Let's Live Magazine, January, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

"A Few Facts About Soils"

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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Over a century ago the federal Congress pointed out the serious need for soil conservation. In view of this and also of the fact that conservation spells sound economics for those who manage and use the soil, it is disturbing that soil maintenance is still neglected.

In the printed report, "Executive Document No. 20, to the First Session of the 31st Congress by the Commissioner of Patents, the Hon. Thomas Ewbank, for the year 1849", it is significant to note that this volume of assembled writings of capable authorities begins with emphasis on agriculture through the maintenance of the soil, which, they said, "should be carefully studied by everyone who desires to enjoy sound health and a long and happy life."

Nutrition recognized

At that early date it was announced that the health of each of us is our own individual responsibility, rather than the responsibility of what is now confused as "public health" by administration (via medicated water supplies, for example). "Most of the ills that flesh is heir to, as well as maladies of plants," according to that document by the printers to the House of Representatives, "have their origin in the violation of nature's laws." Already the dependence of us all upon the fertility of the soil that is nutrition and health was recognized.

The initial paper of the annual report is by one Daniel Lee, M.D. He deplored the scant attention given to agricultural education. Even he began his remarks with emphasis on the soil. "It is indeed wonderful," he said (on the seventh page of the report of the Commissioner of Patents, under whom agriculture was listed at that early date), "how long those enlightened, reasoning farmers who, like Washington, cherish a due respect for their high calling, have had to beg and beg in vain of State Legislatures, and of Congress, for a little assistance to prevent the universal impoverishment of American soils. Whatever has been done to arrest the exhaustion of aerated lands has been effected not only without due aid from Government, but in spite of a mistaken policy, which encourages the removal of all the elements of bread and meat from cultivated fields, and their speedy transportation beyond the possibility of restitution."

After six pages of citing the need for more agricultural statistics, Dr. Lee gives "A Few Facts About Soils" which deserve repetition, for they bear the same significance they did in 1849:

1 part in 1000

"Soils contain, as a general thing, not more than one part in a thousand of the atoms, in an available condition, which nature consumes in forming a crop of any kind. This statement expresses a fact of great practical importance; since the husbanding of these fertilizing atoms is the first step toward arresting the impoverishment of the earth. It is the matter in the soil which makes crops in one arrangement of its atoms, and forms manure in another condition of the same atoms, that the farmer should learn to preserve from waste and loss. [1]

"Soils of different degrees of productiveness, where their mechanical texture and physical properties are alike, always contain unlike quantities of the food of crops. It seems to make little difference how small is the amount of the lacking ingredient of the composition of cultivated plants. Its absence is fatal to the farther growth of the crop after its appropriate aliment fails in the soil. It is easy to discover the wisdom of this universal law. [2]

Could supply?

"Suppose nature should organize grass, grain, and other plants, which serve as daily food of all the higher order of animals, as well without bone-earth (phosphate of lime) as with that mineral--would it be possible for such grass and grain to yield to the blood of domestic animals, and of man himself, that solid earthy matter which imparts strength to human bones and to those of oxen, horses, sheep and swine? Certainly not Although *iron* is always present in the food and blood of animals, no farmer ever killed a calf, a pig, or an ox which had iron for the frame of its system. No anatomist ever saw a bone in a body of a person formed of other than the earth's atoms such as Providence has fitted for that peculiar function in the animal economy.

"The brains and muscles of all animals contain both sulphur and phosphorus, as constituent elements. If their daily food, derived as it is from the soil, lacked either sulphur or phosphorus, must not this radical defect in their nourishment soon induce weakness and disease, and finally result in premature death? To prevent consequences so disastrous and so obvious, nature refuses to organize plants without the presence in the soil, *in an available form,* [3] of those peculiar atoms adapted alike to the wants of vegetable and animal vitality. This wise provision should be carefully studied by everyone who desires to enjoy sound health and a long, happy life.

"There are only some fifteen kinds of elementary bodies used by nature in forming every vegetable and animal substance produced on the farm, in the orchard, or in the garden. . . . Every product of agricultural labor is either a vegetable or an animal substance; and in its production, not an atom of new matter is called into existence; nor is it possible to annihilate an atom when it decays. [4]

"In the language of science, all matter which is neither vegetable nor animal, including air and water, is *mineral.* [3] All minerals are either solids, like sand, clay and lime; or liquids like water; or gases like common air. The farmer deals largely with atoms in each of these forms. . . . He should know that plants alone subsist on mineral or disorganized food--that if it were not for plants in the ocean or on the land, neither marine nor land animals could have a being. In the absence of all vegetables it is obvious that all animals must be carnivorous or cease to consume the organized aliment. Being wholly dependent on mutual destruction for the means of subsistence, every day would diminish the aggregate supply of food, and the last animal would soon die of starvation."

It is helpful to reread some of these basic facts today, when the contention has been common that the soil has no effect on the nutritional or health values of the food products we consume. Also, when we and our food are so far removed from the soils that create both of us, the remarks by this doctor of medicine over a century ago are most significant. They verify the truth in the age-old statements, "We are what we are because of where we are", and "We are what we eat." There are many hidden helps for health in unopened books about nature's immutable laws exhibited by agriculture.

1. Rpt. of the Commissioner of Patents for the year 1849. 31st Congress, 1st Session, Part II Agriculture, Washington, 1850, p. 23.

2. This duplicates what later was the "Law of the Limiting Element", attributed to Justus van Liebig, of Germany.

3. In italics in the original.

4. A similar statement of science now is known as "The First Law of Thermodynamics".

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HIDDEN IDEAS IN UNOPENED BOOKS

"Agricultural Education"

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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The lack of agricultural policy, the prevailing government discords concerning any policy, and the need for an educated citizenry that appreciates agriculture and the soil as our basic resource supplying food, was a complicated problem a century ago. That we have no better solutions for the problem today than the Congress had for it in 1849 is a lamentable fact when we boast of the high literacy of our population.

As basis for this lament, even a century ago, there was the report in 1849 by Daniel Lee, M.D.* that "As a nation of farmers, is it not time that we inquire by what *means,*** and on what *terms,* the fruitfulness of the earth, and the health and vigor of its invaluable products, may be forever maintained, if not forever improved?

"A governmental policy which results in impoverishing the natural fertility of land, no matter by what particular name it is called must have an end. It is only a question of *time* when this truly spendthrift course, this abuse of the goodness of Providence, shall meet its inevitable punishment.

Land's fertility

"To illustrate such an important fact as well as a principle, let us suppose a farmer produces crops worth $1000 and they cost him, including all expenses for labor, wear of implements, interest on capital, etc., $850. But it often happens, if he should undertake to replace in his cultivated fields as much of the potash, soda, magnesia, phosphorus, soluble silica, and other elements of crops, both tillage and cropping had moved, it would cost him $175 or $200 to effect that purpose. It is only by *consuming the natural fertility of the land* ** that he has realized any profit.

"In a national point of view, all labor that impoverishes the soil is worse than thrown away. No fact in the science of political economy is more important than this. . . . This to impoverish land is to wither the muscle of both man and beast employed in its tillage.

"If all the sheep in the United States gave us as good returns in wool for the feed consumed, as the best 100,000 do, it would add at least 60 million pounds to the annual clip of the important staple.

"In one of his letters to Sir John Sinclair, General Washington said, in substance, that, at the time he entered the public service in the War of the Revolution, his flock (about 1,000) clipped five pounds of wool per fleece. Seven years after, when he returned to his estate, his flock had so degenerated that it gave an average of only two and one-half pounds per head, which was the common yield of Virginia sheep then as it is now.

Less and less productive

"Neither the earnest recommendations of the illustrious farmer of Mt. Vernon, nor the prayers of two generations of agriculturalists, nor the painful fact that nearly all tilled lands were becoming less and less productive, could induce any legislature to foster the study of agriculture as a science. Happily, this term, when used in connection with rural affairs, is no longer the subject of ridicule. Some pains have been taken in this report, to prove that $1,000 million, judicially expended, will hardly restore the 100 million acres of partially exhausted lands of the Union to that richness of mould and the strength of fertility for permanent cropping, which they possessed in their primitive state.

"The continued fruitfulness of the earth is an interest far greater and more enduring than any form of government.

"If the 22 million people now in the United States may rightfully consume the natural fertility of one-third of the arable lands of the country, the 44 million who will be here 25 years hence may properly extinguish the productiveness of the remaining two-thirds of all American territory.

