Soil and Survival of the Fit

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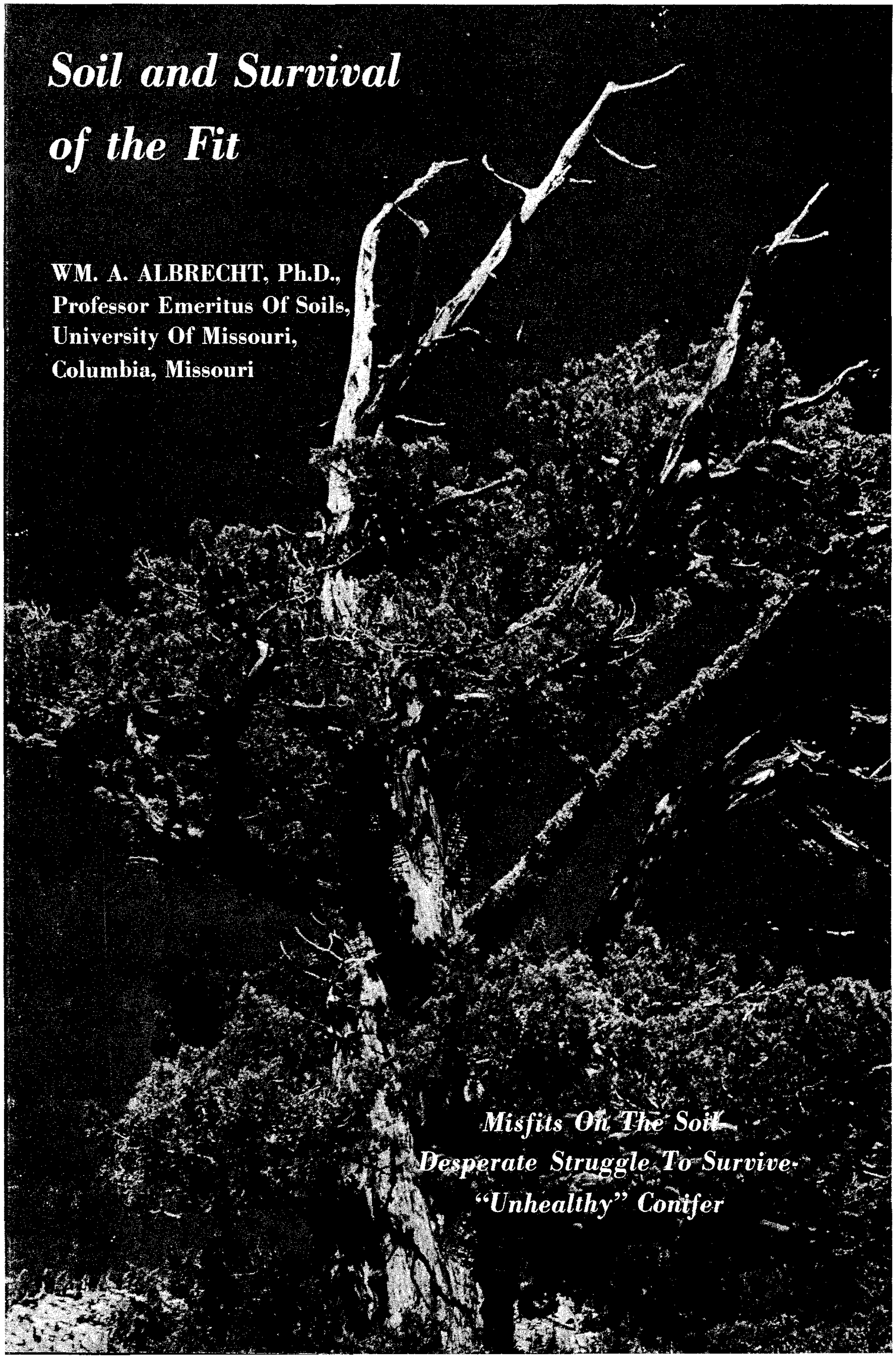

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"Unhealthy" Conifer

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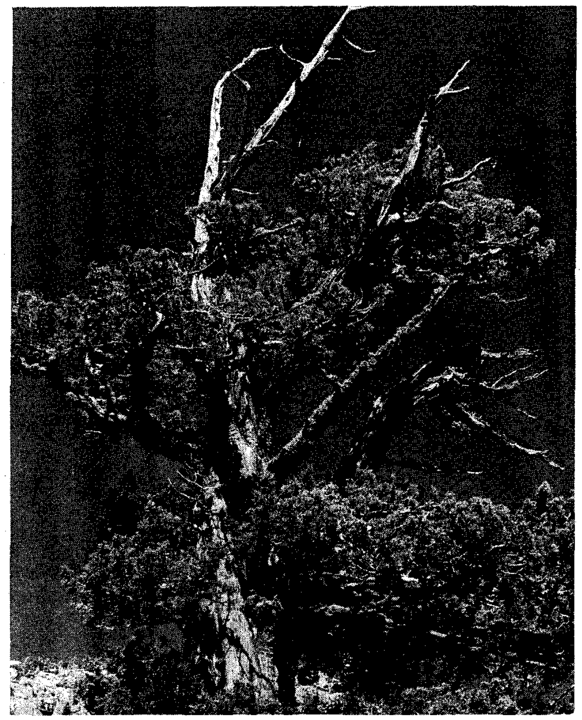


