The biology revolution

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Contents

Background

To be healthy we need to eat a wide range of minerals and complex organic molecules. Our bodies seem able to sense the lack of these essential trace elements and compounds so it sends signals for us to eat more, even if what we are eating is unhealthy food dominated by sugars and fats and does not contain these essential ingredients.

The simplest way of solving this is to eat fruit and vegetables which are grown in soil with the required minerals and allowed to mature so the plants can produced these complex molecules (phytochemicals). By far the cheapest, easiest and most reliable way it to grow some of the fruit and vegetables you eat. It is easy to add the required mineral to the soil but it requires a complex chain of soil biology to make the mineral available to the plants and hence us.

This article shows why and how to create a balanced soil ecology particularly in a small wicking box which may be used in an apartment without access to a garden, although the same principles can be applied on a large scale to those lucky enough to have the space.

Moisture and air in the soil are critical for a healthy soil biology and wicking beds are an effective way of maintaining this moisture - air balance but the approach described here can be used in any soil as long as the moisture - air balance is maintained.

Soil biology is incredibly complex and reductionist science is continuing to help us better understand the simply incredible varieties of creatures which live in a healthy soil, but there is a long way to go before we have even identified and classified the vast number of creatures. Even at some distant time in the future when we understand all these creatures we have only just began because what really matters is how these creatures interact together working as a system.

In reality we do not need to understand every species, what really matters is how the system works overall; this has led to shift in scientific approach focusing on the system as a working entity. Much of this article is about the systems approach, some consider this a new type of science, but it could be a very old debate, the Greeks were the great reductionist thinkers laying the foundations for our modern science, by contrast the Romans were amazing civil engineers using the system approach to create great buildings, aqueducts and roads.

The Greek certainly had the theoretical concept of strength of materials expressing the strength of a material by the length it could support. I doubt if there is even a word in Latin for tensile strength but it was the Romans that built the great aqueducts.

Soil biology and the nature of technical revolutions

We are in the midst of a revolution, the soil biology revolution. While revolutions can change society it is easy to miss the coming changes.

When the technology to produce cars cheaply was developed who would have imaged that this would change the entire layout of our cities by creating the car dominated suburbs.

I was swept up by the computer revolution, totally changing my direction to start a company writing computer aided engineering software which literally changed an industry. It is now virtually impossible to buy any modern product which has not been prototyped, tested and refined on a computer.

The advent of the personal computer should have been another revolution but it was only the creation of the internet that really changed society. I will focus on one particular bit of the internet revolution - Google Alerts.

When I left Uni I worked for a period in a cooperative research association. One of their strengths was their comprehensive library so you could refer to virtually any publication in the field. Later in my life, when I left academia to set up my own high tech company one of the immediate problems was how to keep abreast of the rapidly changing technology. Technology never lives in isolation but evolves from the work people are doing all around the world. My only solution then involved virtually living on a 747 with trips lasting up to six months twice a year.

Now I can live on my rural eco village in Queensland and set up Google Alerts to read the latest publications in any area I please, I currently have some seven Google Alerts running and if I find a particularly interesting book I can download this onto my Kindle and start to read it before breakfast, probably within hours of its publication. I may spend several hours a day on the net studying the latest information but without this access to technology there is simply no way I could do what I currently am doing.

This is indeed a revolution.

Of course the net is not only a source of valuable information it is full of miss-information, how do I sort out the real from the crap? Why does not someone invent a little smiley face - red and grinning to say this is a lie and green - or glum and serious to say this is for real.

The soil biology revolution

Now let's turn to the soil biology revolution and start with my personal experiences. From what I understand farming and cropping before the war was a pretty traditional operation, but I was not there to see it. But I was born and Hitler declared war and proceeded to try and starve Britain into submission.

I was too young to have real memories but I do have some mental images which have survived. I still have a clear image of the blitz, I had no idea what was going on but my stored image was how beautiful it was. The sky was lit up with search lights, flashes of light and noise. I have a clear image of being picked up and rushed down the garden to the air-raid shelter. May be so clear because I dropped my teddy and they refused to go back and pick it up. Add that to your list of war crimes Hitler.

One of the major achievements of the British Government was helping fend off the food blockade by getting the population to take up growing their own food. I have clear images of all the sacks of potatoes which were stored in every conceivable place, under the stairs, kitchen sink, anywhere and everywhere together with the ubiquitous jars of pickled cabbage.