Wanton waste

"There has been enough of the elements of bread and meat, wool and cotton, drawn from the surface of the earth, sent to London and buried in the ground or washed into the Thames, to feed and clothe the entire population of the world for a century, under a wise system of agriculture and horticulture. Down to this day, great cities have ever been the worst desolators of the earth. It is for this that they have been so frequently buried many feet beneath the rubbish of their idols of brick, stone, and mortar, to be exhumed in after ages. . . . Their inhabitants violated the laws of nature which govern the health of man and secure the enduring productiveness of the soil. How few comprehend the fact that it is only the elements of bread and meat evolved during the decomposition of some vegetable or animal substance that poison the air taken into human lungs, and the water that enters the human system in daily food and drink! These generate pestilence and bring millions prematurely to their graves.

99 in 100

"Why should the precious atoms in potash which organized the starch in all flour, meal and potatoes consumed in the cities of the United States in the year 1850 be lost forever to the world? Can a man create a new atom of potash, or of phosphorus, when the supply fails in the soil, as fail it may under our present system of false economy? Many a broad desert in Eastern Asia once gladdened the husbandman with golden harvests. While America is the only country on the globe where every human being has enough to eat, and millions are coming here for bread, how long shall we continue to impoverish 99 acres in 100 of all that we cultivate?

"Both pestilence and famine are the offspring of ignorance. Rural science is not a mere plaything for the amusement of grown-up children. It is a new revelation of the wisdom and goodness of Providence--a humanizing power, which is destined to elevate man an immeasurable distance above his present condition. To achieve this result, the light of science must not be confined to colleges; it must enter and illuminate the dwelling of every farmer and mechanic. The knowledge of the few, no matter how profound or how brilliant, can never compensate for the loss incurred by neglecting to develop the intellect of the many. No government should be wanting in sympathy with the people, whether the object be the prevention of disease, the improvement of land, or the education of the masses. One per cent of the money now annually lost by reason of popular ignorance will suffice to remove that ignorance.

"If 'knowledge is power', ignorance is *weakness;*** and the removal of this weakness is one of the highest duties of every republican government. Either the assessors or collectors of state and county taxes should be provided with blanks to collect useful information, as well as money, from the people.

Obligation

"There appears to be no government that realizes its duty 'to promote the general welfare' by widely diffusing among its citizens a knowledge of the true principles of tillage, and by impressing upon them the obligation which every cultivator of the soil owes to posterity, not to leave the earth in a less fruitful condition than he found it."

A century ago this doctor left that suggestion which would give us a set of officials who are better informed on the problems of the callings and struggles of those from whom they are taking the moneys for government. It would generate their more sympathetic understanding of the difference between earning a living in cooperation with mother nature and collecting it from human nature.

* *Report of the commissioner of Patents for the year 1849. Part II Agriculture. Thomas Ewbank, Washington, 1850.*

** *In italics in the original.*

Let's Live Magazine, March, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

"The Natural" vs. "The Artificial"

(Of the Land and Landscapes in our Future) [1]

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
Prof. Emeritus of Soils, College of Agriculture, University of Missouri, Columbia, Mo.

It is all too easy to criticize a new landscape and to say that it is good or bad, beautiful or monotonous. . . . This vagueness lies in the lack of any scale which would help us to make evaluations . . . from a functional and aesthetic point of view. Good or bad must be related to something.

"Observing the changes of the rural landscape in most countries, the conclusion may be drawn that modern man is not only the conqueror but also the originator of vacua. The most representative phenomenon of contemporary landscape development is not the reclamation of deserts and sea-lands, but the creation of vacant landscapes where there formerly existed a wholesome human environment.

Treated as a vacuum

"During the past 100 to 150 years our expanding technological civilization [2] treated much of the old land as if it was a vacuum. By systematic burning and clearing of vegetation, by levelling and rectangular subdivision, the *'tabula rasa'* [3] for man's exhaustive economy was prepared. By disregarding the ecological chain of biological, topographical, climatic, hydrological and social conditions of life in the landscape, land management led finally to the creation of what the Dutch call so significantly 'the steppe of culture.' This widespread and monotonous type of landscape is characterized not only by being climatically and aesthetically unattractive but also by functional defects such as water and wind erosion, an unbalanced water cycle and declining soil fertility. The landscape constitutes today, a vacuum of a much greater extent than the potentially reclaimable water-covered and desert areas.

"The deterioration of the old rural landscape and the formation of an unsatisfactory environment on the new land cannot be explained just by what is called our 'alienation from nature,' or the artificiality of the environment created by us.

What's "natural"

"Let me state my interpretation of the notion 'natural.' I believe that *the notion of the 'natural' condition of man does not express a past condition, left behind with the process of civilization, but a balanced relationship between human capabilities and natural forces which can be achieved, renewed or reestablished at any level of civilization under the condition of the existence of wisdom, good will and energy.*

"The modified landscape is not identical with the unnatural landscape. I believe the cultural landscape is by definition always a man-modified environment. And yet, *in the past, the artificial increase of its functional values for man did not reduce its biological and aesthetic values.* . . . In the case of 'the steppe of culture' the land use aim is narrowly conceived as a rule, and of temporary nature. It is limited to the maximum exploitation of soil fertility within the minimum of time, and this implies a readiness to abandon the land after the exhaustion of its reserves as if it were a mine. . . .

Our cardinal aim

"*The fact that, in the past, communities realized that the land had to serve for generations as a cultivable and renewable source of life, as a permanent place of habitation, work, celebration, movement and rest, is the main cause for the sensation of environmental wholeness and aesthetic satisfaction which we experience in a preserved, traditional landscape.* As planners for the future of the land, however, our cardinal aim should not be to preserve or to emulate such landscapes, but to regain the scope; which originated in them.

"The most obvious aim for the development of new land lies today in the efficient and intensive production of food and raw materials for the needs of populations. *This is the quantitative aim and it should be brought into harmony with the broader spatial and temporal aims of development which we generally characterize as qualitative. It very often seems, though, that the quantitative aims emerge from the immediate short range considerations, and that the qualitative aims are related in the future."*

Three principles paramount

In his view of the future Dr. Glikson cites: "The first principle: The cultural landscape should be planned for an optimal sustained level of soil fertility. Consideration of the needs of intensive production on one hand, and of soil protection, vitalization of microbial soil life and preservation of the water cycle, on the other hand, have all to be taken into account and to be balanced with each other. Once this is accepted (we) make use of ecology as an applied science. A balanced relationship between man and the land means the achievement of a new ecological climate in the landscape, which is arrived at by a conscious and rational effort of man. . . . *Sustained soil productivity as a cardinal purpose of cultivation should become a major landscape-shaping factor overriding consideration of a more temporary character.*

"The second principle: The standard of living of a modern rural population in industrialized countries must be adjusted to that of the urban population, though *rural life will always represent a different kind of life.*

"The third point: The general increase of leisure and of demands for more first-hand experience of different environments, combined with the availability of faster and cheaper means of communication for the masses, have revolutionized the mobility of the whole population of industrialized regions. Today this free, so to speak, uneconomic movement is still in its very beginnings, but is rapidly gathering momentum.

The re-creational movement

"If there is any room at all for an optimistic view toward the future, one may forecast an uprise of the urge for direct biological and social contacts resulting, among other things, in a return movement of urbanites to the landscape. We should not regard this development as a new and overwhelming danger to the landscape. . . . It would involve the rediscovery, reconstruction, re-creation of the cultural landscape with the active participation of the urban population. We should meet this development by planning an environment both accessible and hospitable to what may be called the recreational movement, re-creational in both the passive and active sense of the word."

"The artificial" dare not go counter to, but must cooperate with, "the natural" in the creative forces by which alone all life survives.

1 Quotations from "Creating New Land: Designing our New Land" by Arthur Glikson, Israel, in "Space for Living." Amsterdam, 1961. Dr. Glikson tells us that landscapes depend on the soils.

2 "Man is not one five-thousandths as old as the planet he inhabits, and yet considers it his property. A few hundred years of technology have already disrupted biological and geological processes that were established over eons. A blind increase in population and industrial civilization threatens the ecological balance as well as human dignity." Paul B. Sears, "The Perspective of Time." Bul. of the Atomic Scientists, XVII: 323, 1961. No. 8.

3 "A mind free from impressions. A scraped tablet."

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HIDDEN IDEAS IN UNOPENED BOOKS

Salt Damage to Seedlings

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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Part 1

Even though we know that saline and alkaline soils damage the germinating seeds in arid regions, we seem to be little concerned about a similar injury from salt fertilizers drilled directly with the seedings on soils of the humid regions.

Yet such damage was demonstrated on Sanborn Field at the Missouri Experiment Station nearly 50 years ago. Apparently that unpleasant fact remains hidden in the field man's notebook, written carefully in longhand but never printed in publications emphasizing large yields from particular soil treatments or plant varieties.