MISFITS ON THE SOIL—DESPERATE STRUGGLE TO SURVIVE—"UNHEALTHY" CONIFER

Wherever the rocks have not developed into soil under the climatic forces of moisture and heat, starvation rather than disease makes the struggle to survive a desperate one even for coniferous trees. (By courtesy of Andew Tau, University of Missouri Photographer)

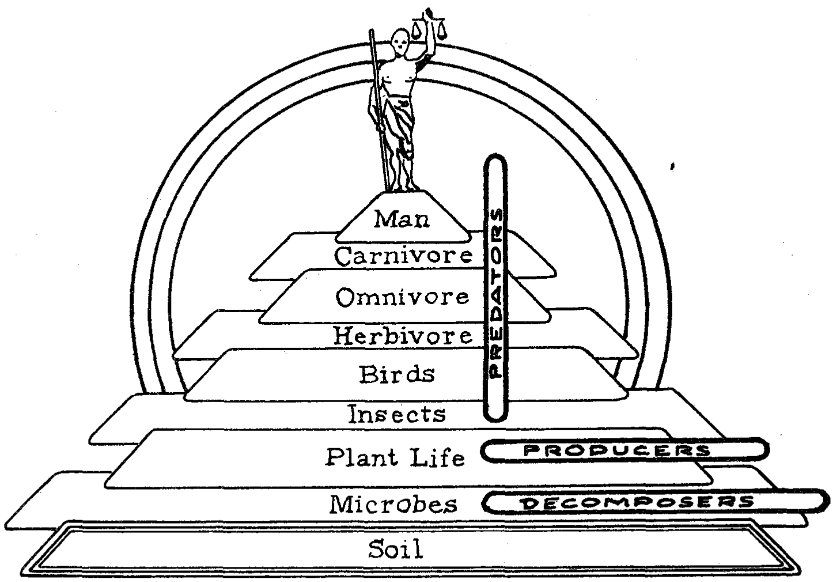
"Man has shaken off the guardianship of Nature... The less there is of nature, the more knowledge is needed."

Albert von Haller,
The Vitamin Hunters,
1962

The organized knowledge of natural phenomena, called "Science", has recently been much worshipped. This was prompted because more applied knowledge has developed our technology, and, thereby, the "high standard of living" according to economic considerations.

Technology results from applying, in practices, the expanding concepts of man in the world. It is a helpful means for enlarging his visions into still broader concepts by research going farther into the unknown to give us more knowledge.

Paper No. 1, given at Third Annual Convention, International College of Applied Nutrition, The Huntington-Sheraton Hotel, Pasadena, Calif., Thursday, March 21, 1963, 10 a.m. - 11 a.m.



(Illustration I) **The Biotic Pyramid**

The lower three strata, soil, microbes and plants are the integrated, basic support of all that is not held in place by the soil and represents the consumers or predators.
Constructive soil development from rock-minerals, and the admixture to that of the accumulated organic matter grown thereby, brought about the evolution and survival of all the many interdependent trophic levels of which man at the apex is physiologically the most complex, hence in the most hazardous position.

BOLDNESS VIA FRAGMENTATION

Impressed though we may be by that expansion, much of our knowledge may be more fragmentary than we realize. But our enterprising make-up prompts us to try marketing promptly even the fragments and extolling them widely. That brings us often to discover later, especially in biological matters, that the sum of the parts—as we have listed them to date—is not equal to the whole of what nature has integrated by evolution over long time periods.

While technology and economics have been prodding our visions to become theories, concepts and principles applied for multiplying our economic advantages, we have been pushing ourselves to encompass larger areas of the earth, and of even outer space. The high speed of such human behaviors is out-running toleration of it by the human body and by any evolutionary modification of its anatomy and functions as adaptations for survival in the synthetic environments of our own production.

