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THE STORY OF THE MICRO-ORGANIC CYCLE

At the Conference of 1967 a most exciting paper was presented from Big Sandy, on restoring soil fertility. It involved the use of lignite, diatomaceous earth and bacteria culture. Soon the attention of thousands was focused on this idea. It even triggered off an *Agriculture Programme* in Bricket Wood, whose head was privileged to spend six months on the Texas campus absorbing the interesting details.

Arriving back in England, all fired-up with new knowledge, we suddenly found ourselves facing a blank wall! Weeks of frantic activity revealed that not *ONE* of these three basic materials was readily available anywhere near *Hertfordshire!!*

The nearest lignite was in Devon, and on the Isle of Wight. The only diatomaceous earth appeared to be either some low-grade material over in Northern Ireland, or that up in a Westmorland lake *under forty feet of water!* (It took research in the geological section of The British Museum to reveal even these dismal bits of information.) Then learning that it is illegal to import soil bacteria came as the final blow!

To set up an agriculture programme like that at Big Sandy, without any of their three basic materials, posed quite a problem. In this issue of *Your Living Environment* you are going to see how we finally achieved the same results by a totally different method. You will also see just how this unwelcome situation rubbed our noses in a great deal of *new* understanding. It was new and exciting to us then. It will *still* be new to most of you today!

A Sabbatical Year For Bricket Wood

The beginning of the Agriculture Programme in England just happened to coincide with the seventh year after the founding of Ambassador College in Bricket Wood, by Mr. Armstrong. So we *started* our programme with a *Sabbatical Year.* Few in this age have ever observed a year of rest, but imagine our surprise to find ourselves so involved, in our very *first* year of operation!

We were happy about the idea, but in some ways it looked like a rather rough start. This was because we mentally approached our *"strange"* observance as most other people do on their first occasion. We thought it was a kind of *penalty* to be paid as the price of maintaining soil fertility! *HOW WRONG WE WERE!!*

Keeping — Brings Understanding

Had we not kept God's year of rest it is quite likely that we would still be without vital understanding on the functioning of the most important law in all food production.

Centred on the return of organic residues to the soil, this law focuses specifically on the contribution of ruminants. Man has relied on barnyard manure through many millenniums. Though often neglected, this source of soil fertility fell into utter disrepute only after man's end-time introduction of chemical fertilizers.

There are many treatments to overcome the effects of soil infertility. Many are *natural.* Some are totally *unnatural!* But finally it became clear to us that the *Sabbatical Year* depicts man's *ONLY* 'permanent' system of agriculture!! We should all remember that the supply of Chilean nitrate, North African rock phosphate and German potash is neither inexhaustible or secure.

If God be our Designer, Creator and Sustainer, there must be another basis for the production of healthy plants. The year of rest taught us that

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in the ultimate analysis, man must depend on a system of soil management in which every square yard is able to supply its *own* fertility! In other words, when everybody is managing his soil correctly *everyone* will *not* be able to dig a hole for minerals in his neighbour's hillside. And *no-one* will be able to run down the road to beg, borrow, or steal his neighbour's straw or autumn leaves.

Why The Emphasis On Ruminants?

Observing the *Sabbatical Year* soon indicated that commercial crop production is totally ruled out at the very time when meat, milk and wool production is most encouraged! Livestock harvest plants from the land just like a modern mechanical hay baler, but there are two differences. The animals return a lot of waste products to the soil and they also trample many plants underfoot. If these are the two main differences between the cow and the baler in relation to soil, the key to the *Sabbatical Year* must be the *return of organic matter* to the land.

The next key involves an understanding of *ruminant digestion,* (cattle, sheep and goats, etc.). Unlike man and most animals, they have FOUR stomachs. The fourth and largest is called the rumen. In cattle it has a capacity up to sixty gallons!

