesting hair to release embodied trace minerals that could be measured by a Inductively Coupled Plasma Mass Spectrometry (ICP-MS)²² machine to parts per trillion was the breakthrough required.

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The way hair grows reflects the biochemical and environmental history of the person or animal on which it grows. Its analysis is a method for the determination of longer term nutritional status as the levels do not vary significantly from day to day, thus long-term patterns are represented. Information giving a record of 40 mineral levels from which dangerous excesses or deficits can be deduced via a non-invasive, quick and painless low cost snip of hair from the nape of the neck adds another important diagnostic tool that has yielded some spectacular results for not just animals but humans as well.

‘The testing is done at arm’s length because we provide a service for doctors and health consultants who send in their patients’ hair samples. I do a number of different tests for the same minerals as a cross reference in order to try to produce the full picture. The capital as well as the cash flow, if you like. However I always check all the results for anomalies personally because, although we ask clients to disclose all shampoos and hair treatments used, they sometimes forget. Because the tests are so sensitive we’ll pick this up,’ explained Brett. ‘One client’s results came in and I had to contact her immediately because her levels of thallium were so high (5parts per billion!) I thought somebody might have been trying to poison her. She laughed and said that somebody had tried to poison her 30 years earlier with rat poison(thallium-based), and she had been in a wheelchair with MS ever since. The upshot was that we worked out a chelating therapy to remove the thallium and for the first time in 30years she is beginning to get movement back into her limbs.’

Neither was this an isolated story. Brett had been working with doctors specialising in child autism with some remarkable success stories. Dr Arden Andersen too has been getting similarly good results with autistic children in the US, showing that autism is a condition that it is possible to reverse with appropriate treatment. Hair analysis can be used as an early indicator of whether treatments are

working too. ‘We can show if the medication therapy worked out is appropriate, because we can check that the treatment is removing the excess toxic mineral(s) because the analysis is so sensitive,’ Brett points out. It’s surprising what other information is shown up by this powerful tool. ‘Patients are often surprised when we know that they have a replacement hip or a shoulder plate ... we can tell which by the levels of titanium and tungsten that show up, as hips need the stronger tungsten/titanium alloy,’ adds Brett.

Another interesting point made was the significance of minerals ratios. Both Albrecht and Reams stressed the importance of mineral ratio balance in the soil. Likewise, mineral ratio balance in the body is similarly important, as the individual mineral levels reflect the critical balance that must be constantly maintained between the minerals in the body. ‘We see asthma occurring where iron and chromium levels are low and silicone is high. We think there’s a possible relationship between selenium and silicone too,’ Brett told me. He didn’t know I’m slightly asthmatic myself, but when my own hair results (see appendix) came back, it clearly showed low iron and chromium levels.

Jerry Brunetti is also a subscriber, as well as living proof, of the idea that similar principles of holistic treatment that he uses very successfully on his animal patients have their place in human health. He firmly believes in the Hippocratic principle that health, or lack of it begins in the gut, and therefore what you eat has direct impact on this principle.

He very much put this to the test in person when he was diagnosed with a non-Hodgkins lymphoma in 2000 and given the gloomy prognosis of sixth months to two years to live if he didn’t resort to chemo and surgery.

Instead, he elected to go down an alternative route of non-toxic and non-surgical nutritional and detoxification therapies, using both his own knowledge and research, as well as the extra guidance and support of similarly predisposed holistic medicine GPs²³. Seven years on, he is clear of cancer and in addition to continuing to provide both education and high quality nutraceutical products for farm animals, also teaches highly detailed courses on the subject of how you can use the right types of food as both preventative and curative medicine²⁴.

3. Increasing soil flora and fauna

Food is not a panacea for the ills of the world, and it would be irresponsible to suggest that it was. Yet hardly a week goes by without some new superfood being unleashed on an unsuspecting public with extravagant claims as a cure-all for the ailment of the day.