Too long, under Pasteur's thinking, have we viewed disturbed body functions as poisons and invasions by microbial predators. Only lately have we come to recognize (a) deficiencies and imbalances of inorganic elements and organic compounds in nutrition; (b) increased stress and tensions of body and mind; and (c) exploited natural environments including the soil under exploding populations, as hazards to survival. We reluctantly accept decreasing quality in foods and increasing defilement of environment as failings in those formerly healthful, natural supports. We are now called upon to manage our environment and to prevent pollutions of air, water, and soil as extra tax burden and added economic demands. All that brings disregard of normal biotic requisites for not only the human stratum, but also for all other trophic levels within the "biotic" pyramid supporting man at the apex and resting on the soil as its creative foundation. Are we building in bold prospects but on a disintegrating foundation? (Illustration I)

ECONOMICS BLINDS US TO ECOLOGY

The 87 percent of our population in congested urban communities views agriculture as just another industry. The soil, which creates all that lives, is considered lifeless "dirt" to be mechanically tilled, seeded, fertilized and irrigated; or just a commodity to be sold and bartered for site values and self-multiplying, unearned increments. Along with that there comes higher taxation, built up to guarantee security for that large urban majority not responsible for, nor cognizant of, the need to maintain and conserve the soil as the basic national strength of all. Then there is, also, the exalted faith in our own management of dead matter by technology, which is apt to turn us toward managing humans, but in the fatal disregard of them as living bodies supported by the soil, a living foundation.

The dominance of politico-economic thought, encouraged by election of its proponents to office, has allowed only occasional concern about the soil. But when such thinking by our leadership boasts of successful management—proved by surpluses of agricultural commodities and our international feedership thereby of more than ten billion folks abroad—we need to view human ecology to note that according to evolution of that species too, as for all species, none other than the healthy and the fit survive.

It is, thus, a simple fact of nature that healthy survival comes not directly from industrial-technological complexities, economic advantages, accumulated wealth, so-called health insurance, nor from massive monetary grants for research in "diseases". The criterion of natural survival simply lists the birthright to use complete nutrition from fertile soils by which the body cells grow, defend and maintain themselves with resulting survival of the species through reproduction of naturally healthy individuals. Man's evolution has been no exception, even though he came along late in the history of his planet and aims to terminate his farther natural evolution by his own controls.

With so much past biotic experience by evolution behind us, is it not a serious indictment of our scientific claims when degeneration of the human body is becoming so prominent in so late a period, and just when man is assuming the management of so much that we once called "Nature"? Degeneration of both body and mind suggests that he is in serious conflict, instead of in cooperation, with much of all that brought evolution to its high state. A view of the climatic soil-fertility pattern on the face of the earth and its role in creation of life for the survival of the fit, including man, may well be a hopeful task for this discussion.

ALL LIFE EXPENDS ENERGY

Living processes represent work done. Work always requires the expenditure of many kinds of energy. All those represent conversions—with the final change —into heat to be dissipated into space. The total energy available to the earth is represented, first, by that left within the original rock minerals. Some of that is released in every stage of weathering when by union with water, as hydrolysis, by oxidation or union with oxygen like burning, and by various other chemical reactions separating minerals into their component elements and less active compounds. Some of those are carried to the sea as solubles. Others are left as insoluble residues, like clay.

The second and major source of energy is the sun's rays. But most of that is quickly dissipated in meteorological manifestations, as weather, save that about one percent of it is absorbed by the living tissues, mainly plant leaves. The energy so captured serves in photosynthesis to reduce the carbon dioxide from the air and the water from the soil into the plant-food compounds, the carbohydrates. But that synthetic service spends most of the energy in its own work with but 0.3 percent of the absorbed energy stored in the plant's own food reserves in those compounds. By the time those carbohydrates are later converted by the plant's life processes (not by sunlight) into proteins of living tissue, nine-tenths is expended in accomplishing that synthesis and only 0.03 percent of the initial sun's energy falling on the earth finally demonstrates itself in creating life. It is the basic laws of thermodynamics which hold down the creative processes of life to the complex set of specific physical and biochemical requirements of which many are not yet comprehended, nor used cooperatively, much less taken over for judicious management by ourselves.

"THE MILLS OF GOD" MUST GRIND

It is quite evident, that the weathering of the rock minerals must come first to release, by their internal energies, the elements of soil fertility and to start creation. In the capture of the first quantum of energy by chlorophyl of the leaf, it is the soil-borne element, magnesium, as the "ash" core of a large organic molecule, that catalyzes the synthesis and storage of carbohydrates. That first stage requires also soil-borne phosphorus to unite three carbon atoms with one of itself. Then two of those initial compounds are united through the phosphorus elements to give the six carbon sugar as the first carbohydrate while the catalytic phosporus elements drop out to repeat that combining performance. In the synthesis of the carbohydrates into proteins, there too, each of the long list of additional nutrient elements from the soil plays its role as constructive matter, as tool, or both. Living processes of plants, animals and man demand not only carbon, hydrogen, oxygen and nitrogen of atmospheric and meteorological origin, but also the calcium, magnesium, phosphorus, potassium, sulfur, as major amounts. Then they require also a list of many others in "trace" amounts to include iron, manganese, copper, zinc, boron, molybdenum, sodium, iodine, chlorine, and others—not fully determined as to essentiality—but all moving in their train from the soil to plants to serve life.

