WHICH IS WISEST—

Soil Management

By Nature or by Man?

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In our studies of how Mother Nature was growing crops which were able to protect themselves against pests and disease and thus able to survive the ages, and to be available for domestication by man when he took over the soil and crop management, we find that two basic requirements had always been met or fulfilled. In the first place, rock-minerals were weathering in the soil to remind us of the poetic claim that "The Mills of God must Grind." In the second place, the organic matter grown on the soil was naturally put back in place on top or within the soil for its decay there. That served to put microbial life into the soil. It generated the carbonic acid there (and other acids of decay) to break some of the nutrient elements out of the rock more rapidly for them to be caught up and held, or adsorbed, by some of the more stable, weathered, non-nutrient elements like the silicon of the clay. That adsorption holds them for plant services when the plant uses the same kind of carbonic acid to take those nutrients off by trading the hydrogen, or acid, for them.

Nature's Mineral Fertilization

By means of grinding fresh rock regularly, forming *natural mineral fertilizers in the soil,* and *by conserving the organic matter to go back to maintain the soil's humus* at higher levels, *nature had protected her crops so they grew annually from their own seeds. By a unique self-protection they were doing well when man came along to take over* with what we call "scientific" crop management and "scientific" soil management. Certainly we are not now duplicating those practices in which nature was more successful than we appreciate, in fact, not appreciative enough yet to copy her practices more extensively.

Emphasis on "Ash" Analyses and Concentration of Soil-Borne Nutrients

When we began the study of how soils feed different plants naturally, we started by chemical analyses of the elements we could separate out of the plant's ash. We listed the kinds and amounts our analytical ingenuity let us specify. We used the ashing procedure to do the same to the soil. Then we tried to match the elements given for the soil against those specified for the plants.

Plant Minerals

Among those in the plant, especially wood ashes, the potassium was the highest one. Phosphorus was next in order; and calcium, or lime, was the third at the top of the list. There was often some sodium. Then there were many other elements of lesser amounts.

Minerals in Humans and Animals

In the ash of the human body, and other warm-blooded ones, there appear again, calcium, phosphorus, and potassium, the same three elements as in plants. But Calcium, (not potassium) comes first in the largest amounts. Phosphorus is second, and potassium is third,

or quite the reverse of the positions in plants. As vegetarians building bodies we ask our physiology to juggle those elements, eaten in one order of amounts in our food, into another decidely different order for building our bodies.

Importance of Legumes

That chemical composition of warm-blooded bodies, demanding high calcium and phosphorus, gives reason for growing and eating legume plants (peas, beans, and other pulses) which are protein-rich as well as mineral-rich to be protein supplements to the non-legume, low-protein or fattening foods we eat. We use legumes also in animal rations as protein supplements to the pasture grasses for prevention of deficiencies in the essential mineral elements and in the nitrogen—the element by which we distinguish, chemically, the proteins or living substances.

Use Atmospheric Nitrogen

Legumes can take nitrogen from decaying organic matter in the soil. But when supplied with generous mineral fertility, especially calcium and magnesium as carbonates in limestone and other substances, legumes can use some of the 70 million pounds of the atmospheric nitrogen, over every acre, to build their own protein from it.

Putting legumes into pasture grass-mixtures was Nature's way of growing good grazing for the American bison on the prairies. That provided a more nearly balanced animal ration to the bison who chose it from among the 60-75 species of plants offered by the prairies and plains. Legumes were Nature's synthesizers of protein by using atmospheric, not chemical-salt nitrogen. They supplemented the non-legume plants in their nitrogen demands from the soil. They also prepared the combined nitrogen for giving more complete protein supplies in the nutrition of other life forms calling for that food supplement.

Complete Proteins Are Not Just More Concentrated Nitrogen

We now have commercial chemical salts of nitrogen so widely available to be applied as fertilizer to pasture grasses to make them "rich in nitrogen," and "crude" protein, as the chemist measures it. Since nitrogen is the element distinguishing the protein, it is apt to be claimed that "we can now grow more grasses per acre and make them richer in nitrogen and, therefore in protein, and to become the equal of legumes. Consequently, we do not need to grow the legumes, which are so hard to grow anyway."