What is clear is that a varied diet with high nutrient density is a vital if not indeed the main component to robust, good health and development. But other factors also contribute to health, and in particular to recovery and healing from illness or accident. Dr Thomas Cowan, a holistic doctor and Weston Price Foundation board member, explores this theme further in his excellent book *The Fourfold Path to Healing*. While he found in his own practice that many patients respond well to nutrition alone, the combination of nutrition with therapeutics, movement and meditation brought synergy to the process effecting faster cures, particularly the difficult cases where patients' anxiety, stress, lack of fitness or lifestyle could override a cure effected by nutrition alone in others. Indeed, there is a huge amount of evidence, both scientific and anecdotal that stress has a major effect in slowing down recovery rates in both humans and animals.

I personally believe that the corollary of all this evidence is that as farmers we not only have a moral duty to farm in a manner that respects the laws of Nature but that we have nothing to lose and everything to gain by doing so. As Goethe wrote in a letter to his friend Eckerman²⁵: 'Nature has no sense of unfair play. She is ever true, ever serious and the errors and misconceptions are always man's'.

Conclusions

- Declining soil fertility as a result of industrialisation of agriculture is leading to measurable reductions of nutrient density in food, impacting negatively on health and disease levels in plants, animals and mankind.
- Many current agricultural and medical practices place a surprisingly similar over-reliance on chemicals/drugs and invasive cultivation/surgery that suppress, excise and cover up symptoms, often with significant collateral damage, rather than achieve a lasting cure of the root cause of the problem. Indeed, there is considerable evidence to suggest that overuse of antibiotics in medicine and agriculture has lead to increasing pathogen resistance such as MRSA.²⁶
- Increasing specialisation in disciplines has led to huge and impressive knowledge gains. However the application of this increased knowledge in a holistic manner seems to be increasingly rare as we veer into information overload yet expect and demand a single, simplistic magic bullet instantaneous solution to every problem.
- The goal of maximising profit via application of a mechanical, reductionist philosophy undoubtedly works for manufacturers of inanimate products and machinery. Its extension to the complexities of living organisms and food production is overly simplistic and flawed. While it may deliver short term efficiency of production gain, it is an ultimately detrimental long term practice, as the early warning signs begin to show ... if we dare to look hard enough about us and can recognise the symptoms.
- Many of the short term routes endorsed by reductionist science that we pursue to maximise profit in agriculture are unsustainable. Within just one century we have swapped a system of sustainable agriculture fuelled by sunlight, photosynthesis and animal power to one that has become dangerously addicted to fossilised sunlight in the form of oil. While we may congratulate ourselves on the ingenuity and cleverness of this achievement, the dawning that oil supplies might be finite is a crude awakening that perhaps we are not so smart after all.
- All is not lost, however. We already possess much of the knowledge required to farm in a sustainable manner. We also have the skill to explore the science behind this and make improvements in a holistic manner. Most of what is lacking is simply the courage needed to overcome the fear of making change and the possibility of a mistake or two along the way.

Recommendations

- **Widen your options.** Farmers need to recognize that just because an option to farm in a way that is better for their own family, livestock and crops, consumers and bottom line health is not offered on a plate doesn't mean that it doesn't exist. Indeed, if it were they should probably be suspicious of vested interest! Think outside the box and take an active role in seeking a better way to farm that encompasses social responsibility in addition to profit. Often the two can be mutually beneficial, actually delivering the often stated goal of maximising profit
- **Get a relevant education.** Few, if any of the methods used by farmers in this report are available on agricultural college syllabuses. Likewise nutrition is given very cursory attention in medical school, an irony given that doctors used to swear the Hippocratic Oath yet their education largely overlooks Hippocrates' famous encouragement to: 'Let food be your medicine and medicine be your food.'
- **Communicate and Network.** Within and especially outside agriculture. Nowadays there is little communication between the medical and agricultural professions in pursuit of the common goal of the nation's health. A particular irony since the Nuffield Foundation clearly recognised the link when the agricultural scholarships section was added.
- **Get started.** Many farmers have the skills, knowledge and intelligence to pioneer many of these ideas already. They shouldn't wait for a grant or government that may never come. The best advice I ever had once I knew the basic principles of grazing was from a Kiwi: 'Just get on and do it!' The same applies here.
- **Get in Touch with your senses.** Make use of all your senses, including your sixth one as part of your feedback monitoring loop to check that your decision-making is on track.
- **Think and act holistically.** By adopting a holistic management plan you stand a better chance of defining a sustainable, profitable future that suits your individual needs and circumstances.
- **Have fun doing it.** No more explanation needed ... it's not all hair shirts!