The illustrations cited so far, suffice to point to the soil as the source of both constructive substances and tools by which, first, the energy is provided for grinding the rocks, then, next for creation of living organic matter. By the death, and accumulation in place of the latter over long periods of time, the living soils are formed. It is on such soils that man, on his arrival, found his nutritional support in the climax crops under their healthy survival by means of proper plant (microbial) nutrition within natural climatic soil settings.

By converse reasoning, then, if any of our transplanted crops are not healthy and do not survive, must we not recognize; first, the failure of the weathering of rocks as supplies of soil fertility support; and, second, the insufficient maintenance of organic matter as accumulation by which a dynamically active soil grinds and decomposes minerals, recycles elements, and provides organic fertility to make the inorganically and organically complete soil support the microbes and the plants? Soil, microbes, and plants are the triune which supports the rest of the biotic structure.

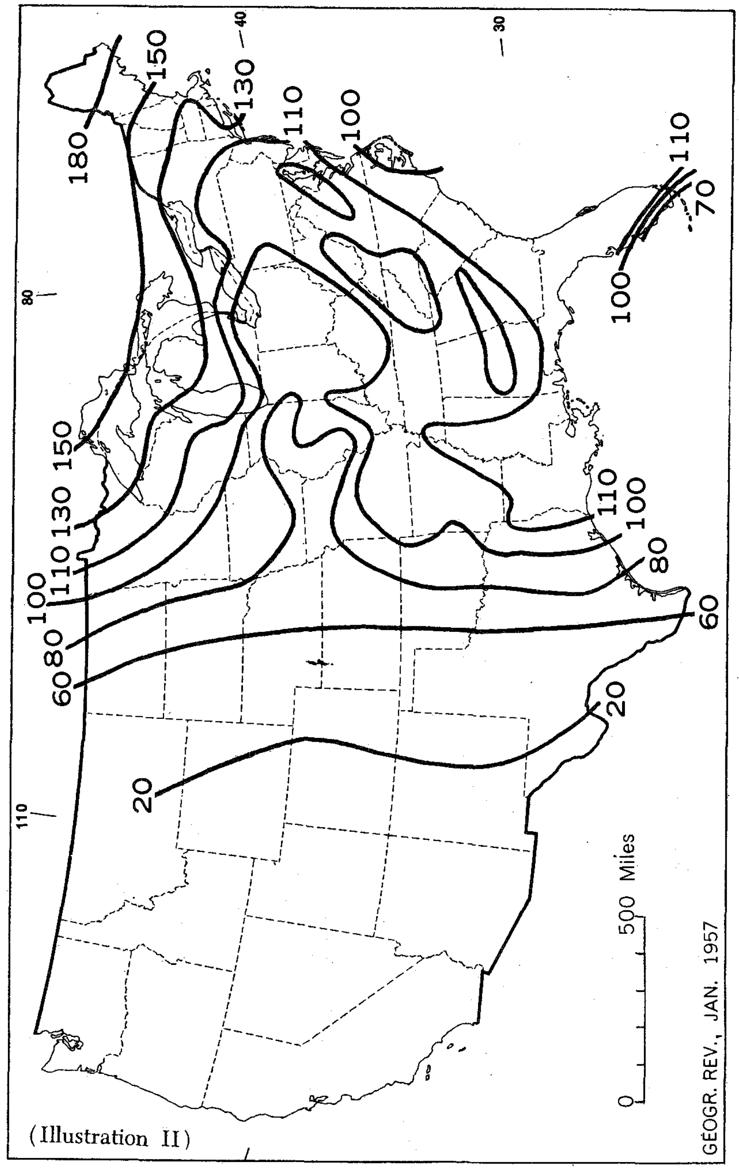
DIFFERING DEGREES OF SOIL DEVELOPMENT DELINEATE BIOTIC GEOGRAPHY

In terms of the degree to which the soil has weathered *constructively* under moderate rainfalls to be still active in rock decomposition and accumulation of organic matter as enriched, living surface soil growing protein-rich vegetation; or as that original mineral supply has *destructively* spent itself weathering under higher rainfalls, warmer temperature and longer times to have left only clays holding little available fertility; there will be good chances or poor ones, respectively, for survival of healthy life forms via energy and protein supports. Species come in with *constructive* soil development. They soon pass out when that is *destructive.*

The former works to multiply life forms from the soil *upward by construction.* The latter works from the top of the biotic pyramid *downward as a simple degeneration.*

The United States may well serve to exhibit and map the ecological patterns of different life forms, determined and located by the different degrees of soil development as different levels of fertility according to the climatic forces of rainfall and temperature. In that relation, it is clear that climate is not significant as a factor of external comfort but is the control as to how plentifully fed any life is with respect to carbohydrates in balance with ample proteins for healthy survival by nutritional support according to the degree of constructive soil development.

By starting from western United States at points just east of the coastal mountains, a traverse eastward across the entire country gives increasing annual



(Illustration II)

Annual rainfalls are distributed as longitudinal belts in the western half of the United States, but as latitudinal ones in the eastern half, to give us our West and our East and to divide the latter into our North and our South.