But proteins are compounds very specific in more than just nitrogen. Nitrogen in some plant compounds may be poison, as it is in regrowth of sorghums with cyanide nitrogen. That *pasture grasses fertilized heavily with nitrogen are not the equal feed value of grasses, growing simultaneously on soils with legumes as companion crops for animals grazing them,* is told us when the latter in that crop combination serves to make them as feed grow more young animal weight than the former does alone.

Growth Elements vs. Energy Elements

Fertilization of pastures, by nitrogen only, is by no means the equal of grasses where they are limed and phosphated to give plenty calcium, magnesium, phosphorus, potassium and all else, for growing legumes along with them. That crop combination, coupled with the fertile soil, exhibits the higher creative power for the living substance, protein, when that demands the higher amounts of ash elements and of the nitrogen from the air to grow a quality of that feed supplement which grasses cannot do, even if they can take more nitrogen than usual from the soil. Consequently, we need *legumes* to grow their bodies of the separate cells. Those *have the "grow" power. Non-legumes* make the carbohyd-

rates, *the "go" power, and the power for hanging on the fat.* But a fattened animal with power to "gain" in weight cannot go very far nor very fast. We need soils high in calcium and other fertility elements to supply "grow" foods. We are still able to grow many "go" foods easily. But only "grow" foods build bodies, protect them against diseases and pests, and enable life forms to reproduce the species to populate the earth.

Nutrient Elements of Positive Charge Are Held On The Clay-Humus Colloid (So Is Hydrogen, A Non-Nutrient).

For growing legumes and better non-legume crops which are mineral-rich and protein-rich, the soils must be well-stocked with calcium, magnesium, and potassium, usually accompanied by sodium, some hydrogen, or acid, all as positively charged elements, in their electrical behaviors. There must also be present some of the trace elements in that same classification of the positive. In order to be available to the plant roots, they must all have been broken out of the rock-reserves and adsorbed, or held, on the clay surface against loss in percolating soil water. But yet they must be exchangeable to the plant root, trading hydrogen, or acidity, for them.

According to our knowledge to date, *the soil's total capacity to hold electrically positive nutrients* in available form *should have about 60-75 per cent* of that capacity filled by *calcium; 6-12 per cent* by *magnesium; 3-5 per cent by potassium,* and *not more than that* much *by sodium, also by all the needed trace elements and by the non-nutrient hydrogen,* or acidity.

Those figures represent the soil's content of positively charged elements in what, to date, we may consider *a balanced plant ration* of that portion of the list of required elements for growing legumes. Simultaneously, it grows more nutritious grasses to make those better grazing, as shown when animals have a choice. It may not be so complete as nutritious feed in baled hay or in mechanically pelleted feeds.

Available Nutrient Elements of Negative Charge Are Held Within The Soil Organic Matter

The preceding remarks have not spoken about the soil's organic supplies of nitrogen, sulfur and phosphorus in the required plant's ration. They have not mentioned some of the trace elements, also connected more actively with the supply of organic matter than with the reserve minerals.

Action of Soil Microbes

We need to look to the organic matter of the soil to make these last three-and more-essential major nutrient elements available to the crops. We need to remind ourselves that it is the organic matter that makes the surface layer the "living soil" and the "handful of dust" with its power for creating life. We must not forget that *microbes are what make a living soil "alive,"* and far more important, we must remember that *soil microbes,* like all other microbes, *eat at the first sitting,* or first table. *Plants eat at the second. Microbes go first for energy food,* since they cannot use the sunshine's energy directly. *Plants go first for "grow" food,* since they can use sunshine energy that way. A sprouting seed "roots" for a living, or for "grow" food first. It puts up its advertising of growth by showing its leaves above the soil in the sunshine second. Microbes are the decomposers of the organic matter, the conservers of the inorganic fertility, of the nitrogen, of the sulphur and of the phosphorus. Those three elements do not escape so much from a soil which has plenty of organic matter and the growing crops to conserve those elements. We need to consider organic matter to conserve, to mobilize, and to increase the nitrogen, the sulphur and the phosphorus of the soils, if those are to be fully productive.