The benefits of natural fertilisation was well understood which led to the joke with two small boys following the milk float to collect the horse dung. One boy asked what they were going to do with it all and was told they put it on the rhubarb; he replied that in their house they put custard on their rhubarb.

But after the war we entered an era of clinical growing. I can certainly remember my parents putting tins of soil into the oven to sterilise. It was the era of the first selective herbicide which caused great excitement and the almost worshiping of modern science and sanitised food production.

One of the practices of this clinically clean era was to use simply horrific chemicals like methyl bromide to kill of all the soil biology, good and bad, - then inject the soil with just the beneficial microbes. What arrogance to believe that they had the understanding to artificially control such a complex issue as soil biology.

The green revolution

This was followed by the green revolution, a combination of improved fertilisers, plant genetics and irrigation. One of the objectives was eliminating the wide spread starvation in under developed countries. Now we understand that the benefits were mixed with the rich farmers, who could afford and had access to the new technologies, benefiting greatly while the already poor peasant farmers got drastically poorer – the hazards of good intentions.

Years later when I went to Africa with the brief to find ways that poor people could grow sustenance food during droughts (which led to the wicking bed) I was ashamed that one cause of the poverty was simply that much of the best land had been taken up by rich Western companies to grow crop like Coffee and the cocoa bean – and I

love chocolate. No doubt the love of free trade agreement in the West has the best of intentions but the benefits don't automatically flow to the poor.

But the advances in agricultural production have not been a total benefit for people in the rich west. We have the highest production of food of all times accompanied by wastage on an unprecedented scale. But we have sacrificed quality for quantity, it has been reported that if we were forced to live on war time rations that we simply would not survive because of the lack of nutrients.

The increase in serious health problems arising from an unbalanced diet have led to widespread health problems such as obesity, diabetes and increase risk of heart attack.

We are of course fighting the massive might of the food processing and distribution corporations, but a direct fight against such market power has little chance of success, the answer is to enable people, even people who have never gardened, to grow at least some of their own nutrient rich food

The systems approach

When Bill Mollison first introduced permaculture I was sold, the arguments of the benefits of a balanced eco system over a chemical based monoculture where overwhelming. I did in fact try a period as a permaculture hippie, but I quickly learned that total self-sufficiency involves excessive amounts of hard work and does not automatically lead to a better diet, just more sacks of potatoes and pickled cabbage.

I decided that poverty may be philosophically and morally great, as long as it is someone else in poverty. I could put on my resume,

Social drop out – failed

(But that failure did lead to the creation of one of Australia's leading exporters of high tech software).

But when I plough through my Google alerts on diet and health I come to the view that it is not necessary to give up all the good things in life to remain healthy, remember the adage giving up wine women and song does not actually make you live longer, it just makes it **seem** longer.

Bill Mollison's permaculture may not be the most practical system but many of his ideas, such as integrated pest control, have been incorporated into modern farming but the concept of looking at how the system worked as a whole was a major advance in our thinking process.

Later Peter Andrews would apply the same philosophy to his natural sequence farming and of course Allan Savory with his holistic management is based on the same theme. Caroline Jones must also be included in this list, together with hundreds of practical farmers and growers who have looked holistically at the challenge of growing healthy food.

I really could not pass this point without mentioning one of my favourite books on the subject Farmers of Forty Centuries (available on the web from Guttenberg press

which is a fabulous source of odd ball information.) This was written in 1910 by a team of leading agricultural scientists from the US who surveyed agricultural methods in China, Japan and Korea. For four thousand years they had a totally sustainable agricultural system based on recycling and conservation, even recycling people. (I hope when I die that they bury me in my wicking bed so I become part of a balanced soil biology eco system.)

The tragedy is that China in particular has adopted the worst of Western practices loading their soils with chemical fertilisers resulting in some of the hardest and most compacted soils I have come across. Amazing that modern soil scientists can write off four thousand years of a successful farming system as 'unproven, lacking a scientific basis'.

This group of original thinkers on the systems approach have attracted a band of dedicated followers, sometimes verging on a cult but the impact on the scientific establishment was not as great as the value of the concept deserves.

Elaine Ingram, who has an impressive academic record and therefore more acceptable to the scientific establishment, may be the most influential researcher promoting this system approach to soil biology. Her term the food web has become universal. An excellent and readable book on the soil food web is Teaming with Microbes by Jeff Lowenfels and Wayne Lewis.

My life has been intertwined with the world of science, but more as an innovator rather than a student of pure science. There is an adage which says;-

A scientist looks at what is and says why?