The rumen, the second stomach and the third, contain no digestive juices. Instead, micro-organisms multiply into billions and digest the grass and hay eaten by the animal. That's right — ruminants don't digest their food intake! They merely gather it for bacteria who do the breakdown and are then digested themselves. Thus the ruminant feeds the bacteria and the bacteria become food for the ruminant.

As these rumen bacteria are fundamental to digestion, we reasoned that they must also have a very significant effect on organic matter that is returned to the soil in the form of dung. But how could a layman determine this for sure? How could we even know for sure if any passed out in the dung?

Bacteria-charged Manure

A simple test can be made by taking a sample of common grass. Divide it and put it in two glass containers, then add a small amount of fresh cow manure to one jar and leave them both in a warm atmosphere for a few days. One can soon discern, even with the naked eye that decomposition is much more rapid in the presence of manure. The difference was so great that the grass in one container had almost decomposed before the other one had changed at all.

Microscopic inspection revealed very little life where there was no decomposition. However at the same power under the microscope, the 'bugs' were working furiously in their millions in the 'dung-contaminated' sample. They appeared to be crowding each other out of the container and the grass was nearly decomposed!

It then took very little reflection to realize that when people built a compost heap, the best known *activator* and the most commonly used is *animal manure* — especially that from ruminants. An *activator* is just a primer for bacterial action, so one might well expect the waste-products of a bacterial digester, (the ruminant) to be the obvious choice for rapid plant decomposition.

So much for the manure that goes into man-made compost heaps, but what about that which is spread around naturally by grazing animals in a pasture? Surely plant decomposition is just as important under these conditions! Of course it is. Even more so. A billion times more decomposition is stimulated every day under these natural conditions than has taken place in all of the little compost heaps that man has ever constructed in 6,000 years. (Why do people get so fanatical about compost heaps?) It was about this time that compost heaps began to fall into balanced perspective. They have a place, but it just does not make sense for man to gather and transport all available plant matter to one point, compost it and then cart it all back again to spread over the same area! (When man learns to handle his soil and animals correctly the *organic-fanatic* may not feel he has to raise such pious hands at the loss of certain city refuse.)

The Role of Animal Residues

Now the picture was becoming clear. Most who have preached the return of animal manure to the land, did so for its own sake. In other words its value has always been based on the amount of actual plant material turned back into the soil. However it should be better appreciated that a mature beast will return less than six tons of manure to an acre of average pasture land per year. Ten to twenty tons is more like the dressing needed to have a worthwhile effect.

This surely puts animal manure in a different perspective! And yet the Sabbatical Year shows what great stress God places on the *return of manure from ruminants to the soil.* We therefore submit that the *most* important role of farmyard manure is to constantly *re-inoculate the soil with micro-organisms!* Its value as humus however, is in no way diminished. But on the other hand, readers will appreciate that God would *not* give

man a soil system lacking self-replenishing sources of bacteria.

After all — without microbial life, *SOIL* is nothing! And without soil, there is *NO LIFE* of any kind! MANURE IS *FIRST*, A NATURAL MEDIUM FOR RETURNING SPECIAL *'BUGS'* TO THE SOIL!! When we came to understand this concept (2½ years ago), its pure simplicity of operation and efficiency was just overwhelming! (The rumen may make them more *SPECIAL* than we realise!)

Plant Bacteria

Thinking our way backwards, the next step towards further understanding was taken by mentally going back into the rumen. There, amidst all that churning bacteria and fermentation one had to contemplate the possibility of disaster. No greater catastrophe could happen to a *rumen* than ingesting a substance that would kill *all* of its *microbial* content!

Everything would come to a disastrous halt! And the animal would quickly die! You may rightly say this would be an uncommon occurrence, but severe fluctuations could occur quite often. And remember that billions of organisms are constantly passing into other stomachs to be digested. Not to mention those we have just discussed that find themselves back in the soil via animal manure. So there is a natural and continuous depletion. Unless this is counterbalanced, disaster would quickly overtake even the healthiest ruminant!