Constant ratios of precipitation to evaporation (as percentages) plotted as isobars to represent effective rainfalls map out the varied degrees of constructive or destructive soil development. They delineate the ecologies of crops, livestock, percentage of land in farms, efficiency of radio reception, and problems of defective health via proteins in nutrition.

rainfalls from 0 to 60 inches. The initial increase to but 40 inches can be held at approximately a constant average annual temperature by travel in a nearly straight line eastward in the western half of the country. In that same area, one can experience, conversely, increases in temperature at constant annual rainfalls by traveling from north to south because of the *longitudinal belts of rainfall.* But in the eastern half of the country there are the increasing rainfalls from 40 to 60 inches to be traversed by going from north to south, roughly, because they are in *latitudinal belts.* Thus, the climatic soil settings give us our East and our West. However, when the effective rainfall, as constant ratios, or percentages, of annual rainfall over annual evaporation of water from its free surface, are plotted by isobars, then areas delineated by those suggest the various ecological patterns.* (Illustration II) Those include distribution of our crops, livestock, percentages of land in farms, and others, within the pattern of production of proteins by the required fertility resulting from the particular degree of soil development. They are not the result of direct relations of those life forms to the climate itself, but via the soil development by climate as a source of nutritious foods.

CARIES OF TEETH, AN EXAMPLE

In considering those several ecological patterns for tabulation in relation to the soil development, let us approach one of them in a reverse and, seemingly, incongruous order by selecting the ecological pattern of a human disease. Let us superimpose the U.S. map of dental caries,** of nearly 67,000 inductees into the Navy for the Second World War, over the soil map. The latter was the result of nearly the lifelong work of observations and mapping in the field by Dr. C. F. Marbut, U.S.D.A.*** The former map was made by recalculating the original data by regions into longitudinal belts with widths of one or two states.

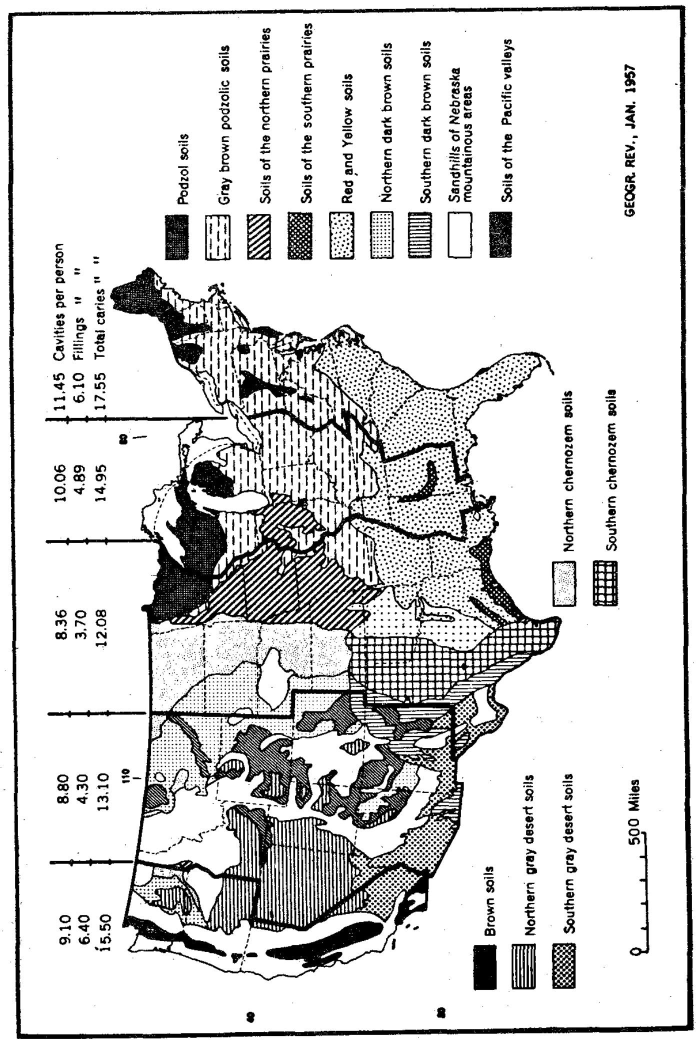
By starting in the mid-continent with one state to the west and one to the east of the 98th meridian, the midline runs roughly from the western edge of Minnesota to the tip of Texas. That is also the line which divides the lime-bearing soils to the west from the lime- or calcium-deficient ones to the east. In those eleven states, a two-state width west of the Mississippi river, from North Dakota and Minnesota southward to Texas and Louisiana, the number of dental caries as the mean value per mouth of men of mean age 24 years was 12.08 (8.38 cavities, 3.70 fillings). For the adjoining belt two states wide on the west, the caries figure moved up to 13.10 (8.80 cavities, 4.30 fillings). Then for the remaining western portion, a belt a single state wide along the coast, the mean value of dental caries was still higher at 15.50 per mouth (9.10 caries, 6.40 fillings). (Illustration III)

By arranging the above figures for mean dental caries per longitudinal belt in the reverse order, namely 15.50, 13.10, and 12.08, they demonstrate decreasing

*William A. Albrecht, Soil Fertility and Biotic Geography. The Geog. Rev. XLVII: 86-105, 1957.