Postscript

There can be few Nuffield Scholars that do not make changes to the way they farm as a result of their travels and experiences. I am no exception. While I am no pioneer, I do like to be an early adopter once I have understood the basic principles and seen them in action on the pioneering farmers' farms.

The easiest, most straightforward part of my plan to change farming methods was overseeding herbs into my pastures. I followed a combination of Newman Turner guidelines coupled with methods I'd learnt myself as well as what other farmers I'd visited had used to good effect and were suitably simple and low cost. Almost a third of the farm was given this treatment in August 2006 with good results in terms of seed take although it is too soon to make observations about grazing behaviour, depth of root penetration, drought survival, increase in microbial activity etc.

I have taken an increased number of soil samples and, after a lengthy search, have now acquired a decent second hand land-drive belt spreader and found sources of high quality supplies to make up and apply remedial fertiliser mixes based on Albrecht soil recommendations.

Before my travels I thought compost teas a little too leftfield. Having seen the brewing, application and effects, including very high brix fruit and veg it produces and studied the process in more detail I'm about to 'just get on and do it' because I now better understand how it will fit into and catalyse and synergise my overall programme of growing nutrient dense food. I also have a number of new friends worldwide who are generous enough to share their knowledge and expertise. As I write, I've received the final components from Sabino Cortez of Erath Earth in Hico, Texas necessary to put together my hydrocyclone-based brewer adapted out of surplus stainless steel tanks from our cheese dairy. Then

begins the steep learning curve experimenting with the compost I have made from biology sourced on the farm.

While I have been acquiring all this extra knowledge and apparatus I began what Dr Arden Andersen calls 'remineralising the manure' as part of the early remedial plan. The cattle have free access minerals and seaweed meal and we pay great attention to which minerals they access, when and how much they eat. It is surprising how much this varies and how this can express in the colour and whorls of the animal's coat, an important indicator of endocrine system function and overall health.

As we gather this information we are slowly building up a picture of information, slowly learning to read the farm better. What is interesting about this is that it has already started to what Jerry Brunetti calls: 'Build the terrain' for increasing beneficial biodiversity. Dung beetles have appeared from nowhere to break down and bury dung with remarkable speed, aerating soil, reducing methane and nitrogen gassing. Earthworm populations are rising too, to perform similar duties, so enhancing soil nutrient status. Bird species are increasing in number and variety and we have an increasing raptor population that suggests rising small mammal numbers. In short, I believe the farm is slowly starting to crank and that just as I weaned my cows off cake, I've begun the process of weaning the farm off oil.

Finally, there also seems to be increasing interest in what I'm up to. I write an occasional column in the Mole Valley Newsletter and I get increasing correspondence and calls requesting more information from farmers. A number of our cheese customers are beginning to want to hear more of the story too.

Footnotes, websites and useful publications

1 Dr Arden Andersen Soil Management Course Feb 2006 NZ.

2 See www.cropscience.org.au/icsc2004/plenary/2/140_hatfield.htm

3 See www.acresusa.com/toolbox/reprints/Educating%20Rida_Purdey03.pdf

4 **Cranfield Report:** Bellamy P.H., Loveland P.J., Bradley R.I., Lark R. M. & Kirk G.J.D (2005) Carbon losses from all soils across England and Wales 1978-2003. *Nature*, 437, 245-248.

5 **The Atlas of Food** by Erik Millstone and Tim Lang. Earthscan Books

6 The Benefits of Biodiverse Forage www.acresusa.com/toolbox/reprints/Oct03_Forage.pdf

7 **Hoxsey: When Healing Becomes a Crime** by Kenny Ausubel.