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(Continued from April Issue)

Soil microbes oxidize carbon, nitrogen, sulphur and phosphorus to get energy thereby. It is in their oxidized forms that those elements are taken into the plant. Carbon is taken into the leaves. The others are taken into the plant root and, thus, all are in cycles of re-use.

It was by that more complete recycling for conservation that nature built up the soils in organic matter which we are compelling our microbes to burn out so rapidly when we return mainly chemical salts and little carbon of organic matter by which in that combination for microbial service these fertility elements must be held in the soil. *Plants and microbes must be a symbiotic activity and not a competition for fertility if our productive soils are to be maintained.*

Nutrient Elements As Salts Are Not Natural Plant Nutrition

Carbon, nitrogen sulphur and phosphorus are the negatively charged elements with which the positively charged hydrogen, calcium, magnesium, potassium and sodium combine to make *the readily soluble inorganic salts.* But in those combined forms they are not held by the soil as such. They *are ionically injurious to plant roots.* They are leached out by percolating rain water. It is the clay-humus part of the soil which filters the positively charged ions, or elements, out of those salts, much like the household water softener takes the calcium, or lime, hardness out of the water supply. The clay-humus holds them as insoluble but yet available to plant roots which are trading acid, or hydrogen, for them.

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butter, cottage cheese, finger salad, home-cured olives, nuts and raisins, another—rye buns and butter, Alta-Dena Cheddar, finger salad, pickles. One of two of the week's dinners consists of Sirloin steak, zucchini squash, green salad, yogurt and cream. The other provides baked salmon, corn on the cob, carrots, salad. Milk can be had at any meal.

A Welcome Contrast

Snacks are not candy bars or soft drinks. Instead the Ashes offer fresh fruit-juice popsicles with added vitamin C; carrot sticks, green peppers, celery, cucumbers, fresh fruit and melons, yogurt, cream, Cheddar cheese, nuts and seeds.

Today, many live-in accommodations for youngsters and young adults consist largely of refined carbohydrates, made chiefly of white flour and/or sugar, with limited amounts of protein and fresh fruit and vegetables. It is thus refreshing to learn about the wholesome food and desirable activities offered at the Meadow Lark Camp at Springville, California.

The negatively charged, soluble nitrates, sulfates, phosphates, so oxidized by the microbes, serve as nutrition for them and for plants to be reduced into the organo-molecular states of living tissue where they are insoluble but functional in large organic molecules and not as salts. On death, they are oxidized again for microbial energy and repeat the cycle.

It is in this natural plan of soil management where we must recognize the real service by the fertility elements of soil, air and water playing their roles in creation before we can take over for wiser management of nature's part in crop production. Her two phases of management stand out. (1) *Nature returned the organic matter* as completely as possible, in that she held many of the fertility elements and kept them available. (2) In the second place *she grew crops where she also added unweathered mineral salts and dusts by winds* with their storms of such *and by overflowing waters with their inwash of deposited minerals.*

Nature Put Each Crop On Soils For Suitable Nutrition And Healthy Survival

By that simple, two-phase procedure of fertility management, nature had many different crops of healthy plants here for man when he arrived. But each crop was on its own particularly suitable soil in its specific climatic, geo-chemical and balanced fertility setting with man and warm-blooded animals on the high-calcium soils. *We have not yet included calcium as the foremost fertility element* when we list the contents of commercial fertilizers, for the inspector, even though we lime the soil to combat its acidity and, thereby, work against the very mechanism by which the plant roots feed our crops.

With a threatening population explosion, and the pollution of our entire environment in our waging a war on pests and diseases, to say nothing of wide use of hydrocarbon fuels, *will we eventually repent as prodigals* in spending our creative substances of the soil, *and return to nature* which we must finally admit is still the greatest creator the earth has known in her quiet patience and transcending wisdom? Let us hope that we return from our prodigality of the soil before it is too late.

Sodium is essential for normal functions of the body. It contributes to the acid-base balance of the body and is responsible for the total osmotic pressure of the extracellular fluids. Normal American intake of sodium ranges from 3-7 gm per day.