It would therefore be unreasonable to assume that there is not a constant replenishing source of rumen bacteria, to guard against such a possibility. Why, of course! The *two glass jars* mentioned earlier!! Even the grass sample without *any* dung added, was decomposing, so *where* did the microbes come from?

A little microscope work will very clearly show that plant leaves and stalks carry their *own* population of tiny organisms. That means that every time a cow or a sheep or a goat swallows a mouthful of grass, their rumen is re-inoculated with 'bugs'.

Anyone knows that the air around us is charged with bacteria. We breathe them in all the time, *but* it is *not* generally realised that *plant bacteria* are in a direct film-like contact with the leaf surface. Their association is such that they are not even washed off by heavy rain, so this filmy environment makes them quite distinct from atmospheric bacteria.

Once again we are confronted with a beautifully designed and simple process. Such a commonplace thing should not be new to us. Then we might reflect on this interesting question: are the changing leaves of autumn anything more than the obvious onset of *decomposition* by *plant bacteria?* You have seen this process *every* year of your life, but have you ever thought of this meaning before? (What a fulfilment of Rom. 1:20!)

Soil Bacteria

If all plants are covered with a thin film of bacteria, it is only logical to ask — do these microbes originate in the atmosphere, or in the soil? Our enquiries (shown in more detail at the end of this *Research News*) indicate that they come from the SOIL!

Some even come from the very *seed* that produced the plant. Believe it or not, *all* healthy seeds are covered with bacteria. The conditions that produce germination, (moisture and heat) also cause the bacteria to multiply and cover the leaves of the plant as it grows out from the soil. Any farmer experienced in planting legumes will know the value of bacteria on seeds. (Most seed companies issue special bacteria cultures with their various legume seeds to inoculate the plant roots. This is done as a precaution against these bacteria being absent in the soil. They often are absent in soil environments that have been abused and mismanaged.)

What you have been given is a series of very interesting *bits* of information, as we came to understand them here in Bricket Wood two and a half years ago. They probably sound very simple and their common connection has been partially established in the telling of this story. But be assured — neither their simplicity nor their connection was obvious at the *beginning* of this research! Coming to this understanding was a *long, slow process!* As always, when one comes to understand something for the first time you look back and think how obvious it should have been from the very beginning.

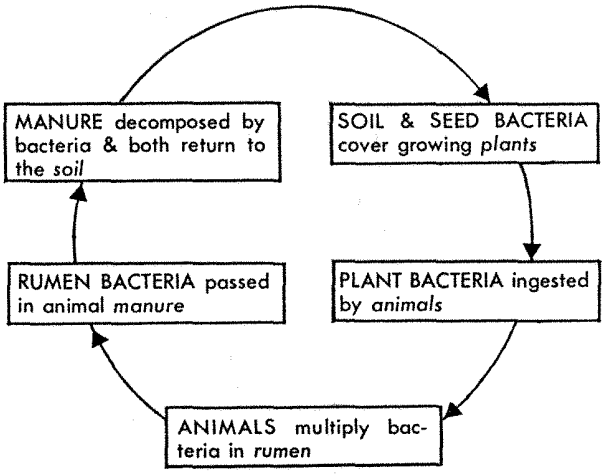
You have guessed it by now — in this story we have worked our way through a complete *FIVE-STAGE CYCLE:*

1. Bacteria from the *soil* and from *seeds* in the soil, cover the surface of PLANTS as they grow up out of the ground.
2. ANIMALS take in plant matter for their continuing food needs and the associated *plant* and *soil* bacteria repeatedly re-inoculate the rumen.
3. Inside the RUMEN, bacteria multiply fantastically as they decompose the plant matter. They then pass down the alimentary tract and provide the bacterial *protein* needs of the animal.

4. RUMEN bacteria that escape digestion are returned to the pasture in farmyard *manure.*
5. DUNG bacteria multiply as they decompose the organic material in which they find themselves and re-enter the *soil,* along with the humus they have created. And so the whole cycle is repeated over and over. That's why *we* named it: M.O.C. or Micro-organic Cycle.