When Prof. J. W. Sanborn laid out the plans for Sanborn Field in 1888, he wanted to learn what will result (a) when the soil is cropped continuously to wheat; (b) when the entire crop of straw and grain is removed; and (c) when the fertility equivalent of only the nitrogen, the phosphorus, and the potassium in the entire crop of 40 bushels per acre is put back in the form of commercial fertilizers. For the salts of that equivalent, he started with sodium nitrate (Chile saltpeter), acid phosphate (16%), and muriate of potash drilled with the fall seeding.

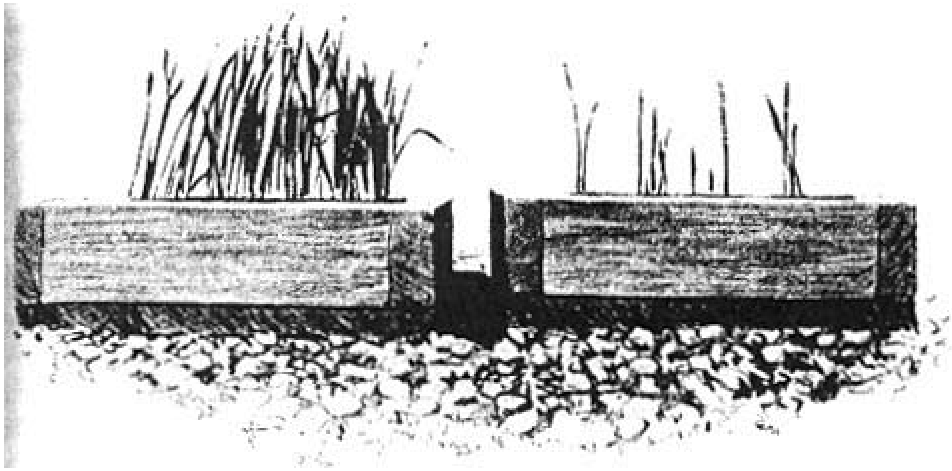
Unexpected findings

The early successful wheat yields were heartening. No one had anticipated a later demonstration of salt damage to the extent of complete destruction of the stand. That had not been put into the plan. It was merely an observation recorded in the workman's notebook and not in the "Official Records." That salt damage should occur was scarcely expected. There had been no previous injury from the fertilizer's contact with the seed, even at that heavy treatment, since the outset nearly 15 years before.

Destruction occurred

But after an unaccounted, yet significant, share of the virgin organic matter of the soil had fed the highly-stimulated microbial fires to burn that supply to a lower level of shock-absorbing capacity for salts, there occurred destruction of the stand following the seeding. There was at that time no thought of placing the fertilizer away from the seed when the cause of the trouble was suspected. Instead, as a test case, the application was split into two parts: one-half the amount drilled with the seedling, the other half applied as a surface dressing the following spring.

Later on in the history of that classic plot, similar trouble was experienced again. A more extensive number of fertility elements, such as the salts of the trace elements, were included in the treatment. This called for the practice of fertilizer placement to avoid the salt damage on the soil, which was now very low in its content of organic matter.



WHEAT EXPERIMENT WITH MIXED FERTILIZERS . . . Muriate of potash, nitrate of soda, and dissolved phosphate. Right, sown in rows. Left, mixed with the soil. (Illustration from Bulletin No. 24, Div. of Botany, Dept. of Agriculture.)

Reports show data

That early problem of damage by salt fertilizers brought about glasshouse tests of many oncoming kinds of fertilizers to learn their "maximum permissible concentration" for different crops and different soils. (The MPC used was for supposedly acceptable poisons in food). There have accumulated many notebooks reporting data by advanced students doing "special problems" and graduate theses. Among them are many interesting reports. These emphasized the damages to the legume crops, even before damage to the wheat, which was usually their "nurse crop." Legumes were recommended for their "natural" nitrogen fixation as more desirable than nitrogen salts fertilizer.

One single table from those student records will serve well here. It illustrates the wide range between danger and safety exhibited in the fertilizing materials and in two kinds of legumes tested in one trial, reported by the data in the table on the opposite page.

COMPARISON TABLE				
Soil Treatments Tested	**Rates of Application**	**Rates of Application**	**Emergence of Seedlings**	**Emergence of Seedlings**
	lbs./Acre	**Gms. / Lineal Ft. in Row**	**Per cent of No Treatment Red Clover**	**Per cent of No Treatment Sweet Clover**
(1) No treatment			100	100
(2) Agr. Limestone 10-mesh	500	4 gms 1 oz. / 7 ft.	91	121
(3) Agr. Limestone 20-mesh	500	1 oz. / 7 ft.	97	100
(4) Agr. Limestone 100-mesh	500	1 oz. / 7 ft.	82	112
(5) Agr. Limestone Superfine	500	1 oz. / 7 ft.	72	108
(6) Hydrated Lime Tailings No. 1	500	1 oz. / 7 ft.	12	57
(7) Superphosphate	250	2 gms. 1 oz. / 14 ft	81	105
(8) Superphosphate + Potash	250	1 oz. / 14 ft.	41	104
(9) Dibasic Ammonium Phosphate	125	1 gm. 1 oz. / 28 ft.	1.2	2.8
(10) Calcium Cynamid	200	1.6 gm. 1 oz. / 18 ft.	0	0

(Continued in May)

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Salt Damage to Seedlings

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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(Continued from April)

Last month we told of some of the early experiments conducted on Sanford Field at the Missouri Experiment Station, as disclosed in a fieldman's notebook, but never set up in print.

The problem of damage by salt fertilizers started glass-house tests later, and many notebooks containing data by advanced students have accumulated over the years. Among them are many interesting accounts of damage to legume crops. Legumes were emphasized for their "natural" nitrogen salts. The accompanying comparison table illustrates the wide range between danger and safety exhibited in the fertilizing materials and in two kinds of legumes tested in one trial reported by the data in the table.

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In those years when lime and phosphates for legumes were first emphasized for agricultural uplift, and the service by lime as plant nutrition rather than improved soil environment was a theory, a glass-house test was run on the possible damage to red and sweet clovers as reported for tested materials in the comparison table.

Erratic in germination

It is significant to note from the differing percentages for emergence of the sweet clover that this "hard-seed" crop was erratic in its germination and seedling survival. It was not so regular in responses as the red clover. Yet the seed was not "hard" enough to escape damages to the stand (as was true for red clover) when (a) the alkaline hydrated lime tailings, (b) the dibasic nitrogen salt of ammonium phosphate, and (c) the slowly-transforming calcium cyanamid were put in contact with it. The data is certainly not erratic in reporting those salt damages from soluble fertilizers.

Some disastrous effects

The more regular data by red clover shows that superphosphate (not inspected for water solubility) was not seriously disturbing to emergence. In fact, this seemed to be less so in the data for 250 lbs./Acre than was the superfine limestone for 500 lbs./Acre. When that phosphate was combined with potassium (a water-soluble salt) the emergence of the red clover was cut to reduce the stand of this legume plant seriously. But when phosphate was combined with nitrogen in dibasic ammonium phosphate, the damage by seed contact was disastrous.

While calcium in the limestone (as a carbonate rock) and in the superphosphate (as soluble gypsum) was apparently without damage to the seedlings of either legume, its combination with nitrogen, as occurs in calcium cyanamid, was the one test with most disastrous effects on both the red and sweet clover.

That cyanamid was most damaging was to be expected when this slowly-transforming compound was put in contact with the clover seed. It undergoes chemical changes when moistened. Time is required for about four steps in those changes by which the nitrogen separates completely from the calcium. However, alkalinity by the latter encourages formation of the di-cyandiamide compound, which is damaging to the seedling. By applying cyanamid ahead of seeding, the danger can be avoided.

Post-mortem learning

Though sad experience has told us long ago about possible crop damage from salt fertilizers in contact with seeds, that fact remained hidden from many. It took years to avoid the trouble through so-called "fertilizer placement" by special machinery, and by building up the soil fertility in advance of the seeding, especially by using the fertilizer ahead on green-manure crops, or via composts and other kinds of fertilizing organic matter. We learn by post-mortems more often and more sadly than by prophecies and reported facts.

Let's Live Magazine, June, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

Purpose of Liming Soil an Enigma

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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More than a quarter of a century ago, 400 samples of 21 different soil types of Missouri tested for exchangeable calcium showed a close relationship of the amounts of this insoluble but available plant nutrient to the soil's capacity to give good crop yields. That was also the time when limestone (calcium carbonate, and calcium-magnesium carbonate) was applied extensively for the purpose of reducing soil acidity, or raising the numerical value of the pH, i.e. the degree of acidity of the soil. The pH value as a soil test report was easily obtained by special laboratory equipment. But measuring the exchangeable calcium (or magnesium) was a tedious manipulation. However, the latter related the soil to potential crop production, while the pH was a technical expression not so readily connected with the nutrition of the crop plants.