8 Fully detailed in J Brunetti **The Keys to Herd Health** DVD accompanying booklet

9 **The Atlas of Food** by Erik Millstone and Tim Lang. Earthscan Books

10 Thousand Hills Cattle Co was set up when CEO Todd Churchill read Michael Pollan's article **This Steer's Life** in The New York Times. Read at www.nehbc.org/pollan1.html or www.thousandhillscattleco.com

11 **The Atlas of Food** by Erik Millstone and Tim Lang. Earthscan Books

12 See **Grass the Forgiveness of Nature** by Charles Walters

13 Dr Christine Jones: **Recognise Relate Innovate** at www.amazingcarbon.com and see also www.envirofarming.blogspot.com/2006_02_01_archive.html

14 Soil Food Web Inc www.soilfoodweb.com

15 See www.westonaprice.org

16 See www.wedge.coop and www.willystreet.coop

17 See www.midvalleyvu.com

18 See www.organicpastures.com

19 See www.greenpasture.org

20 See Dr Mary Enig: **Know your Fats** and Ron Schmid: **Untold Story of Milk**. New Traditions Publishing

21 See www.safe.com.au

22 See www.missouri.edu/~umcreactorweb/pages/ac_icpms1.shtml for more info on ICP-MS

23 See contained in Acres USA reprint at www.acresusa.com/toolbox/reprints/interview-brunetti_may02.pdf and www.agri-dynamics.com

24 See DVD **Cancer, Nutrition & Healing** by Jerry Brunetti

25 Article in Journal of Nat.Science: Microwaves on Life April/June 1998 read in Pat Coleby's library

26 See **The Lost Language of Plants** by Stephen Harrod Buhner. Chelsea Green Publishing

25 Topic covered in books **Man Must Measure** by Jan Bonsma and **Reproduction and Animal Health** by Gearld Fry and Charles Walters

Additional Reading

- **Eco-Farm – An Acres USA Primer. Grass the Forgiveness of Nature. Weeds Control without Poison. Unforgiven,** *all by Charles Walters*
- **Soil Fertility & Animal Health and The Albrecht Papers** *both by William A. Albrecht*
- **Silent Spring** *by Rachael Carson*
- **Soil, Grass and Cancer** *by Andre Voisin*
- **Farming and Gardening for Health or Disease and An Agricultural Testament** *by Sir Albert Howard*
- **The Biological Farmer** *by Gary Zimmer*
- **Politically Incorrect Nutrition** *by Michael Barbee.* Vital Health Publishing
- **Real Medicine Real Health and Science in Agriculture** *by Dr Arden Andersen*
- **Paramagnetism and Tuning in to Nature** *by Phillip S. Callahan*
- **Nutrition Rules!** *by Graeme Sait*
- **One Straw Revolution** *by Masanobu Fukuoka*
- **Soil Minerals – The Key to Farming Wealth and Your Own Health** *by Brown Trotter*
- **Folk Medicine** *by D C Jarvis*
- **We Want Real Food** *by Graham Harvey*
- **Sea Energy Agriculture** *by Maynard Murray, MD*
- **The Keys to Herd Health and Holistic Veterinary Care DVDs** *by Jerry Brunetti*
- **Lessons in Nature** *by Malcolm Beck*
- **Compost Tea Brewing Manual 5th edition** *by Dr Elaine Ingham*
- **Teaming with Microbes** *by Jeff Lowenfels & Wayne Lewis.* Timber Press
- **Killer Foods** *by Dr Michael W Fox*

Most of these books are available through AcresUSA online bookshop at www.acresusa.com

Good condition out-of-print titles can often be sourced second hand through Abe books website at www.abebooks.com