**Wm. A. Albrecht, A.B., M.S., Ph.D. Our Teeth and Our Soils. Annals of Dentistry 6:199-213, No. 4, 1947. Also, Mo. Agr. Expt. Sta. Cir. 333, 1948.

***Curtis F. Marbut, Atlas of Agriculture, III. Soils of the United States, U.S.D.A. Bureau of Soils, 1935, 98 pp.



(Illustration III)

There is a close correlation between human health and the differing soils and their differing degrees of development (fertility) according to the climatic pattern, illustrated by the dental caries among Navy inductees, 1942. Teeth, as exposed parts of the skeleton, are composed mainly of calcium and phosphorus to point to the soil as important in the health vio nutrition of man, animals and all segments of the biotic pyramid supported by the soil.

dental disease, hence improving health of teeth (and of hidden skeleton), in the western half of the United States by 25 per cent according to the *increasing constructive soil development.* That occurred in going eastward from 0 to 40 inches of annual rainfall in the temperate zone, or from the west coast to the mid-continent.

This latter area falls between the two rainfall-evaporation ratios of slightly less than 60 and a bit over 100 percent. There the rainfalls do not leach the soils destructively, yet they remove the excess of dangerous salts. It is the region where summer droughts bring complaints, while single dust storms may be depositing as much as a thousand pounds of unweathered rock dust for natural renewal of fertility and the unappreciated maintenance of the soil's productivity. The mid-continent was the area where the additions of unweathered minerals in dust storms* and of organic matter from deeply rooted grass crops, supporting the Indian and the bison, gave us the clear-cut example of all those as healthy, climax crops. But in our haste to take over for economic gain, those biotic requisites exhibited there for survival of the fit were unrecognized and destroyed. Consequently, we have left for us none of the natural standards for soils, crops and man under natural health and survival to which we may repair.

CHEMICAL COMPOSITION OF PLANTS AND DIFFERING DEGREES OF SOIL DEVELOPMENT

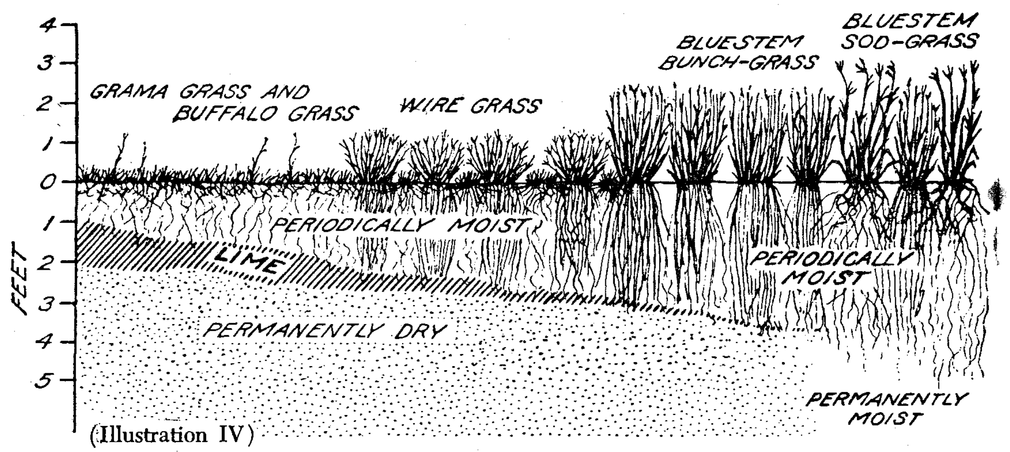
Calcium and phosphorus are the major chemical components of teeth and bone. But their deposition as a solid structure is managed by a very small amount of living organic substance serving also in healthy tooth maintenance. Calcium and phosphorus head the list in that order as amounts of the separate nutrient elements in the total ash of animal bodies. In plants, they are second and third with potassium first.

Dr. H. L. Shantz, one of the earliest plant ecologists, while mapping the plants in western United States,** also observed the differences in the soil profiles under them. He mapped the decreasing magnitude of the calcareous layer and its increasing depth and disappearance within the soil profile according to his traverse across the Plains and Prairies to the mid-continent. He associated the shift of the kinds of plants with the decreasing calcareousness of the soils of the western half of the country in which Dr. Marbut mapped those as "Pedocals."