An innovator looks at what is not and says why not?

That would be a good inscription for my grave but it does highlight the difference between science and innovation. Science with its continuous search for understanding may be the basis for much innovation by proving a secure basis of understanding, but modern science has two great weaknesses.

First the inevitable need for greater specialisation in reductionist science leads many scientists to look at important issues form too narrow a base leading to conclusions and recommendation which are not valid in a wider context.

The second weakness is the ability to tackle problems with multi variables. The classic science approach is to keep all variables except one constant so the effect of that one variable can be studied in isolation; this often leads to invalid results when variables interact with each other.

This problem has been recognised by some within the scientific community; Taguchi's work in this area is well appreciated but in my experiences is difficult to apply in the real world. More recently fuzzy logic has been developed, this was once described to me as like a drunken man wobbling along a road, making small changes to the multiple variables leads to continuous improvements in the system overall. This is not unlike the process of evolution itself, if a change works better use

it, if not discard it. A bit hit and miss for many scientists but a pragmatic approach to what otherwise may be an insoluble problem.

The approach of the innovator is inevitably different to classic science. Certainly the innovator will study the latest development in science to use as a basis but then has to venture into the world of managing ignorance to come up with a practical solution to a real world problem.

This problem of multi variables is exactly what we face with producing healthy food. There is an enormous amount of published research on what makes healthy food (unfortunately often contradictory) but there is a great deal we simply do not know about how the system works as a whole. We need the skills of managing ignorance.

So let me now turn to the how I, as an innovator, have attempted to tackle the complex challenge of producing healthy food in the real world.

Practical solutions

My experiences in Africa showed that the most urgent problem for the poor peasant farmer with an unreliable rainfall was to store water; it is not lack of rain but variability. My original solution was the first generation wicking beds which were nothing more than a hole in the ground lined with plastic so water was stored in the ground protected from evaporation - a solution within the reach of a peasant earning $2 a day.

But I quickly realised that this was a system which would enable anyone, with either no growing experience or simply too busy to tend a garden, to grow some of their food.

I think that total self-sufficiency is unsustainable for all but the totally dedicated. I also think that a head on battle against the multi-national food giants that dominate the industry is not wise. But it possible to have a more balanced diet growing and eating some high nutritional home grown food - it can almost be thought of as an alternative to the various health remedies and pills on which some people spend an exorbitant amount of money.

The wicking bed solves one of the great problems of producing quality food by providing controlled water to the soil biology and the plants coupled with an adequate supply of air. This does require that the wicking bed is operated correctly. Water is supplied form underneath and travels upwards by a combination of simple wicking but probably more importantly the movements of water through the plants roots system.

This leaves the upper layer of soil open so air can readily move through the soil, even better - the cycling of water means stale air is expelled when the base of the bed is filled with water and fresh air is sucked in as the plants use the water - a form of natural soil breathing.

When I look at some of the wicking bed systems which are being promoted I feel a little guilty that I have not adequately explained these fundamental principles of how a wicking bed should work.

However the wicking bed by itself only tackles one of the problems of growing healthy food, namely providing a combination of adequate water and air, it does not by itself solve the problem of providing the plants with the required nutrition which requires the help of the soil food web.

The soil food web

There has been extensive research into the nutrients a plant needs, the vast majority of a plants bulk comes from water and the carbon in the atmosphere, next are three ingredients of fertilisers N,P,K then the macro nutrients such as calcium, magnesium etc. then the trace element which are needed as catalyst for photosynthesis. This is well documents in many books such as Building Soils Naturally by Phil Navta and Teaming with Nutrients by Jeff Lowenfels. (I think Amazon should give me a commission.)

However these focus on the nutrients needed by the plants, not us as animals. We need an even bigger range of nutrients, such as selenium reported to be a key element in the reproduction of DNA which fortunately the plants may absorb from the soil and pass straight onto us. Unfortunately there has been much less research on these nutrients that we need and are passed onto us virtually by serendipity by the plants.

We can of course readily add mineral to the soil, for example this can come from rock dust mined from volcanic rocks or commercially available minerals with better controlled contents which are commercially available albeit at much higher cost. However these essential minerals are not soluble and hence available to the plants for this we need the soil biology.

The rapid expansion of our understanding of soil biology can be seen by setting up a few Google alerts, however this research is very much in the classic scientific pattern of detailed investigations into the multitude of organisms in the soil.

And as Elaine Ingram has so eloquently pointed out in her phrase ‘the soil food web’ this is a system with each component interacting with the other numerous creatures.