Appendix

Kinsey Agricultural Services, Inc.										PLOT ID: E3B6H			
297 County Highway 357 - Charleston, MO 63804 Phone 573-693-3990 Fax 573-693-6227 e-mail ben@kinseyag.com													
Client PENGREEP FARM LTD / BEN MEAD										City : TRURO, CORNWALL, ENGLAND Date : #####			
Location		PENGREEP				Previous Analyses & Applications							
Crop		PRENNIAL RYEGRASS / PRENNIAL R											
Field / Sample		N HARRIS / NH1											
Lab No.		C0013											
Total Exchange Capacity (M.E.)		16.24											
Desired Ca : Mg Ratio		68 : 12											
pH of Soil Sample		6.1											
Humus Content, Percent		4.9											
BASE SATURATION PERCENT						%		%		%			
Calcium (60 to 70%)		54.70											
Magnesium (10 to 20%)		20.37											
Potassium (2 to 5%)		3.69											
Sodium (.5 to 3%)		2.56											
Other Bases (Variable)		5.18											
EXCHANGEABLE HYDROGEN (10 to 15)		13.50											
		RECOMMENDATIONS											
		Amendment				kg/ha		kg/ha		kg/ha			
NITROGEN		ENR Value		111	CAN (17% N) (a)		280						
					AMSULF 21-0-0-24 (b)		673						
SULFATE - S		Value Found		22	SULFUR 90-92% (c)		73						
PHOSPHATES		Desired Value		560	MAP 11-52-0		280						
		Olsen Value		500									
		Value Found		-60									
		Deficit/Surplus											
CALCIUM		Desired Value		4951	CALCIUM CARB (d)		3363	Amend		added			
		Value Found		3982									
		Deficit/Surplus		-969									
MAGNESIUM		Desired Value		525									
		Value Found		890									
		Deficit/Surplus		+365									
POTASSIUM		Desired Value		710	POT SULFATE 0-0-50		224	[OPTIONAL]					
		Value Found		523									
		Deficit/Surplus		-187									
SODIUM		Desired Value		84	VERY HIGH								
		Value Found		214									
		Deficit/Surplus		+130									
								P.P.M					
Boron		p.p.m.		1.27	BORON 14.3%		11						
Iron		p.p.m.		54	FE SULFATE 21% (e) (f)		448						
Manganese		p.p.m.		139	NONE								
Copper		p.p.m.		2.10									
Zinc		p.p.m.		12.80									
Molybdenum		p.p.m.		2.56	NONE								
Cobalt		p.p.m.		0.86	COBALT SULF 21%		560gm						
<p>(a) Apply for early growth.</p> <p>(b) Apply half with CAN and half in late July.</p> <p>(c) Sulfur applications including sulfate form of 98 kg/ha or more need to be applied at least 6 months prior to next soil sampling.</p> <p>(d) Apply Limestone at this rate only if no lime has been added in the last three years or gypsum in the last one year. If so we need to revise rates accordingly.</p> <p>(e) Ferrous Sulfate - should only use the white or blue-green in color. Black or rust colored is never recommended. CAUTION: Apply so as to avoid getting the dust from the material on the leaves of actively growing plants.</p> <p>(f) Only apply at this rate if yellowing or stunting is evident now or in past crops. otherwise use on a smallest plot to establish need or test subsoil for iron levels.</p> <p>(g) WARNING: Do Not apply recommended Ferrous Sulfate until particles from lime application can no longer be found on surface.</p>													
A service of Kinsey's Agricultural Services : Checked by NK										0600142_46190			
BROADCAST AND BROADCAST UNLESS OTHERWISE SPECIFIED													

Appendix



SAFE Analytical Laboratories

P.O.Box 2060, Burleigh Junction. Qld. 4220

Ph: 61 7 55220404 Fax: 61 7 55220505

First Name	Last Name	Address				
Ben	Mead	Pengreep Ponsanooth Truro				
City	State	Postal Code	Country	Gender	Ethnic Origin	Age
Cornwall, UK		TR37JH	United Kingdom	Male	British	47
Home Phone	Mobile Phone	Fax Number	Practitioner / Consultant			
0044 1209861114						