Close agreement

At that early date, the evaluation of the soil types with their arrangement in order of decreasing production of crops and livestock and their similar classification as an arrangement into six groups, A, B, C, D, E, F--by the soil surveyors--showed a close agreement with their decreasing amounts of exchangeable calcium by soil test as set forth in the accompanying table.

TABLE: Soils arranged in Order of Decreasing Productivity Shows a Closely Similar Order for Their Amounts of Exchangeable Calcium.		
Groups	**Soil Types**	**Exchangeable Calcium, milligram equivalents per 100 gms. soil**
	Marshall	14.80
A	Summit	12.64
	Grundy	12.71
	Knox	11.32
	Pettis	10.86
B	Crawford	10.68
	Charlton	10.21
	Eldon	8.99
	Oswego	9.19
	Putnam	8.89
	Bates	7.86
C	Memphis	6.22
	Hagerstown	5.91
	Lindley	8.64
	Union	6.64
	Cherokee	5.57
	Baxter	5.57
D	Gerald	3.82
	Boone	7.59
E	Lebanon	5.51
	Clarksville	4.29

The more productive soils supplied calcium in this exchangeable form to plant roots in quantities three times as great as did the poorer soils. The total quantities so active were large enough, and the differences between soils were great enough, for an accuracy of measurement which left no doubt about it.

Evaluation possible

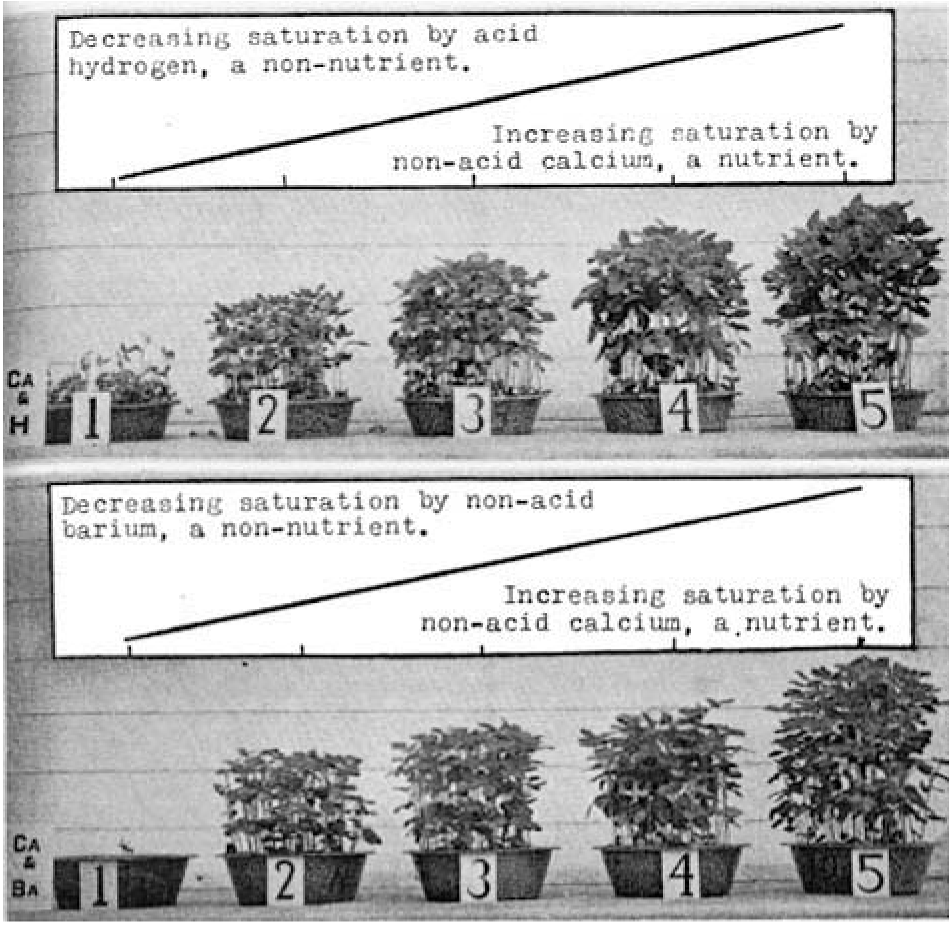
Measurements of the clay-humus in the soil made possible the evaluation of the degree of saturation of that part of the soil from which the calcium (and magnesium) are exchanged. Thus, soil testing for calcium moved itself more closely toward indicating potential nutrition of plants, especially the legumes as producers of proteins.

The term "pH" expresses the concentration of hydrogen as an active ion separated out of any compound. Like the calcium and magnesium, it too is a positively-charged one. Hence, any of these three can exchange for any other on the clay-humus colloid. Unfortunately, the hydrogen is not a plant nutrient coming from that source, while calcium and magnesium are. So when the hydrogen from cropping, weathering, leaching, etc. replaces the calcium and magnesium, we say the soil becomes "sour" and the crop fails. But the real cause of legume failures is the "going out" of the nutrients, calcium, magnesium, potassium, etc., the presence of which makes the soil non-acid, and not by the "coming in" of the hydrogen by which it is made sour or acid.

In error

When those two exchanges or soil phenomena occurred simultaneously with the legume failure the soil's increased acidity was quickly recognized. We made the error of considering the soil acidity, the hydrogen concentration, the cause of crop failure when it was the fertility deficiency of calcium (and magnesium), or the failing plant nutrition, that was responsible.

The validity of this conclusion was experimentally established by preparing a purely hydrogen-saturated clay and then separating lots of it as a series of increasing degrees of saturation by calcium. Half of these were prepared to give a series of increasing calcium saturation with reciprocally decreasing saturation by hydrogen, or with decreasing degrees of acidity.



SATURATION TEST . . . The soybean growth followed the increasing saturation of the clay and constant amounts of total calcium in the soil, regardless of whether the calcium was accompanied by decreasing acidity (Ca + H, upper series), or by no acidity and decreasing amounts of the non-nutrient Barium (Ca + Ba, lower series). Mo. Agr. Expt. Sta. Res. Bul. 243, p. 20, 1936

The other half of the lots was a series given barium to just replace the decreasing hydrogen or to approach the neutral condition for all of the lot. This gave increasing saturation by calcium and reciprocally decreasing saturation by the non-nutrient barium. These clays were added to sand in such amounts as to supply constant totals of exchangeable calcium per pot or sand-clay combination and were planted to soybeans. They resulted in literally duplicate series of crop growths according to the differing saturation by calcium that resulted, irrespective of the presence or absence of the acidity as shown in the accompanying illustration.

Enigma solved

Thus the enigma of the purpose of applying lime was solved long ago when such experiments told us that the benefit from liming the humid soil comes from its nourishment of the crop by calcium, and not from its reduction of the soil acidity by the carbonate accompanying the calcium in the limestone. Seemingly, this truth is still much hidden in unopened reports.

Let's Live Magazine, July, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

Immunity Against Leaf-Eating Insects Via Soil as Nutrition

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
Prof. Emeritus of Soils, College of Agriculture, University of Missouri, Columbus, Mo.

More than three decades ago researchers in soils at the Missouri Experiment Station turned to the study of the soil as the basis of nutrition. This was prompted by the vision of the creative biochemistry of plants as a unique performance in which that life stratum is the only one in the biotic pyramid (a) which captures part of the sun's energy and builds it into the carbohydrates as energy and body-fuel values for itself and for all other life forms dependent on it, and (b) which starts with a handful of ash elements from rock, soil, water, and air to create protein, the only chemical substance that carries life.

Important criterion

It seemed fitting that agricultural production should consider the health of the crops through proper nourishment as an important criterion of successful soil management. It certainly would impose more critical measures on that endeavor than those considering only bushels and tons of crop yields, or pounds of fattened livestock per acre, with emphasis on economic returns.

From soil as nutrition come health and survival values according to which evolution has thus far established the ecological pattern of microbes, plants, animals, and man. The need to measure biotic quality of agricultural production in terms of health and survival seemed self-evident for a research, project deserving public confidence and financial support.

Monetary support

In terms of immediate value for farm practices rather than basic physiological facts, such a project would anticipate being questioned. But industry quickly reported its interest in such research. It promptly offered its support through monetary grants. Consequently the soil as nutrition was set up in its research program. It was firmly established early by the discovery that the cohabitation of the nodule-producing bacteria with the legume plants enabled those crops to use atmospheric nitrogen for increased production of proteins, but only when the plants were healthy as the result of properly balanced fertility of the soil.

Refined controls of the soil fertility established the additional fact that the available nutrients determined the so-called "fixation" of nitrogen from the air into the living protein of the legume crops. This extra supply of nitrogen, going from the soil air via microbes, root-nodules, and balanced soil fertility, was found to be a unique help by which the plants not only produced more carbohydrates as fuel foods from sunshine energy, air, and water, but also synthesized therefrom more protein supplements which promote healthy growth, natural self-protection, and immunities.