Calcium in the soil has been considered a requisite for natural nitrogen fixation by the leguminous plants, through their use of nitrogen from the gaseous supply in the atmosphere. They use it to enrich themselves in protein through microbial cooperation in root nodules, and to add nitrogen and organic matter to the soil on plant death and decay there. Also, calcareous soils foster nitrogen fixation by microbes living independently of the plants. However, they require soils rich in organic matter. Accordingly, legumes grow naturally on the pedocal soils of the western half of the United States. Also, the non-legumes or grasses, associated with them, are richer in proteins and inorganic essential nutrients to suggest the

*Some of that dust originates in dry river bottoms with their unweathered deposits as is true of loess soils in Iowa and Missouri from the Missouri River.

**H. L. Shantz and Raphael, Zon. Atlas of American Agriculture. I. Natural Vegetation, U.S.D.A. Bureau of Agricultural Economics 1924, 29 pp.



(Illustration IV)

The changing types and larger growths of the virgin plants along with the thinning layer of calcium carbonate, which disappears with greater depths in the soil, are the biotic and chemical evidences of the increasing constructive soil development as the annual rainfall increases in western United States on going from the West to arrive at the Mid-continents.(Sketch by Homer L. Shantz.)

soils as support for the brawny bison and the well-muscled (not obese) Indian. Calcium has been considered the *protective* nutrient element. (Illustration IV).

On going east from the mid-continent with its mean caries figure of 12.08 and using the longitudinal belt two states wide from Wisconsin-Michigan southward to Mississippi-Alabama, and then the similar remaining belt of Atlantic coastal states east of a line from Western Pennsylvania to the western edges of Georgia and Florida, the series of three mean figures for caries per mouth becomes 12.08, (8.36 cavities, 3.70 fillings), 14.95 (10.06 cavities, 4.89 fillings) and 17.55 (11.45 cavities, 6.10 fillings) on continuing eastward to higher rainfalls and excessive development of the soil. By arranging the figures in reverse order to go from higher to lesser rainfall or from the eastern coast to the mid-continent namely, 17.55, 14.95, and 12.08, there is a health improvement of 45 per cent, (using the latter areas as the base) according as the excessive soil weathering is reduced.

When dental disease in terms of number of people afflicted is certainly the number one health problem, the correlation of this breakdown in body skeletal structure with the classification of the soils for their active contents and deficiencies of only the nutrient calcium (and phosphorus) certainly leaves no doubt about the significance of soil for survival even in terms of the many ash elements only.

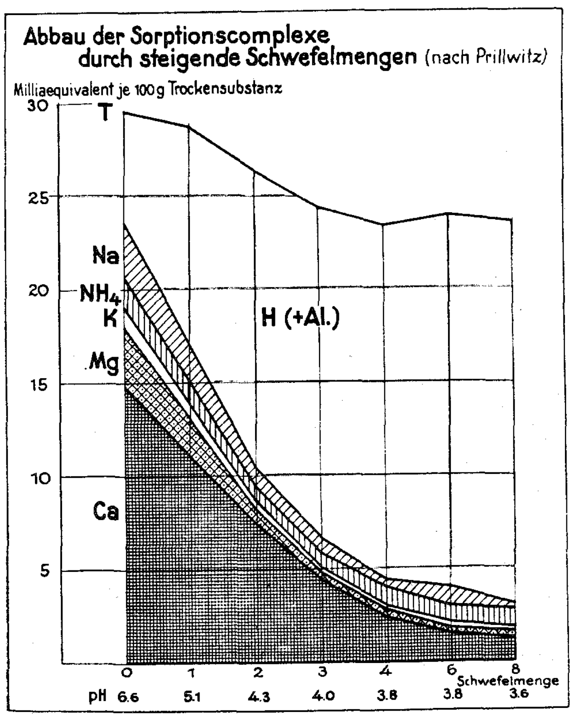
With the increasing degree of soil development under increasing rainfall, the soils change from the Pedocals to the Pedalfers. The latter are high in aluminum (Al) and iron (Fe) which are less mobile, less needed elements left in the soil while the other more essential ones have been washed out to the sea. There is a corresponding increase in the relative amount of clay. That also changes in kind to have less absorbing power for holding exchangeable fertility elements, but keeps holding potassium plentifully to grow more woody plants.

Potassium has long been associated with carbohydrate synthesis and transfer in woody plants, like forests, when its name "pot-ash" goes back to home-made soap in which it was the lye (alkali) to react with the fat for making soap. Thus in western, partly-developed soils and in plants high in protein there is the high ratio of calcium to potassium and other nutrients held on the clay and in the crops grown. In the eastern, highly developed soils, the calcium is low while the potassium is high in the ratio for both clays and crops. That shift in the ratios of just two of the many nutrient elements in the soil is cause enough to shift the food values (in what the soil grows) as much as from carbohydrates, balanced by proteins, inorganic and organic essentials, to values mainly of carbohydrates and many shortages in other nutritional services. It brings the crop from more complete nutrition for growth, health and survival down to deficient nutrition, masked by rapid gains of fattening bodies with health degenerations accordingly. All this comes with naturally excessive soil weathering, and also with man's exploitation under disregard of equivalent returns of minerals and organic matter to maintain the fertility.