Only *now* can we begin to understand the full significance of *mixed* farming and why LIVESTOCK are the key to any permanent system of agriculture. The M.O.C. can be broken at any point, but this is extremely unlikely so long as the soil has a *regular* (but not necessarily permanent) association with ruminants.

THE MICRO-ORGANIC CYCLE



Confirmation from Other Sources

Coming to these conclusions and such understanding was a gigantic break-through. It was this foundation of fundamental knowledge that enabled us to proceed with the Bricket wood Agriculture Programme, in spite of the total absence of the three basic materials used in Big Sandy.

What we now call The Micro-organic Cycle was understood *only* because we were shown the specific importance of RUMINANTS in relation to *soil fertility.* And we focused in on the role of ruminants *only* because our programme started out observing a SABBATICAL YEAR! Conversely, understanding the vital part played by the ruminant in soil fertility, meant that we also understood the *Sabbatical Year* better than *ever* before!

As soon as this point in our research was reached there was a great sense of urgency to press on and *confirm* our new beliefs and opinions. This could have been done by long and costly research, but we possessed neither the *technique,* the *equipment* nor the *money.* The only other way open to us was to dig into the writings of other researchers.

At first this did not seem like a very attractive proposition. But limited success came quickly and we plunged deeply into previously unknown material with mounting excitement. Those which follow are brief sample excerpts that sent us wild with delight. They do not appear necessarily in the order in which they were located:

As the Bible triggered it all, it should therefore come first — God's Word tells us that:

"... the seventh year shall be ... a sabbath for the Lord: thou shalt neither sow thy field, nor prune thy vineyard.

"... And the sabbath of the land shall be meat for ... thy cattle and for the beast that are in thy land ... " (Lev. 25:4,6 & 7).

"... These are the beasts which ye shall eat among all the beasts that are on the earth.

"Whatsoever parteth the hoof, and is cloven-footed and cheweth the cud, among the beasts, that shall ye eat." (Lev. 11:2-3).

"Wherefore ye shall do my statutes, and keep my judgments, and do them;

"... And the land shall yield her fruit, and ye shall eat your fill, and dwell therein in safety" (Lev. 25:18-19).

Let us now however, make a complete circuit of the M.O.C. through quotes from the works of famous scientists:

How Many Microbes in Soil?

"... it is clear that big variations often occur in the soil population between areas which are separated by only 20 - 50 cm.

"... The bacterial numbers vary most, soils with a pH greater than 6.0 usually have counts by dilution methods of ten million or more. In soil with a low pH, however, the numbers may be very much less and in acid podzols the count may be less than a million per gram." (*Micro-Organisms In The Soil,* by Alan Burges, p.66-67.)

Two interesting side comments here — *first,* it is a well known fact that organic matter exercises a high buffering capacity in soil *against* the action of acid substances. *Secondly,* it is widely accepted that artificial fertilizers have a general tendency to *lower* soil pH.

It thus becomes obvious, in the light of the above quote, just what man can expect both when he fails to return *organic matter* to the soil and

when he substitutes regular applications of *chemical fertlizers.* SOIL-MICROBE POPULATIONS WILL DECREASE!

Bacteria On Seeds

"Seeds have on their surface, (and partly also inside) numerous micro-organisms and ... seed-born bacteria can pass onto the roots (*Rempe,* 1951)." (*Ecology of Soil Bacteria,* p. 386.)

Plant Bacteria

"Various organisms are growing in the slimy bacterial layer that is characteristic of the epedermis of green plants" (*Textbook of Agricultural Bacteriology,* p. 150).

"... in a germ-free environment ... the particular bacteria attached to the seed multiply rapidly and cover the whole plant with an almost continuous thin slimy layer of bacteria. The slime not only prevents them being washed off by heavy rains, but also helps to preserve a sufficient amount of moisture even during periods of drought. Besides dew, small amounts of sap excreted by the plants are available to the bacteria.