Discoveries made

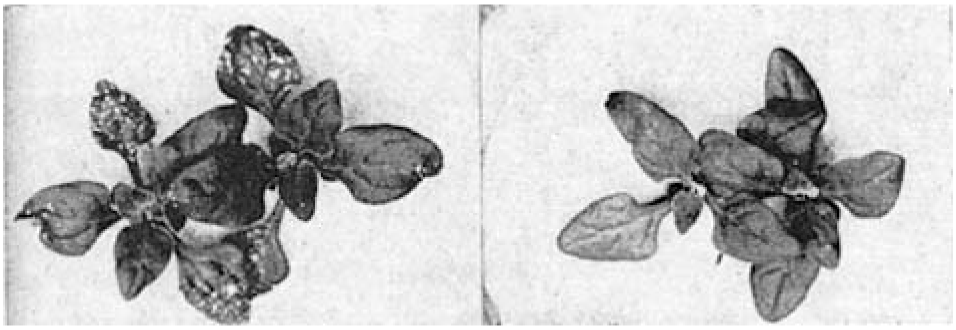
Through carefully controlled variations of plant nutrition by means of colloidal clay, [1] it was discovered that microbes and plants might be a case of either cooperation or competition. Under the soil's fuller services, including rock breakdown for required inorganic elements and the essential organic decomposition, the microbes causing nodular growths on the legume roots were not a dangerous germ giving destructive and malignant tumors. They were not signs of an infectious disease. On the contrary, they indicated mutually helpful services on the parts of both plant and microbe because the soil was the properly balanced nutrition for both. The soil was the difference between healthy plants and sick ones.

Natural evolution

The delicate variations in the suite of the nutrient elements absorbed on the controlled clay, as the highly dynamic soil, fraction in root contact, were the means of setting the stage for many (often accidental) exhibitions of the particular nutritional conditions which were established by natural evolution and are required to develop a crop to its healthy climax of immunity from pests and diseases. We forget that nature applies no poison sprays as external protection. Healthy growth through soil as proper nutrition brings internal immunity.

Accidental exhibition

As a clear-cut illustration of healthy and sick plants in terms of insect pests, there was the accidental exhibition by the non-legume crops of spinach. One-half was attacked by the leaf-eating thrips insects while the other half was completely immune and free of them. The damage was greatest where the soil offered the least nitrogen as plant nutrition; the immunity was greatest where more nitrogen was available. Simultaneously, there was a reduction in the severity of the attack according as the amounts of calcium available in the soil were increased. (See accompanying illustration.)



GROWS SELF-PROTECTION . . . The spinach plant was severely attacked by leaf-eating thrips insects (left) when the soil offered only 10 milligram equivalents of nitrogen per plant. But when the nitrogen offered was doubled, the plant grew a self-protection (right). Increasing the calcium served to grow larger plants.

Through doubling the amount of nitrogen given to the soil by three stages to give four rows with 5, 10, 20 and 40 milligram equivalents per plant, there was demonstrated the natural, accidental infestation by the thrips in the first two, and the complete self-protection in the second two rows. Even more significant was the additional protective effect by calcium on the infested rows as supplemental or better balanced nutrition.

Questions

Does this merely say that nature was successful in the course of evolution by simply feeding plants via soil to grow them healthy and immune to insect infestations? Does the converse not indict us? Are we not fighting infestations and infections of our garden and field crops because we do not manage the soil properly as nutrition for growing naturally healthy ones? Shall we not arrive at the all-important question and finally inquire whether crops which require artificial protection but are carried along in their unhealthy growth until harvest time can be a nutritional guarantee for healthy animals and for man consuming them? The varied vitamin C content, the accumulation of oxalates and other chemical data on the spinach were reported. Unfortunately, nature's facts reported by research have remained hidden in unopened books for one generation thus far to remind us that we learn but slowly.

(1) W. A. Albrecht. Colloidal Clay Cultures. Preparation of the Clay and Procedures in its Use as a Plant Growth Medium. Soil Sci. 62:23-31, 1946.

(Continued in August)

Let's Live Magazine, August, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

Immunity Against Leaf-Eating Insects Via Soil as Nutrition

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
Prof. Emeritus of Soils, College of Agriculture, University of Missouri, Columbus, Mo.

(Continued from July)

In the preceding number some hidden ideas were uncovered in the unopened volumes of research reports. We discussed the demonstration of the Missouri Experiment Station in which some spinach plants were either attacked by leaf-eating thrips or were immune to them, according to how much the soil was respectively deficient or sufficient in nutrition for the crop. The relations were shown for the variation of the element nitrogen and for calcium in combination with it.

There was the implication, then, that other nutrient elements might demonstrate similarly as determiners if we were able to choose and control the available amounts in the soil equally as accurately and appropriately as the nitrogen and calcium were controlled by means of the colloidal clay technique. The reported research included also the data on the measured damage to the leaves and some of the chemical analyses of the crops. Some of the latter deserve discussion to connect soil as nutrition for the plant with the nutritional values of vegetables for the human.

Questions raised

At the outset here, the immunity of the plants to insects should raise some simple questions when so much has been said about "resistance." We might question the technology of "systemic insecticides," or the use of poisons fed via the roots into the plant system to destroy the insects eating the growing crop. Our vision is reluctant to picture this means as a "natural" method of providing self-protection. As an illustration, the commercially available "Meta-Systox" arouses concern since, as a poisonous sulfur-phosphorus combination, it simulates Parathion, widely known for its serious danger to humans. There are scarcely such delicate discriminations between poisons for insects and for humans when, on the cellular basis, the life processes of both are so nearly identical.

When we note, in the case of the Missouri studies, that the insects refused to eat the spinach grown on the more highly nitrogenous soil, we are apt to say "the plant had developed a resistance." That term "resistance" has not been well defined. Much less does it explain just what life processes are responsible for all that is included in the term.

Survival

We forget that the insect, like any form of life, including the plant, is eating to survive. For that it must show discrimination in what it consumes, even as the plant's uptake of nutrients must vary to determine the particular survival of each species.

Should we not emphasize then the positive action of each life form going on its way to survive by nutrition for health, rather than spending itself physiologically in preparing against enemies and storing substances as means to resist? Would evolution suggest loading down the individual with ammunition rather than with potentials for healthy maintenance? In viewing the soil as nutrition, we subscribe to the viewpoint of a positive health as natural for survival. The nutrition for health suggests itself as the most logical research approach, especially when soil management is the variable control.

Governing factor

The data, emphasizing nitrogen as the factor governing either the infestation or the immunity of the spinach crop are given, in part, in Table I (*). Included is data showing (a) the decreasing insect damage, (b) the increasing yields of fresh weights, (c) the decreasing concentrations of vitamin C, and (d) the decreasing concentrations of Oxalate, all in accordance with more nitrogen available in the soil in which the crop grows.

TABLE I.

The extent of damage to spinach by leaf-eating insects, the crop yields and the concentrations of vitamin C and oxalate in this vegetable according to the increments of nitrogen offered by the soil growing it.

Soil Nitrogen m.e. / Plant	Damages % Surface	Yields Gms/10 plants Fresh Wt.	Vitamin C Conc. Mgs / 100 gms	Oxalate % of D.M.
5	38.6	121.3	28.7	8.17
10	39.5	219.1	29.6	7.37
20	6.9	376.8	27.2	7.12
40	3.6	4.18	20.9	6.02

By presenting the data graphically (Figure I) it becomes very clear that (a) damage by insects, (b) the oxalate which makes the calcium and magnesium within the plant insoluble and indigestible, and (c) the vitamin C (ascorbic acid) all became less, while the yield became larger and crops healthier as the nitrogen in the soil was increased.

