[Calcium](https://www.seleneriverpress.com/historical-archives/all-archive-articles/132-calcium)

By Dr. William A. Albrecht

**Summary**: A comprehensive discussion of the amazing role of calcium in the soil and its effect on crops and animals, written by one of the greatest soil scientists of all time. Dr. Albrecht, who chaired the soils department at the University of Missouri College of Agriculture, is known in the organic farming movement as the "father of soil fertility research." Born in 1888, he published his first article on soil fertility in 1918 and would publish research papers continually until his death in 1974. Albrecht was a friend of Dr. Royal Lee, and the Lee Foundation published several of his papers, which are available [in this archive](https://www.seleneriverpress.com/srp-historical-archives/albrecht-william). From *The Land* magazine, 1943. [Lee Foundation for Nutritional Research](https://www.seleneriverpress.com/the-lee-foundation-for-nutritional-research) reprint 8.

[*The following is a transcription of the original Archives document. To view or download the original document, click* [*here*](https://www.seleneriverpress.com/images/pdfs/CALCIUM_by_soil_scientist_WILLIAM_A_ALBRECHT_1943_reprint_8.pdf)*.*]

**Calcium**

**I.**

Calcium is at the head of the list of the strictly soil-borne elements required in the nourishment of life. It is demanded by animal and human bodies in larger percentages of total diet than any other element. Its own properties, as for example its relative solubility in some forms; its pronounced insolubility in others; its ease of displacement from rock and soils by many elements less essential, and the multitudinous compounds it forms; all make it the mobile one of the earth’s nutrient ions.

These properties are responsible for its threatening absence from our surface soils that are bathed in the pure water of rainfall, and for its presence in the water at greater soil depths in the distressing amounts that make it appear as stone in the tea-kettle or as post-bathing rings in the bathtub.

These same properties, that seemingly impose shortages and hardships have given cubic miles upon cubic miles of limestone in geologic sea deposits to belater uplifted as land areas widely distributed in close proximity to the soils now suffering shortages of calcium needed for plant and animal nutrition.

While calcium is moving by aqueous aid in this cycle from the surface soil of our land to the sea and back to our soils again, this very nomadic habit makes possible its services in nourishing life. Like other natural performances, it does work while running down hill. If maximum benefits to life are to accrue while this natural cycle continues, we must understand it and help to fit life into it.

An understanding of calcium and its role in the nutrition of life is the start in getting acquainted with the first on the list of all the soil-given elements. Its behavior bids fair to be profitably elucidated through the help of our observations of animals, animal assay methods, and other bio-chemical behaviors. When all the other soil-given elements are similarly studied, they will no longer remain as micro-nutrients beyond our general understanding as they must when the research light has no more candle-power than that of simple chemical analysis. Calcium may well be the “test case” or “pilot plant” experience to guide our thinking and understanding of all the other nutrient elements of the soil for nutrition of microbes of plants, and of animals.

Chemistry has long been the science of analysis. Nature has presented herself as something to be examined, to be taken apart, and to have its parts measured, named, and classified. Functional significance of each part was assigned as fast as experimental procedure could study each as a single variable while all others were held constant. Only recently has chemistry become the science of synthesis. Its synthetic efforts are now giving us dyes in manifold colors and fibers of rayon and nylon for fabrics that fairly rival the rainbow itself. Nutritional minerals and medicinal compounds as complex as the vitamins themselves are now products of the chemist’s skill.

Nevertheless, nutritional studies still move forward mainly on the pattern of analytical procedures. Many are the parts and the factors in nutrition that remain unknown. We are still wondering how many golden eggscan be laid by that great goose known as Nature. The list of carbohydrates, proteins, fats, minerals, and vitamins, has had increasing numbers of compounds within each of these to be given particular emphasis. A list of a dozen or more minerals coming from the soil has given each importance far beyond the magnitude each of them represents as a percentage of the body composition or of our daily diet. The vitamins of recent recognition as essentials on the dietary list have already increased in number until a total of about fifty is certainly goingto drive many people to the drugstore. Three specific fatty acids are now listed, and some thirty amino acids must be ingested if nutrition is to be without some health troubles.