"... all growing plants are covered by an almost continuous layer of bacteria specifically adapted to their habitat" (*ibid.* p. 149).

"Under natural conditions, plants such as grasses have nothing comparable to leaf-fall in the way that a deciduous tree such as oak or beech has; instead, the leaf tissue and stem dies in situ and under damp conditions a major part of the decomposition occurs while the tissue is still attached to the plant. *Webster* (1956, 1957) has shown that ... primary saprophytes ... advance up the stem as the new leaves unfold, and different saprophytic fungi are associated with different nodes. Comparable results were obtained by *Frankland,* (1966)". (*Ecology of Soil Bacteria,* p. 483).

Hay Bacteria

"When grass is made into hay, part of the bacteria will die, but slime production and spore formation enable many of them to remain alive although in a dormant state.

"... Unfavourable weather, however, stimulates unavoidably the growth of bacteria and molds and their destructive activities become sometimes very marked especially when clover or alfalfa is made into hay.

"... The so-called hay bacillus can be easily brought to good development if hay is placed in water and the mixture boiled for a few minutes. After a few days the liquid is covered with a whitish film characteristic of these organisms" (*ibid.* p. 152, 153).

Now we see that even *hay* retains bacteria on it! Notice also the way in which these tests confirm our results in the previously mentioned *"glass containers".*

Furthermore it is interesting to note from the above quotes that *moisture* and *warmth* are precisely the conditions the rumen provides when plants and accompanying microbes are ingested! If the presence of legumes stimulates bacterial decomposition *outside* the rumen, they would surely aid animal digestion on the *inside.* (Today animal feeds have an acute *lack* of legumes, yet legumes are our *best* source of high quality vegetable protein. Other related effects are that legumes don't grow well on poor soils and neither do livestock!)

Rumen Bacteria

"In herbivorous animals such as cattle and sheep, the compound stomach appears to be ... a compartment in the alimentary canal where fibrous foods may be held to undergo a soaking and 'fermentation' before passing on through the canal. The rumen, or first compartment, is very large in the adult animal and may hold up to 50 or 60 gallons of soft food material.

"... The rumen, reticulum and omasum are non-glandular and thus do not produce acid or digestive juices. Because proteolytic enzymes and hydrochloric acid are absent, they do, however, provide excellent compartments for the growth of many types of micro-organisms — both bacteria and protozoa — that are taken in together with the food.

"... Thus the ruminant is provided with a variety of proteins derived from the bodies of micro-organisms. On passing into the true stomach and into the intestines, these organisms — which have multiplied in the rumen, recticulum and omasum — are digested, and their bodies serve as a source of food protein. Several of the B vitamins are also synthesized in the rumen." (*Introduction to Livestock Production,* by H. H. Cole, pp.457-458.)

Manure Bacteria

"The solid excrements of animals are made up of partly decomposed food residues and of the bacteria that cause their decomposition ... calculated on the basis of fresh weight the number of living cells would approximate 20,000 to 40,000 millions per gram." (*Textbook of Agricultural Bacteriology,* p.222.)

"Regular additions of a source of decomposable organic matter, such as farmyard manure [added to soil] appears to increase ... the [microbial] ... population.

"An example of this effect is given by the comparison of the microflora on the unmanured plot on the Broadbalk Field at Rothamsted with the adjacent plot which has received 14 tons per acre of farmyard manure in most years since 1843 ... manure has doubled the humus content of the soil and almost doubled

the total cell count; however, the number of protozoa has increased fivefold," (*Ecology of Soil Bacteria,* Liverpool University Press, pp.78-79.)

Bacterial Research — Complicated!

"... The bacterial cell as a biological unit is wonderfully equipped to cope with the continuously changing environment" (*ibid.* pp.370-372.)