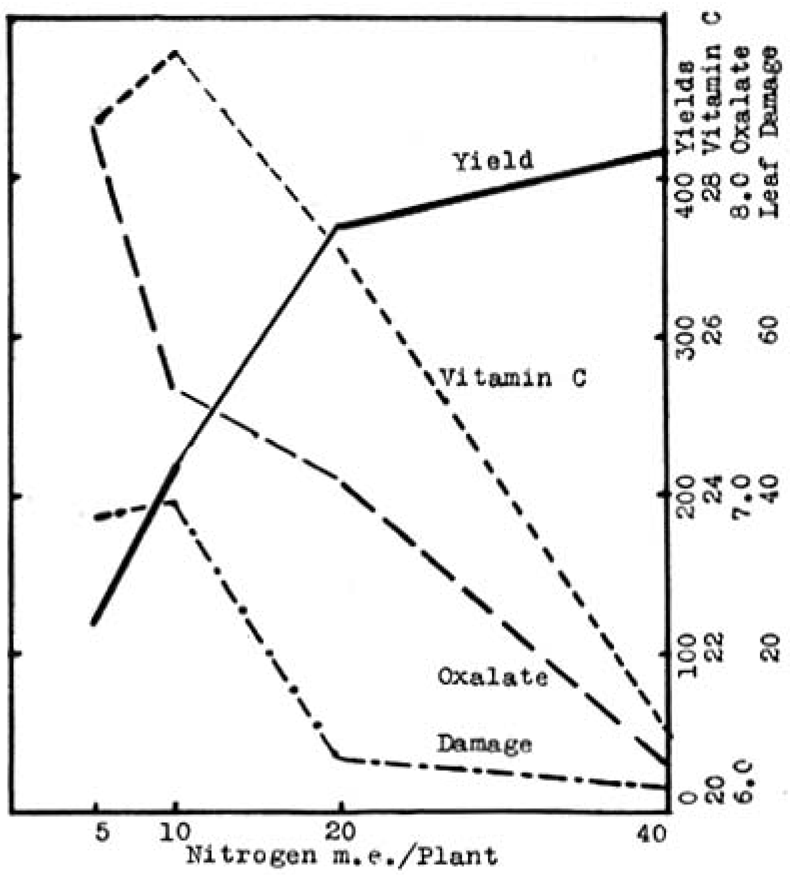


FIGURE 1 . . . Chemical analysis of spinach crops grown with increasing amounts of nitrogen in the soils, 5, 1 0, 20, and 40 m.e. per plant, gave increasing yields related directly to the soil treatment. But the concentrations of vitamin C and oxalates in the plants, as well as area of leaf damage by the insects, were inversely related. (Yield = gms. / 10 green plants. Vitamin C = mgm./100 gms. Oxalate = % of D.M. Damage % of leaf area.)

Metabolism index

These demonstrated relations between the nutrition and the self-protection by the plants raise some questions about the functions of the vitamin C and the oxalate within them. If the increased growth by increased nitrogen represented healthier plants (even to the point of defense against insect attacks), then the decrease in oxalate suggests that its accumulation to higher concentrations is an index of poorer metabolism and less healthy plant growth.

Similarly, the decreasing concentration of vitamin C with healthier plants suggests that this vitamin is not contributing directly to healthier plant growth. Shall we not view its function as that of a catalyst or a "whip" to drive the chemical metabolisms of the plant more rapidly by its higher concentrations of this oxidative vitamin when the reacting nutrients become deficient or imbalanced? Considering our own foods, is a higher concentration of vitamin C a mark of higher nutritional quality? Or does it indicate less healthy growths with imbalanced chemical composition, providing poorer quality nutrition for us consuming them?

These are still unanswered questions. But they suggest that we dare not neglect much longer the research studies in soil as it determines health and immunities of all life strata if we are to stem the rising tide of degeneration of our body functions, which cannot be termed "disease" by infection.

(*) S. H. Witwer and Leonard Haseman, Soil Nutrition and Thrips Injury on Spinach. Jour. Econ. Entom. 33:615 - (5), 1946.

Let's Live Magazine, September, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

Garden Soils and Bio-geochemistry

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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Though most of us take our soils for granted, there is an increasing interest in the effects by the soil and its original rocks (a) as the rocks are weathering to develop the soil, and (b) as those materials and processes may determine the healthful, or possibly poisonous, quality of the food grown thereby.

Bio-geochemistry is a relatively young science. It is the study of the ecological pattern, that is, the distribution of life forms on the earth in relation to the chemical potential of the rocks and minerals for soils to grow their food support. This science gave an early impetus to the study of plant compositions for their help as indicators of concentrated ore bodies for mining. Because rocks make soils, and because the fertility of those as nutrition, for food crops, determines the biotic geography, the geologists are concerning themselves with the nutritional qualities of food supplies according to their contents coming from soil minerals. They emphasize the trace elements in particular.

Analyses given

Prof. H. V. Warren of the Department of Geology of the University of British Columbia has given us the chemical analyses of the soils and of the vegetables (both total and edible parts) for the four trace elements, copper (Cu), zinc (Zu), molybdenum (Mo), and lead (Pb) of two gardens. They are within 200 yards of each other. Both are soils developed from the same rock formation. They are in a community noted for its high incidence of multiple sclerosis. "Lead has been suspected as a possible cause, but the case against this base metal has never been proved." [1]

His data is given in Table I, with quantities of the elements reported as parts per million in the dry matter and in the plant ash. Only that part of the soil which passed through an 80-mesh screen was extracted by the two acids, one extremely strong, aqua regia, and the other very weak, acetic acid.

TABLE I **Trace Elements in Garden Soil and Plants** (Amounts as plants per million, ash of plants in parentheses)					
		"A" GARDEN			
80 mesh fraction of soils	**No of samples**	**Copper**	**Zinc**	**Molybdenum**	**Lead**
Aqua regia extraction	5	11	71	3	84
Acetic acid extraction	5	4	21	N.A.*	11
Whole vegetable sampled	9	7 (55)	54 (391)	6 (44)	7 (44)
Edible portion only	5	6 (60)	46 (421)	3 (31)	5 (37)
		"B" GARDEN			
Aqua regia extraction	5	20	58	1	55
Acetic acid extraction	5	0.2	16	N.A.*	4
Whole vegetable sam;led	7	3 (25)	37 (257)	9 (73)	6 (43)
Edible portion only	3	2 (27)	19 (250)	10 (90)	2 (33)
*N.A. = not analyzed.					

Since it has been established that "oven-dried (moisture-free) food products normally contain 0.1 to 1.0 p.p.m. of lead," and "in the ash these values range from 2 to 20 p.p.m.," [2] it is evident that "anybody who eats food from these gardens would obtain from five to 15 times his normal intake of lead.

Much to learn

"There is much to be learned yet before we have 'normals' for trace elements in foods; also before we can risk any statement for 'normals' of them in soils. We are not certain as to what part of a trace element in the vegetable is taken into the system, and what passes through the digestive tract unchanged. This is illustrated by calcium in an oxalate compound in some vegetable greens, like those of the goosefoot family, while in the mustard family this indigestible compound is not so prevalent." [3]

"Until the chemical forms in which a trace element is present in any food can be determined, and likewise the digestive peculiarities of the eater of any food, it is not possible to assess the nutritional significance of abnormal amounts of such elements as lead, selenium, and molybdenum in vegetables.

Evidence given

"There is abundant evidence," Prof. Warren reports, "to show that an anomalously high or low trace element content in a rock formation is reflected in comparable anomalies in the soils derived from those rocks. Soils, in turn, pass on their trace element variations to the vegetal matter growing on them, even when these trace elements are not thought to serve any known purpose in the plant physiology.

"Vegetal matter used as food may not contain as high concentrations of some trace elements as some vegetal matter not normally thought of as food. Nevertheless, most foods can be shown to reflect the trace element peculiarities of the soil and of the rocks to which they are related. An over-abundance of trace elements, such as mercury, lead, cadmium, or selenium, whether eaten in vegetal or animal foods, can seriously affect the health of humans. Deficiencies of the elements, such as copper, iron, manganese, zinc, and molybdenum, may also cause nutritional problems.

"It would appear, then, that any diet marked by imbalance of one or more trace elements, or, indeed, in any macronutrient, must be viewed as a potential cause of ill health. This would seem to be true whether applied to primary foods, such as oatmeal or cornpone, or to secondary foods, such as milk or cheese."

All of us responsible

Much is yet to be learned by those professionally concerned with nutrition and health if they will consider the possible contributions by the many other sciences not so directly related. Shall we not agree that all of us, whether scientists or not, are individually concerned and responsible for our health, dependent as it is in each case on nutrition in terms of what we take and what we avoid? If we are to survive by means of the natural chemo-dynamics that operate the assembly line of creation from rocks to soils, to foods and to life, then all sciences may well become more concerned about what they can contribute toward making us more fit for it under rapid population increase.

1 Harry V. Warren, F.R.S.C., "Role of Geology in Diet," Canadian Dietetic Association Journal 23, No. 1, 1961.

2 Harry V. Warren and R. E. Delavault, "Lead in Some Food Crops and Trees," Journal Sci. of Food and Agric. 13:96-98, Feb., 1962.

3 S. H. Witwer, Wm. A. Albrecht, and R. A. Schroeder, "Vegetable crops in relation to soil fertility. V. Calcium contents of green leafy vegetables," Food Research 12:406-413, 1947.