Synthesis has not yet been much used as a technique to help in our understanding of biological behaviors. We have not yet formulated the ideal toward which we are striving because normal bodies and good or perfect health are yet widely unattained. The analytical procedures and single-element controls are still in vogue, unsatisfactory though they may be. The isolation of one essential compound and the demonstration of its essentiality by abnormalities its absence invokes, is still the main procedure in nutritional studies. Plant physiology, likewise, demonstrates the plant troubles when, for example, the calcium supply is varied, or when phosphorus is reduced, or either is completely withheld. All the separate items on the essential list have had their individual effects demonstrated, and we are mapping the world in terms of their individual absence. Little has been done, however, to vary two or three elements at the same time. The number of combinations would run the experimental trials into legion, and consequently such experiments have not yet been undertaken extensively.

But such multiple variations are the situations in Nature where all the soil-given nutrients, for example, may be varying during the life or growth cycle of a single organism. It is impossible, therefore, in natural performances to segregate the effects of separate elements. They can be evaluated only as a summation in terms of the final plant or animal. It is for this reason that we must resort to the bioassay method. It becomes necessary to use the animals themselves to obtain more gross results of value in terms of our own life before all of the intricate individual processes can be learned and life itself synthesized thereby.

**II.**

Nutritional thinking, however, is moving forward rapidly. It is not limited to compounds like the carbohydrates or proteins and the chemical reactions they undergo. It is giving detailed attention to the catalysts that speed these reactions, if vitamins can be considered in this category. Body catalysts for improved mineral management, like thyroxin for example from the thyroid gland and the activities of the parathyroid in control of the calcium and phosphorus in storage and in circulation, they are bringing into the limelight the importance of supplies of these elements as well as their catalysts.

Calcium behavior in nutrition is no exception to this concept of complex interrelation when its supplies in the bones, in the bloodstream, and in the alimentary tract may be moved through this series in either direction according to certain relations of its amounts to the supplies of the catalyst, vitamin D, exercising control. Then when there are a dozen soil-given elements, each with its variable supplies and possible catalyzed behaviors to be synchronized, the possibilities for shortages or deficiencies multiply themselves quickly. Attention to calcium can only be in terms of its deficiencies as gross manifestations, when all of its many functions are not yet catalogued.

The soil is formed from the rocks and the minerals by the climatic forces of rainfall and temperature. The presence or absence of calcium in the soil has long been the soil scientist’s index of the degree to which the soil has been developed or to which the rocks have moved towards solution. As rocks are broken down to form soil by increasing but not large amounts of rainfall, there is an increase in the soil’s content of active calcium. Then as the larger amounts of rainfall go higher and temperature increases also there is calcium depletion. Life forms, whether of the lower, like the microbes, or of the higher, like plants, and animals, all are part of this calcium picture. The distribution of the different plants and of the different animals as well as their densities of population take their ecological pattern very much according to the calcium supply. The United States divide themselves readily into the East and the West, according to the lime content of the soil. The dividing line across central United States puts lime-rich soils to the west and the calcium-deficient soils, to the east. This is also according to the lesser amounts of rainfall to the west and to the higher rainfalls and temperatures to the east, these differences having been so related as to weather the soils just enough to leave those in the West with calcium, and to carry the weathering to the point of the removal of the calcium in the East. Higher temperatures and rainfall as in the southeast, not only remove the calcium but change the clay complex so that it has little holding or exchanging capacity for any of the soil mineral elements.

In these facts there is the basic reason for calcium deficiency and many other deficiencies in the humid tropics. Here is the basic reason for the confinement of the population of the wet tropics mainly to the seashores where fish return the flow of soil fertility in part from the sea back to the land. Such facts account for the sparsity of population in the humid tropics and yet we marvel at the tremendous vegetative growth of jungle densities. We forget that its contribution for human use is mainly wood or fruits, which if not actually poisonous have little food value and at best only drug value as the coffee, the cinchona, and the alkaloids. It is this larger soil picture with its highlights of calcium presence and its shadows of calcium absence that makes the pattern to which all life, whether microbe, plant, animal, or man, must conform.