For example the benefits of fungi, particularly mycorrhizal fungi and bacteria are well understood and documented, but these are relatively immobile and need larger creature such as the worms and nematodes to transport them throughout the soil. Again the benefits of these may not be available until they are eaten by larger creatures and the nutrients released.

But this complex cycle is dominated by the plants themselves, with a few exception like cyanobacteria these micro-organism are incapable of photosynthesis and are totally dependent on the plants for their source of energy. The plants have evolved to emit exudates to both feed and attract these micro-organisms and of course when they die they provide a major source of food.

But while the science may be rapidly expanding it is still a very long way from a comprehensive understanding, so how do we manage our relative ignorance of these incredibly complex areas.

I see this as the role of the innovator whose basic tools of the trade is to take the scientific knowledge that exists and couple this with the art of managing ignorance to set up an integrated system.

(As an aside I should mention that managing ignorance inevitable means a continuous series of failures, this has certainly been a feature of my life as one apparently good idea after another crashes into the dust. My advice to would be innovators is if you can't handle failure don't be an innovator.)

The first job of an innovator is to have a clear understanding of the required end product or service. I know that the majority of people reading my newsletters are already keen gardeners with a high degree of expertise who are probably already enjoying a healthy diet. My aim however is to have a system which enables people who have no knowledge of gardening to have a healthy home grown diet, even if they live in flat or condo.

To my keen gardener readers I offer an upfront apology. I know that you already have a high level of expertise and for example understand such complexity of how it is important to have the certain competing elements, such as calcium and magnesium or potassium or phosphorous in the right ratios, that Ph. affects the availability of some elements etc. But this makes the system just too complex for the non-gardener.

Fortunately the professional grower understand this so food waste which can be turned into compost as a food source provides a free balanced source of the major nutrients. This also goes someway to offsetting the horrendous waste of food which in a recent UN survey is some 30% of total food production, a horrible waste of resources and source of pollution.

The minor and trace elements can easily be added so the basic nutrient balance in the soil can be readily managed. However the missing link to make this all work is the soil biology.

There are many supplies of individual components required to form soil biology, anyone can buy mycorrhizal fungi, compost bacteria, worms and a whole range of biology from specialise suppliers. My philosophy is not to try and compete with these specialists, who know more about their particular areas than I will never know.

My approach is to use these experts as suppliers by incorporating their products into a fully working integrated soil and plant eco system. Additionally many of the components of the soil biology web are already available in the natural environment. I can collect soil and plant samples from undisturbed land which I can then use as inoculants in my beds. I am using an open style wicking bed which is open to the natural soil biology.

I can then take small samples of this functioning eco system which can economically be posted to customers. Much soil biology, particularly the fungi are delicate and easily damaged by working the soil. So I use a boring tool to take a small sample with minimum disruption so the biology can move back into the disturbed area.

The plan

My plan is simple based around the concept of independent coaches. I and the coaches will promote the benefits of a healthy balances diet with the critical trace mineral and elements. People who are comfortable about making their own wicking boxes can build their own, while those who have some hesitation about making and operating their boxes can contact a local coach for help.

The coaches can locate suitable local supplies of the material needed which are difficult and expensive to transport and either buy in bulk or advice customers on where they can be purchased.

Customers can buy minerals directly. (Or as I am already buying in bulk I may offer small retail packs. This will depend on demand.) But my main operation will be to supply the soil biopacks, these are inoculants so only a small quantity (500 grams) is required per box. This is cheap enough to post.

I have now located a source of biodegradable containers so that all that needs to be done is to cut the bottom off and put in a hole in the bed.

So what are the potential snags? First the soil biology packs are a living ecosystem so need to be planted into the soil without long delays or they will simply die. Secondly like any inoculant they take time (several months) to spread and if they are neglected they may dry out and die.

Next steps

My next job is to write up a short brochure on the soil biopacks – this article which may be a little long is really intended for my regular readers who may be interested in the details of this project. I also have to write an article on composting in a small space; I may be a bit weird but I have always been fascinated by the composting process and have always been lucky enough to have plenty of area to play in. But composting in a small flat without smells or flies is another project I am working on.

I think my nose has become accustomed to the smell of compost (I quite like if anyway) but Xiulan is very quick to tell me if it is not acceptable. I think if I make too many mistakes I will end up sleeping on my compost pile, such is the fun of life.

Dear readers I welcome your comments and if you would like to write an article about your experiences I am more than happy to circulate among my readers.

Colin