Let's Live Magazine, October, 1962

HIDDEN IDEAS IN UNOPENED BOOKS

Bio-assays Rather than Chemical Analyses

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
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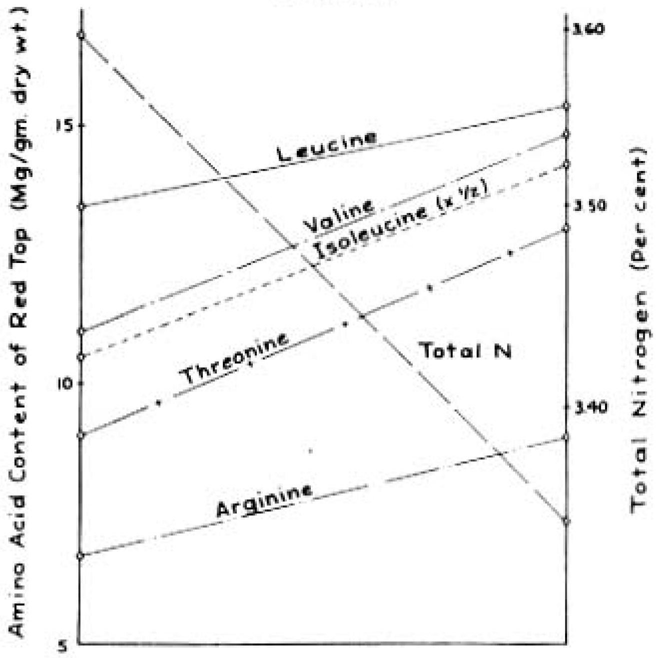
Many investigators continue to seek the functions of soil-borne nutrients," says Victor L, Sheldon*, "by correlating some morphological or physiological response with the quantity of some single inorganic element present in the plant ash. Nitrogen, as it is most often determined by burning the protoplasm in concentrated sulfuric acid, is no exception to this outmoded search. It remains a common practice, also, to multiply this total nitrogen value by some arbitrary factor, giving a dubious but readily accepted number, as the protein content of the material.

"In this study*, it was often found that the suite of essential amino acids increased (often each one) while at the same time the Kjeldohl or total nitrogen (in the dry matter) decreased. This fact is shown in the figure (Figure I for a non-legume).

FIGURE I

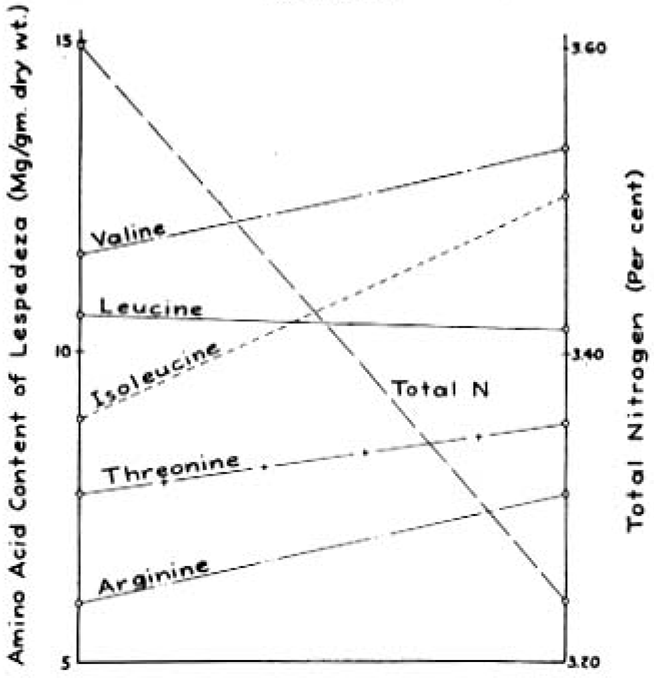


Increase in Phosphorus in Media
Concentrations of Amino Acids in Redtop Hay
Showing Their Independence
of Total Nitrogen Content When Phosphorus
Was Applied.

"Arginine, threonine, isoleucine, valine, and leucine increased when phosphorus (increasing) was applied to the soil even when the total nitrogen (concentration) within the plants decreased. Conclusions based on the nitrogen content alone would have shown this a false criterion as to the status of the protein constituents (amino acids) in the plants.

"A similar situation is suggested for lespedeza (a legume). The addition of more phosphorus resulted in higher concentrations of valine, isoleucine, threonine and arginine while simultaneously the concentration of total nitrogen decreased from 3.6% to 3.2% (Figure II). Since it is the amino acids that are required in metabolism and not the elemental nitrogen *per se,* we need to adopt a newer criterion by which to measure plant production as it represents nutrition for the higher forms of life consuming it."

FIGURE II



Increase in Phosphorus in Media

Concentration of Amino Acids in Lespedeza
Showing Their Independence
of Total Nitrogen Content When Phosphorus
Was Applied.

In his test applications of combinations of calcium, phosphorus, and potassium in contrast to their use singly in relation to the concentrations of amino acids in the forage crop, he says, "Wide variations would scarcely be expected when relatively small amounts of these inorganics were applied. . . . Yet fully five years after these treatments were applied, the quality of bluegrass in terms of its constituent amino acids continued to be modified by the applications of calcium, phosphorus, potassium and nitrogen. . . . Where the applications of the first three elements were reduced and nitrogen added to balance the fertility better, the grass contained more of each of the amino acids.

"These data point directly to the need for balance among the elements coming into the plant from the soil."

In reading the preceding remarks which were hidden in a typewritten thesis, we are reminded of the higher concentrations of nitrogen that may occur in the greener forages when fertilized singly with that element by applications either through cow droppings or commercial fertilizer forms. But we are also warned that, while correcting the soil's deficiency of nitrogen is quickly reflected in exhibition of better color and more vegetative mass, that response is not proof of the nitrogen's making more protein, nor that the protein contains a more complete array of required amino acids. The latter result depends on the presence of nitrogen, of course, but that exhibitive element must be balanced by other elements operating, seemingly, more modestly with less showy effects waiting to be reported through bio-assays, that is, by grazing animals demonstrating healthier growth.

** Victor L. Sheldon, Biosynthesis of Amino Acids by Forage Plants According to Soil Fertility, Thesis, Doctor of Philosophy, Missouri, 1950.*

Let's Live Magazine, November, 1962

Their Questions - - My Answers

by William A. Albrecht, B.A., B.S., M.S., Ph.D.
Prof. Emeritus of Soils, College of Agriculture, University of Missouri, Columbia, Mo.

This month we are deviating from oar usual course, namely that of presenting the next chapter in the series of "Hidden Ideas in Unopened Books" which Dr. Albrecht has been writing exclusively for LET'S LIVE. We believe the readers of his articles will be interested in a report of the questions asked Dr. Albrecht at the recent National Dietary Foods Associations Convention (San Francisco) and his impromptu and informative answers. -- Ed.

Vaccinations

Q. Do vaccinations pollute the blood and do damage to the system?

A. If you take water into your system as a drink, it goes into your blood stream directly from the stomach. But if you take fats they move into your lymphatic system. When you take other substances, like carbohydrates and protein, they go into the intestines and from there are passed through the liver, as the body's chemical censor, before they go into the blood and the circulation throughout the body. Most of your vaccination serums are proteins, and they are put by hypodermic needle directly into the blood and are not censored by the liver. Consequently vaccinations can be a terrific shock to the system. I try to avoid vaccinations. I react violently to some of them. When I had a typhoid fever shot for traveling abroad it made me deathly sick and left me stone deaf in one ear. I have only partially recovered my hearing in that ear.

Wheat values of Kansas

Q. Believe you said when you were a young man going to college the wheat in Kansas had as high as 17% protein and that it now is much lower.

A. Yes, the wheat values of Kansas as protein percentages in going from its eastern to western part ranged from 10 to more than 18. By 1951 they ranged from 9 to 14.

Sodium propionate

Q. Should sodium propionate be used as a preservative?

A. It does not have much food value. Occasionally it sets up allergic reactions. Your body will probably handle it, but why handle excess? The liver is the only organ in your body that can regenerate itself. Why should we overload our bodies to knock out all too soon the chemical censor we have in them?

Proper soil supplement

Q. If you are just starting out with a little farm or garden, what, outside of manure, would be the proper supplement for the soil?

A. The first thing one should work out would be the proper calcium supply and likewise the magnesium supply. I would look after the calcium supply by the soil test. If you can't look after it by a soil test, you could grow some legumes and by their failure the need to build it up would be indicated.

Getting the facts over

Q. What approach would be most effective in getting the facts to the government? (*We presume the inquirer means the true facts about the organic or nutritional way of growing plants.*)

A. You must learn that this business of studying nature takes a lot of hard work and late hours, and almost everyone is on an eight-hour day. We have lost our curiosity about nature. Unless one is curious, he doesn't learn much. I don't have much solution for you in connection with getting immediate results as to response by busy folks in government to what reforms some of us deem so necessary. It is usually about a generation before you get much encouragement.