Microbes as the agencies of decay testify to the level of the nutritional conditions by their rates of destruction of the debris which they rot or on which they feed. Pine needles decay slowly because they are grown on a calcium-deficient soil and are consequently deficient in this element essential in the diet for microbes, and deficient in all the nutritive values associated with calcium in plants. Timothy hay and timothy sod decay slowly. Clover hay and clover sod rot quickly. “Clover and alfalfa hays” says the farmer, “are hard to make because they spoil so quickly.” This is merely saying that such hays, as products of soils rich in calcium and therefore themselves rich in this element, allow the bacteria to multiply faster, or nourish themselves better. Consequently, they consume clover and alfalfa hays more rapidly than they consume timothy or pine needles. Cattle choices agree with the microbial choices.

Rapid decay of certain substances points to these as balanced diets for microbes and is an index of chemical composition and nutritional value for higher life forms that we too often fail to appreciate. We have been thinking of the disappearance of the debris as it rots and have not been measuring the growth of the microbial crop. Microbes, as a kind of guinea pig, for quick evaluation of the dietary contributions of the substances on which they feed, offer a neglected scientific technique for judging much that might be considered human food. Insects can serve likewise. If neither microbes nor bugs care for certain substances should these be considered as of food value for higher life forms? Whole wheat flour “gets buggy” so much more readily than white flour and by just that much is it a more wholesome food?

Calcium for microbes in the soil’s service as a plant food factory has only recently become appreciated. Legumes cooperate with nodule bacteria for the appropriation of nitrogen from the air in many soils only when calcium is supplied as lime. Not only the plant, but the legume microbe too, makes high demands for calcium. The microbe separated from the plant must be given liberal supplies of calcium if this cooperative struggle for nitrogen or protein is to be successful.

**III.**

Microbial decay processes within the soil by which nitrogen as ammonia is converted into nitrate also depends on the calcium supplied. Unless the clay of the soil, for example, has calcium present in liberal amounts, this conversion of nitrogen does not proceed rapidly. The function of calcium, as it makes the phosphorus of the soil more effective, was suggested by microbial behaviors. With calcium and phosphorus absorbed on a clay medium, the growth of certain microbes made the medium acid while other, but closely similar, microbes made it alkaline. This difference occurred because both calcium and phosphorus are brought off the clay and into solution with the result that intermittently one or the other of these dominates over the other; phosphorus dominating to make the medium acid, calcium domination to make it alkaline. Microbes apparently separate both calcium and phosphorus at the same time from the absorption forces of the clay but consume one or the other differently after this separation to bring about the acidity or the alkalinity. Here are calcium and phosphorus in the microbial diet, and here they are closely associated in their nutritional services just as they are found associated in plants, and just as they function together in animals mainly as the compound of the different calcium phosphates.

Microbial nutrition suggests itself as indicator of soil fertility and therefore of plant and animal nutrition. Microbes, as they grow rapidly and rot vegetation quickly, or conversely as they grow slowly and rot it slowly, indicate the soil nutrient supply by revealing the composition of the products grown by that soil. Pine needles decay slowly. Oak leaves decay slowly, but elm, linden and other soft wood leaves decay rapidly. The Swiss farmer selects leaves from the portion of the forest with the soft wood trees for bedding litter for his cows and goats because these leaves rot more completely in the manure than oak leaves do. The service of the leaves in decay when mixed with animal excrement and in the return of their nutrients to nourish the grass are judged by the Swiss farmer through this microbial indicator. The rate of decay can be taken as a universal indicator of the nutrient balance for microbes and therefore as balance for higher life forms.

The organic matter produced on a soil and going back into the soil reflects by its rate of decay the plant composition and therefore the soil fertility producing it. The size of the microbial crop as reflected by its activity and like any other vegetation is determined by the nutrients being mobilized in the soil. If calcium is deficient there, then the organic matter grows a less proteinaceous composition or is mainly of carbonaceous content. Such vegetation is a poor microbial diet. It reflects this factwhen it accumulates or remains for a longer time while the proteinaceous, or more calcium-rich decays more rapidly.