Patient Sample Details

Test No 7182

Date of Test 27/02/2006

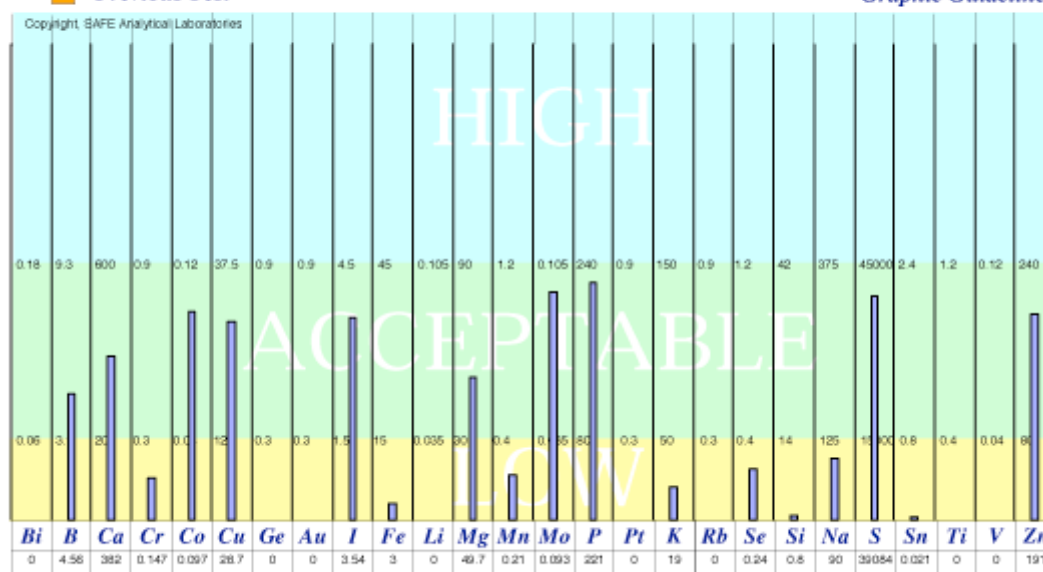
Sample Type Hair

- ☒ Current Test
☐ Previous Test

S. Weight	Location	Hair Condition	Occupation	Pregnant
0.2439 Gram	Nape		Farmer	
Medication		Shampoo	Conditioner	
Nil				
General Health	Colour Agent	Colour	ColourDate	Hair Spray
Good				