Adding life to compost

Q. Has there been any experiment in your type of agronomy in adding life to the compost heap so that it can multiply and grow?

A. In composting you have a kind of yeast performance with fermentation when the pile is moist. As the heating process dries out the water, air goes in, then an oxidation or burning process drives off carbon dioxide. In your surface soil you alternate those processes. Cultivation is the opening of the draft. "Energy" foods burn out of soil or compost. Growth foods are kept in by the microbial bodies. Then you have variations of synthesis by microbial growth in a soil of high energy supplies, due to the organic matter in it. When the organic matter of high energy, but low growth, value in the compost is spent, the synthesis is not dominant. The pile is cold. Decomposition sets in and that releases growth foods as well as energy foods.

Fungi have a tremendous faculty for drilling through tough organic wastes. The fungi and those rougher feeders starting the composting process have a greater power to break soil apart than do the plants. Bacteria, like plants, feed after the fungi have worked over the organic wastes.

Super-phosphates

Q. In your soil tests of fertilizers I noticed that super-phosphates were used.

A. When I went to Missouri 40 some years ago, there was one phosphate used, and that was super-phosphate. At that time it was also recognized that phosphates were the major soil treatment with a good response by most of the farm crops. We are now appreciating the importance of phosphorus more in many biochemical reactions.

This year the man who won the Nobel Prize got it for photosynthesis, the mechanism in which he found phosphorus playing an important role. I have a feeling that phosphorus has a greater part in biochemistry than we realize. It is playing bigger roles in soils when combined with the organic matter there. We have phosphorus tied up in so many ways that we do not know all of its biochemical sources.

Organic and inorganic

Q. I am sure you are aware of the newspaper and magazine articles of the past several months, saying there is no difference between minerals that are organic and those that are not. Is there a difference between iron, sulfur, and others? Is there a difference between feeding plants organically, or organic minerals?

A. In your blood stream you have iron in the hemoglobin. It is there in about the proportion of one part of ash to about 40 parts of combustible substances like carbon, hydrogen, nitrogen, or organic matter.

We have finally come around to the word "chelation." In hemoglobin the iron acts as part of the whole, not separated from it as sodium is in a solution of ordinary salt. In the hemoglobin we say the iron is "chelated." So we say phosphorus is chelated by soil organic matter and thereby more available to the plant from the soil. Nature doesn't separate the organic and inorganic.

The use of kelp

Q. My problem is this. I have a small city lot. I would like to grow my own vegetables. Is there some simple way, like using kelp?

A. You are talking about a biased case when you call on me. I use kelp. I am a hypothyroid case. I started using kelp about 20 years ago and I still use it when I start to get unusually tired whenever I feel I shouldn't.

This kelp is a good idea and it will take care of a large share of your other trace element needs as well as the iodine which serves for hypothyroid folks in many cases.

Back into the soil

Q. I am just a little confused on these super-phosphates. I have always put organic matter on my soil, and I have had wonderful results. For organic matter I use cuttings, manure, oyster shells, or ground phosphates.

A. I would say you have just about covered the waterfront. You are putting pulverized phosphate minerals into compost. Thereby the phosphorus is more highly mobilized for plant nutrition. Manure supplies nitrogen, heating, and a whole series of changes.

Oyster shells supply calcium, and you are completing the cycle of "out of the soil, back into the soil."

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HIDDEN IDEAS IN UNOPENED BOOKS

Less Soil Organic Matter Spells Lower Form of Vegetation

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In 1945 the microbe *Streptomyces aureofaciens,* which produces the antibiotic aureomycin, was isolated by the late Benjamin M. Duggar, Ph.D., from the soil of experimental plot No. 23 (which was in continuous timothy) of Sanborn Field at the Missouri Agricultural Experiment Station.

Noteworthy is the correlation between the climatic setting, soil conditions, the associated or competitive crops on that untreated plot and the unique power of self-protection against bacteria exhibited by the timothy. This is particularly important, if we dare classify S. aureofaciens as a climax crop of that microbial group, due to its greater presence in the particular plot, in the particular soil type, and in a particular degree of soil development under the climatic forces, all reflected as unique among the many soil samples collected from the 50 states and several foreign countries. We need to remind ourselves that any climax crop, whether microbe, plant, animal, or man, surviving more fitly than other similar crops, has a certain group of other life forms beneficially associated with it.

American bison

The American bison was a climax animal crop of the plains and the prairies. It grazed on certain plant species, notably the many grasses and legumes. Certain microbial life forms were prominent in the soils of its habitat. These included Azotobacter (and Clostridium) which could use gaseous nitrogen from the air to build the protein of these free-living cells. There was also the soil microbe Rhizobium, building its protein similarly but by symbiotic relations with legume plants and their root nodules. These soil microbes were starting with atmospheric nitrogen, getting energy from decaying organic matter, and building the protein foundation for the brawny bison of pioneer days on those grassy areas and for the herds of cattle and sheep that took over that climatic setting later.

Since every form of life has survived naturally where it has been most fit, it has been a challenge to continue observations, isolations, and tests of this antibiotic-producer in Missouri soils in order to catalog its behaviors in relation to climatic range, soil types, and managements of soils and crops supporting it as a climax soil microbe.

Significant fact

The first significant observation was the fact that the initial soil sample giving the choice specimen of S. aureofaciens (No. A 377) as producer of aureomycin, came from a plot with no soil treatment given to continuous timothy with its annual crop removal. In contrast, this microorganism could not be isolated from the plot alongside (No. 22), also given to continuous timothy with its annual crop removal, but with the annual application of the equivalent of six tons of barnyard manure per acre.

Yet "the only soil we have ever seen which was really 'loaded' with S. aureofaciens was Duggar's sample 65 which indicates it was collected from below the bluegrass and on the roadway adjacent . . . (Sanborn Field) . . . , unplowed about 50 years. This sample yielded a total of 18 S. aureofaciens strains. Besides the original A 377 which came from plot 23 in Sanborn Field, two isolates were obtained, one from plot No. 10 and one from plot No. 9," according to Edward J. Backus, Ph.D., now head of the Microbiology Department, Biochemical Research Section, Lederle Laboratories.

Samples collected

The originally fruitful sample from plot No. 23, giving strain A 377, was taken when a dense crop of the "weed" *Audropogon virginicus* had taken over seriously enough to grow a ton and a half of its vegetation after hay-cutting in June.

As a test of the possible association of S. aureofaciens with this plant, commonly called "broom sedge," samples were collected in the spring of 1962, again from plots 22 and 23, Sanborn Field (plowed and reseeded in autumn, 1961). Also, samples were taken from a pasture on the farm of A. Sapp, Ashland, Missouri, representing Putnam silt loam, similar to Sanborn Field--one where broom sedge was very prominent and one where it was absent and drainage was somewhat impeded to give a mossy growth. The pasture has been in unplowed sod for more than 20 years.

Duplicate condition

Again, the two samples from Sanborn Field in 1962 were reported duplicating their original condition, namely, two trains of strongly pigmented S. aureofaciens isolated from the untreated plot No. 23, but none from the adjoining manured plot No. 22, both in timothy since 1888. From the samples of the same soil type, that is, Putnam silt loam, of the older unplowed pasture at Ashland, Missouri, there was isolated from the area "growing Andropogon vir-ginicus and not plowed since 1920 one strain of S. aureofaciens, this being culturally almost identical to Dr. Duggar's original A 377 strain." From the Ashland soil "growing no Andropogon virginicus, one strain of S. aureofaciens was found, being a more intensely pigmented type than A 377," according to the report by Dr. Backus of the Lederle Laboratory, through whom the results of the test were obtained.

Isolations were made from other samplings of untilled Putnam silt loam as Dr. Backus reported. "We did find single strains of the organism in each of the three samples which we collected (October, 1948) near Centralia, Missouri. One of these samples had an Andropogon cover in a railroad prairie remnant, while the other two were associated with bluegrass sods."

Indicates declining fertility

Since Sanborn Field seems to support the antibiotic-producing S. aureofaciens under conditions of low soil fertility, constantly threatening invasions of "weed" crops which animals refuse to eat, as undesirable invaders demanding tillage for their exclusion, and under old pastures and roadways with little or no crop removal, it would appear that this antibiotic-producing soil microbe is an indicator of declining soil fertility for farm crops.

Since this bit of soil life is of the fungus order getting its energy from resistant organic matter, and then producing its antibiotic for self-protection against so many other microbial forms injurious to animals and man, shall we not consider this laboratory-classified, lowly form of soil-supported life an indicator of the soil's need for uplift of inorganic fertility and supply of organic matter in order to bring its crop output to higher nutritional values? In our past agronomic experiences, there are hidden reports telling us that when our soils have less organic matter reserves they can produce only vegetation of lower nutritional value for higher life forms, and may even be producers of powerful poisons.