The microbes, as lower plant forms, give us the ecological pattern of higher plants serving to nourish higher animal forms. They point out, in general, that the vegetation produced on soils amply supplied with calcium is mineral-rich and proteinaceous to serve the microbes well in their nutrition. On the soils deficient in calcium, the vegetation is carbonaceous, protein-deficient, mineral-deficient, and lacking in many organic and mineral complexes requisite not only for microbes but for the higher life forms as well.

Microbes give us this larger ecological picture in agreement with the soil map of the United States. Prairie soils or calcareous soils, with their proteinaceous and mineral-rich vegetation are in the West and forest soils and carbonaceous vegetation are in the East. Calcium is the index factor associated with these differences. As a very helpful factor, it needs to be given recognition and attention in connection with the larger picture of crops and foods of correspondingly variable nutritional values produced on these different soils.

**IV.**

The delayed appreciation of the significance of calcium in plant nutrition may be laid at the doorstep of a confused thinking about liming and soil acidity. The absence of lime in many soils of the non-temperate zone has long been known. Lime in different forms such as chalk, marl, gypsum, or land plaster, has been a soil treatment for centuries. Lime was used in Rome in times B.C., and the Romans used it in England in the first century A.D. Chalking the land is an old practice in the British Isles. The calcareous deposits like “TheWhite Cliffs of Dover” were appreciated in soil improvement for centuries before they were commemorated in song. Liming the soil is a very ancient art, but a very recent science, of agriculture. It was when Leibig, Lawes and Gilbert, and other scientists began to focus attention on the soil as source of chemical elements for plant nutrition that nitrogen, soluble phosphate, and potassium became our first fertilizers. It was then that the element calcium and the practice of liming were put into the background. Unfortunately for the wider appreciation of calcium, this element in the form of gypsum was regularly a large part of the acid phosphate that was applied extensively in fertilizer to deliver phosphorus. Strange as it may seem, superphosphate fertilizer carries more calcium than it does phosphorus, and consequently calcium has been used so anonymously or incidentally that its services have not been appreciated. Fertilizers have held our thought. Calcium was an unnoticed concomitant. It has been doing much for which the other parts of the fertilizers were getting credit. Appreciation of the true significance of calcium in plant nutrition was therefore long delayed.

More recently soil acidity has held attention. This again has kept calcium out of the picture. Credit for the service of liming has been going to the carbonates with which calcium is associated in limestone. It was a case of the common fallacy in reasoning, namely the ascribing of causal significance to contemporaneous behaviors. Here is the line of reasoning: “Limestone put on the soil lessens the acidity, and limestone put on the soil grows clover. Therefore the change in acidity must be the cause of the growing clover.” At the same time, there was disregarded the other possible deduction, namely: “Limestone put on the soil applies the plant nutrient calcium. Therefore the applied calcium must be the cause of the growth of clover.”

The labeling of calcium as afertilizer element of first importance was delayed because scientists, like other boys, enjoyed playing with their toys. The advent of electrical instruments for measuring the hydrogen ion concentration gave tools and inducement to measure soil acidity everywhere. The pH values were determined on slight provocations and causal significance widely ascribed to them, when as a matter of fact the degree of acidity like temperature is a condition and not a cause of many soil chemical reactions. Because this blind alley of soil acidity was accepted as a thoroughfare so long and because no simple instrument for measuring calcium ionization was available, it has taken extensive plant studies to demonstrate the hidden calcium hungers in plants responsible in turn for hidden but more extensive hungers in animals. Fortunately, a truce has recently been declared in the fight on soil acidity. What was once considered a malady is now considered a beneficial condition of the soil. Instead of a bane, soil acidity is a blessing in that many plant nutrients applied to such soil are made more serviceable by its presence, and soil acidity is an index of how seriously our attention must go to the declining soil fertility.