"One of the things that emerges ... is that measuring the activity of micro-organisms is a very complicated problem. The closer you come to a soil system, the more complicated it becomes. This is not a new idea, but it is an idea that is worth recalling. It is good for the soul, good for the data and good for the interpretation of that data.

"The fact that the bacterial cell generally produces more vitamins than needed for its own metabolism and excretes the excess into its environment is of considerable ecological importance. This holds not only for the soil ecosystem..." (*Ecology of Soil Bacteria,* p.123).

Bacteria Can Acquire Characteristics

"... If one considers the period for which animals and plants have existed on this planet and the great numbers of disease-producing microbes that must have thus gained entrance into the soil, one can only wonder that the soil harbours so few bacteria capable of causing infectious diseases in man and animals" (*Hylife With The Microbes,* by Selman Waksman, p.19).

Professor Waksman may well have done much more than "WONDER" about this fact! If just changing the *environment* turns a *pathogen* into a *NON-pathogen,* it would seem that man has been ignoring a very obvious solution to many problems. Do you comprehend the implications of this simple statement? If such an idea ever became popular, the ramifications for our medical and veterinary professions could be quite shattering, not to mention the *'legitimate'* drug industry!

Here is another quote from a different source that could also stir unusual thoughts in the minds of some readers:

"Grass, hay and straw contain almost regularly ... bacilli related to B. tuberculosis. Some of them have been explicitly named 'grass bacilli' or 'timothy bacilli'. When found in milk, butter and cheese, they have been repeatedly mistaken for true tubercle bacilli. In their typical form they are not pathogenic for men, but their virulence can be increased and their general character may be so changed experimentally that they assume practically all the features of the tubercle bacillus" (*Textbook of Agricultural Bacteriology,* pp. 151-152).

Is this author making the same point as Waksman, only in reverse? It would certainly appear so! We quite understand that some of these quotations are pretty radical stuff and not easy to accept, especially by those who have been educated to classify bacteria as either *good* or *bad.* (Anyway, perhaps we will come to see that the whole system of bacterial classification needs to be thrown into the melting-pot.)

Consider the following quote on species definition — it is not taken from some obscure little axe-grinding tract, but rather from an expensive full report on the 1967 international symposium of the world's leading bacteriologists:

"Dr. Gordon ... defined species in a way which horrified me a little. It really boiled down to this — 'A species is what a competent taxonomist says is a species, i.e. that the newly isolated strains, the old one in the culture collection and any old thing we think is this same organism constitutes a species ... Those of you who know me, know that I do not believe in species" (Dr. S. T. Cowan, National Public Health Laboratories, Colindale. *Ecology of Soil Bacteria,* pp. 370-372).

The fore-going quotes are just a selectionfrom the material we now have. It will be seen how each one supports a part of the whole (which we named *The Micro-organic Cycle*). All we did was make a mental connection between the individual parts. Scientific specialists had worked on each one, but had not assembled them as a complete and meaningful picture!

Soil, plant and rumen bacteriologists work in totally different knowledge compartments and evidence indicates that they have little contact. That rare specialist who does step outside his own field is still at a disadvantage. Why? Well for one reason, he knows NOTHING of the *Sabbatical Year!* Therefore he will not understand HOW, or WHY ruminants are the keystone upholding fertility in the soil, for all mankind!

It is now three *years* since we first understood and named the M.O.C., but our knowledge is still increasing on this subject, e.g. it is less than three *months* since our latest additional knowledge was added on the role of dung pats in seed production and pasture management (see *"Plant Breeding — God's Way"* in Vol. 1 No.11). These new facts dovetail completely with all our earlier understanding on the inseparable tie-up between the SABBATICAL YEAR, LIVESTOCK, BACTERIA and SOIL FERTILITY!

You can now see how circumstances have worked out the initial difficulties facing the Bricket Wood Agriculture Programme and at the same time uncovered fantastic new knowledge!

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