Nutrient / Other Element

Graphic Guideline

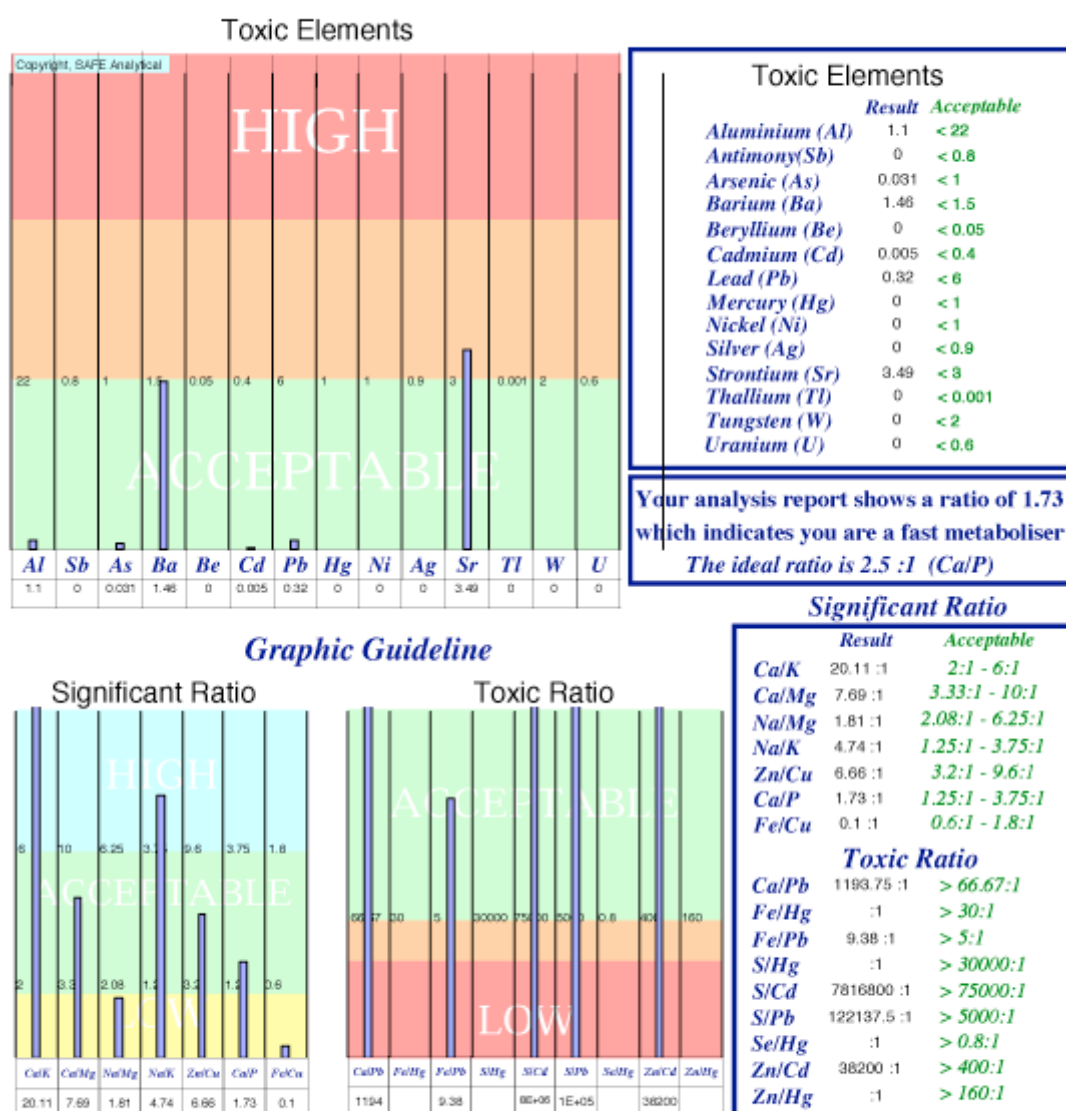


	Result	Acceptable		Result	Acceptable		Result	Acceptable
Bismuth (Bi)	0	0.06 - 0.18	Iron (Fe)	3	15 - 45	Selenium (Se)	0.24	0.4 - 1.2
Boron (B)	4.56	3.1 - 9.8	Lithium (Li)	0	0.035 - 0.105	Silicon (Si)	0.8	14 - 42
Calcium (Ca)	382	200 - 600	Magnesium (Mg)	49.7	30 - 90	Sodium (Na)	90	125 - 375
Chromium (Cr)	0.147	0.3 - 0.9	Manganese (Mn)	0.21	0.4 - 1.2	Sulphur (S)	39084	15000 - 45000
Cobalt (Co)	0.097	0.04 - 0.12	Molybdenum (Mo)	0.093	0.035 - 0.105	Tin (Sn)	0.021	0.8 - 2.4
Copper (Cu)	28.7	12.5 - 37.5	Phosphorus (P)	221	80 - 240	Titanium (Ti)	0	0.4 - 1.2
Germanium (Ge)	0	0.3 - 0.9	Platinum (Pt)	0	0.3 - 0.9	Vanadium (V)	0	0.04 - 0.12
Gold (Au)	0	0.3 - 0.9	Potassium (K)	19	50 - 150	Zinc (Zn)	191	80 - 240
Iodine (I)	3.54	1.5 - 4.5	Rubidium (Rb)	0	0.3 - 0.9			

Note

External contamination including hair colouring, shampoos and hair treatments can result in elevated readings in certain elements.

Appendix



Levels

All Mineral levels are reported in parts per million (ppm)

Nutrient Elements

Are considered essential for many biological functions of the human body such as reproduction, skeletal veracity, muscular movement, endocrine function and overall development and metabolic processes.

Toxic Elements

Are found commonly in our environment and to some degree in our bodies. These toxic minerals or 'heavy metals' can be detrimental to our general health and well being. Toxic excess is accumulated and interferes with the body's biochemical function.

Ratios

To calculate a ratio value, the value of two minerals is compared by dividing the mineral level of one level with the mineral level of the other.

Significant Ratio

If certain minerals in the body are disturbed, normal biological functions and metabolic activity can be negatively affected. Even at very low levels, the interactions between minerals still exist and can ultimately affect metabolism.

Toxic Ratios

People with raised toxic levels may not always produce symptoms that are associated with a particular heavy metal. Toxic minerals can also cause disturbances in various essential minerals leading to their improper metabolic function.

Acceptable Range

This reference range should be viewed as a general guideline for healthy individuals.

The views expressed in this report are entirely my own and do not necessarily represent the views of the Nuffield Farming Scholarships Trust, nor of my study sponsor or any other sponsoring body.

Ben Mead N.Sch

Pengreep
Ponsanooth
Truro
Cornwall
TR3 7JH

Tel 01209 861114

Fax 01872 870789

Mob 07974 931242

Email bmead@lynherdairies.co.uk