Now we face new concepts of the mechanisms of plant nutrition. By means of studies usingonly the colloidal, or finer, clay fraction of the soil, it was learned that this soil portion is really an acid. It is also highly buffered or takes on hydrogen, calcium, magnesium, and any other cations in relatively large quantities to put them out of solution and out of extensive ionic activities. It demonstrated that because of its insolubility, it can hide away many plant nutrients so that pure water will not remove them, yet salt solutions will exchange with them. This absorption and exchange activity of clay is the basic principle that serves in plant nutrition. This concept comes as a by-product of the studies of calcium in relation to soil acidity.

Imagine that a soil consists of some calcium-bearing minerals of silt size mixed with acid clays. The calcium-bearing mineral interacts with the hydrogen of the acid clay. The hydrogen goesto the mineral in exchange for the calcium going to the clay. Imagine further that the plant root enters into this clay and mineral mixture. It does so more readily because of the presence of the clay. It excretes carbon dioxide (possibly other compounds) into this moist mixture to give carbonic acid with its ionized hydrogen to carry on between the root acid and the clay particle and the mineral. The hydrogen from the root exchanges with the calcium absorbed on the clay in close contact.

Thus plant nutrition is a trading business between root and mineral with the clay serving as the jobber, or the “go-between.” The clay takes the hydrogen offered by the root, trades it to the silt minerals for the calcium and then passes the calcium to the root. Thus nutrients, like calcium, and other positive ions as well, pass from the minerals to the clay and to the root, while hydrogen or acidity, is passing in the opposite direction to weather out of the soil its nutrient mineral reserve and leave finally the acid clay mixed with unweatherable quartz sand. Acid soils are, then, merely the indication of nutrient depletion.

**V.**

Calcium plays more than the role of moving only itself into the plant. This element is serving, apparently, in the mechanism of moving other nutrients into the plant (and possibly excluding some non-nutrients). Careful studies of plants growing on colloidal clay have shown that no growth is possible unless calcium is moved into the crop. As the supply of calcium becomes lower, the crop may be growing but losing back to the soil some of the potassium, some of the nitrogen, some of the phosphorus, and even some of the magnesium planted in the seed while taking none of these nutrients from the soil. Unless the calcium is serving its function in the plant, the crop may be growing and contain in both the top and the root less nitrogen, potassium, and phosphorus than was in the planted seed.

Here is an unappreciated service by calcium. Calcium is associated with more delivery of phosphorus to the crop when a phosphorus application on limed land, for example, puts three times as much of the phosphorus into the crop as when phosphate fertilizer is put on without lime. It is associated with the more effective movement of nitrogen from the soil into the crop. It plays some role, possibly in the mechanism of the root membrane through which phosphorus goes more efficiently perhaps as a calcium phosphate than as any other form. Nitrogen may go through more effectively as a nitrate. Here are some services by calcium of which the details of mechanism will be fully elucidated only by future researches.

Calcium plays what might be termed the *leadership* role amongst the nutrient ions not only as to their entrance into the plants but also as to their combination into the proteinaceous compounds around which cell multiplication and life itself center. As the protein concentration of forages rises, there is also an increase in the calcium concentration. Also there is accumulation of evidence that with the increase in protein there goes an increase in vitamins. Legumes, the more nutritious of the forages, have long been known for their demand for calcium and high content of protein. They are also high in other minerals, so that calcium in the plants seems to synthesize the soil-borne nutrients into the organic combinations though it does not itself appear as part of the final products. Potassium, quite unlike calcium, is more directly effective in the compounding of air and water into carbohydrates, and like calcium does not itself appear in them. Potassium is effective in making bulk or tonnage, of forage. Calcium is effective in bringing higher concentration of proteins, and other nutrients essential, within that bulk. Accordingly as the active calcium dominates the supplies of nutrients in the soil, so proteinaceous, and with it a high content of growth minerals, characterize the vegetation produced on the soil. As potassium dominates, there is plenty of plant bulk but its composition is highly carbonaceous or it is dominantly woody.

Here is a general principle that is helpful in understanding the ecological array of vegetation. According to it, the vegetation is highly proteinaceous and mineral-rich on our prairies in the soil regions of lower rainfall or those soils retaining a high mineral content with calcium prominent. Contrariwise, vegetation is mainly wood, or like the forest, on the more leached soils with lower mineral content but with potassium naturally dominant.

This ecological picture served as a stimulus for some soil studies of the chemical activities of the potassium and the calcium when present on the clay in different ratios. Prof. C.E. Marshall of the University of Missouri, has designed electrodes and membranes for measuring the ionic activity of calcium and potassium of the soil in the same way as hydrogen ion activities are measured. His data of what might be called pK, and pCa in the same manner as we speak of pH, demonstrate clearly that the ionic activities in a mixture of elements are not independent of each other as is true in mixtures of gases. Rather they are complimentary in some combinations, or opposing in others. Considering calcium and potassium in combination, the latter gains ascendancy in relative activities as the ratios between the calcium and the potassium become narrower. Thus as calcium is more nearly weathered out of the soil, potassium becomes relatively more active in moving into the plant. Here is the physicochemical soil situation that provokes the protein-carbohydrate relation which in turn represents the “grow” foods versus “go” food situation so prominently basic in our hidden hungers and the disturbed animal nutrition.

The soil as it is nourishment to make one kind of plant or another kind, that is, whether the plants are truly nourishment for animals or are only so much internal packing material, is the real basis for and real help in understanding the animal distribution whether wild or domestic, whether lower or higher. Cattle growing with ease and success is common in Texas, but meets increasing difficulties as one goes eastward. Donkeys are “sweethearts of the desert” where their sure-footedness—and sturdy but fine bones—among rock soils may well be associated with highly calcareous feeds grown in more arid regions. Crossbred with the horse, the resulting hybrid, or mule, is at home farther east in higher rainfalls and on more leached soil areas. But even then, he is found most commonly on the limestone soils of Missouri, Arkansas, Kentucky, and Tennessee. Grown to maturity in these areas and then shipped to the cotton South, the mule survives to render labor because with no hope for posterity his calcium supply transported within him in his bones is not depleted by reproductive demands. Picture further the sheep and goat according to their concentration on different geographic areas, and with them to go the increase of so-called “troubles and bad luck” in raising them as they are in the humid, more acid soil regions. The soil fertility, so prominent as the foundation of animal reproductive performances, has not been appreciated. We need to see our most nutritious foods in those animal products connected with the reproduction of the animal, namely eggsand milk. Reproduction goes forward only on a plane of liberal supplies of soil fertility and is therefore the safety factor in our living and can be a safety factor in our thinking.

This picture of animal ecology and its nutritional reasons based on the soil does not present itself without calcium playing a prominent part in the causal forces. Soil treatments that supply calcium in the humid regions are readily detected by the animal if it is given an opportunity to manifest choice of grazing the herbages on differently treated areas. Domestication has dulled the instinct of wise food choice in some animals, as for example, greediness of the high-producing milk cow brings bloat on herself. This is less common among cows not so highly domesticated toward intensive milk production. Nevertheless, there is still enough appetite instinct left in the cow when she refuses to eat the grassspot where urine was dropped to bring about unbalanced plant composition by an excessive nitrogen application. Her refusal to eat sweet clover, and her preference for bluegrass over white clover, are all evidence that the foster mother of the human race is her own nutritionist and knows her carbohydrate-protein ratios for a well balanced diet. She is demonstrating daily her appreciation of the whole series of effects and causes in variable plant composition as they go back through vegetation to the soil to demonstrate relations between calcium and potassium, and other nutrient ions of the soil. We need to observe our animals and learn from them. When we accuse the mule of stubbornness in his refusal to eat or to drink, the reflection may not be on this dumb beast as much as on his master, too stubborn to learn from nature.

**VI.**

By means of the biological assay, our animals are telling us that they can be fed more efficiently by wise fertilizer treatments of the soil. Soil treatment is not merely a case of the plants’ service as mineral haulers to carry calcium from the field to the animal feedbox, but rather, lime, for example, is applied to make the plant factory much more efficient in gathering its various nutrients from the soil and still more efficient in synthesizing these with carbon, hydrogen, and oxygen from air and water into the extensive list of complexes and compounds whose service to growth and good health we are slowly unraveling. Soil management is more than a practice guided by economics; it is a responsibility of nourishing microbes, plants, animals, and humans to their best growth and health.

Animal growth studies testify to the importance of liming for its help in better animal nutrition. Sheep studies and rabbit feeding trials using Missouri soils with various forages point clearly to the more efficient conversion of roughages into meat when lime was used as a soil treatment. Increases as high as 50 percent in animal growth from the same amount of feed consumed are efficiencies that surely cannot be disregarded when food is to win the war and protein is the particular food deficiency. In terms of production with reduced labor, the better feeding of animals by means of soil treatments surely must not be neglected when the same acre with a constant labor input can deliver so much more as food products in the form of meat.

Improved products from animals come in for greater efficiency also by way of lime and fertilizer used on the soil. The wool of the sheep was improved when fed hay grown on soil given lime and phosphate over that grown where only phosphate was used. Fatty secretions were visibly different but quality differences in the fiber were revealed on scouring the wool. Milk, another animal secretion, so commonly considered of constant nutrient value has permitted rickets in the calf, irrespective of ample green feed and ample sunshine for both mother and calf on soils deficient in lime.

Animals and their products have been a safety factor in man’s diet in that animals are additional helps in collecting from a wider range all possible helps toward the food man needs. Historic man’s survivals have possibly been more largely the result of his herds and flocks than we are wont to believe. But even with the help of animals the soils may still be so deficient that animal products fail to give the full service commonly credited to them. As we push meat and animal products out of their more common place in our diet, and as we go more nearly to strictly vegetarianism, the attention to the soil is all the more important. Man dare scarcely circumvent the animal in the biotic pyramid suggested by Aldo Leopold that includes soil, microbes, plants, animals, and man in that order from the bottom upward. He may claim vegetarianism, in that he survives without consuming meat, but seldom does he exclude milk, cheese, and fish completely and become strictly vegetarian. It is true that nations, highly vegetarian like the Chinese and Japanese, consume mainly rice. It is granted that they are highly vegetarian but not to the exclusion of the minimum of some chicken broth or some fish. This fish required for survival may be only the head of this animal as reported by J.B. Powell, the journalist of Japanese prison experience, whose refusal to eat even this amount of animal products cost him his feet, lost by gangrene, when the companion prisoners as fish head eaters were not so unfortunate.

Current attention to the calcium and other fertility elements in the soil promises better nutrition and health. Although proper nutritional requirements are still very much the result of chemico-analytical thinking, we are still discovering more essential parts in the proper diet. We are not yet strictly synthesizing purely chemical diets. A significant share of a good diet still consists of the so-called “natural” food so that nature is still, for many of us, the best dietician when we prefer to stake our future health on omnivorousness and plenty of natural foods from fertile soils. Synthetic diets will meet the supreme test, not when they are merely able to make animals grow or to keep them alive, but rather only when they can carry animals through their regular reproductive cycles for several generations with numerous and healthy offspring. The natural growth processes, initiated and guided in the main by the chemical nutrients coming from the soil, are still the main basis of nutrition. Calcium as the foremost element on the list of the nutrients demanded from the soil has given us a pattern of the importance of its role in nutrition. It points with suggestions of importance to the other nine or more elements whose nutritional significance we do not yet understand as well. Observations and scientific studies under the present appreciation of our soil as the basis of health will soon increase our knowledge of nutrition when we recognize the larger principles as they apply to all the life forms including microbes, plants and animals no less than man. We shall rapidly come to recognize that our national health lies in our soil and our future security in soil conservation guided by nutrition’s universal laws.

*By William A. Albrecht. University of Missouri College of Agriculture, Columbia, Missouri. Reprinted with the author’s permission from The Land, Vol. 3, No. 1, December 1943, by the Lee Foundation for Nutritional Research.*