EXPERIMENTS VERIFY THE DIFFERING COMPOSITION OF CROPS ACCORDING AS SOILS VARY IN DEVELOPMENT

Some studies were made of the chemical compositions (calcium, phosphorus and potassium) of collections of agricultural crop plants grown across the United States in the areas representing major degrees of soil development. Those included (a) soils developed but slightly, (b) moderately, and (c) highly or excessively. According to the data, the concentrations of each of the three elements within the dry matter of plants decreased in going from west to east and from lower to higher degrees of soil development. For calcium, the values for the three areas were 1.92, 1.17, and 0.28 percent CaO in the dry matter. For phosphorus, the percentages (P_2O_5) were 0.78, 0.69, and 0.42. For potassium (K_2O) the values were 2.44, 2.08, and 1.27, respectively, across from west to the mid-continent and the east. That was according to more rainfall and thereby higher acre-crop yields, mainly of carbohydrates rather than proteins in the vegetation. The totals, or combined, values for the three elements in similar order were 5.14, 3.94, and 1.97. That emphasizes the decreasing inorganic contents of feed and food crops, with slight drop between the first two but a decidedly large decrease between the last two. The mineral content on the eastern and southern more highly developed soils is but two-fifths, as possible nutritional values, of what grows on but slightly developed soils.

Those data exhibit another fact telling of variable plant compositions according to variable soils growing the crops. The nutrient elements vary independently. Though there may be possible correlations between them, those are not direct controls. In the above data, if the values for the three elements on the highly developed soils are each set up at 1.00, then for calcium the values for the three degrees of development of the soil become 6.80, 4.10, and 1.00; for phosphorus, 1.90, 1.60, and 1.00; and for potassium 1.90, 1.60 and 1.00. These would suggest some common cause for the close correlation between phosphorus and potassium, but certainly not between those two and the calcium. The former two drop from 2.00 to 1.00; the latter, or calcium, drops from almost 7.00 to 1.00. This points to the higher concentration of these three essentials in the vegetation according to growth on soils of the West and the mid-continent in contrast to those in the East and Southeast. It also points to the shift in ratios, namely, a high one between calcium and either of the other two, toward the lower ones according as the weathering or depletion of the soil increases. That such holds for soil exploitation has been experimentally demonstrated. (Illustration V)



(Illustration V)

Experimental studies using increasing additions of sulfur to the soil to be oxidized and to hasten soil development under rainwater percolating through the soil demonstrated:

(a) the weathering of the clay-humus colloid to lower the soil's total exchange capacity (note lowering top line);

(b) the more rapid loss of exchangeable calcium than of other nutrient cations;

(c) the substitution of the non-nutrient cation, hydrogen or acidity H(Al) for those; and

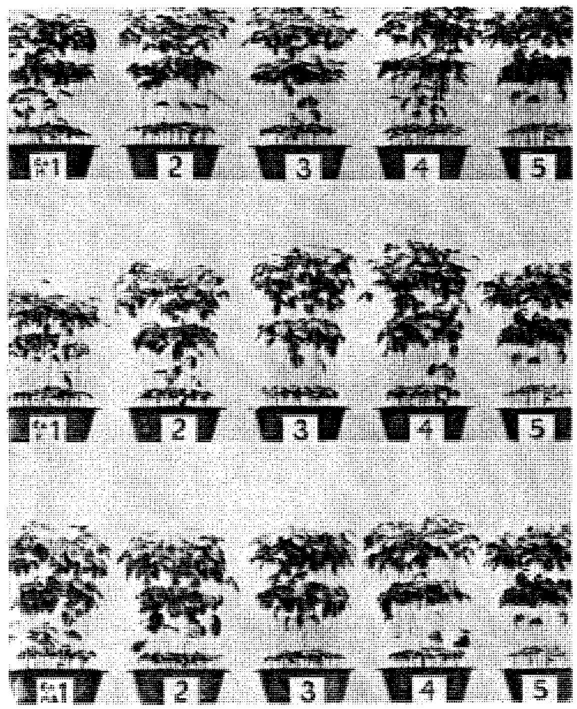
(d) the decreasing ratios of the amounts of exchangeable calcium to other cations to shift the diet of plants toward one less efficient in supporting their production of proteins.

The above is but one illustration of variation in the ratio of some of the components of the plant's diet taken from the soil naturally, and the effects on the plant's chemical composition or value as food for animals consuming it. Scientific studies are legion tabulating scores of ratios between two (possibly three), elements as those affect variation in plant composition. Ratios between calcium and magnesium, calcium and barium, or calcium and methylene blue demonstrated decidedly variable effects on the inorganic variables of soybean plants by the magnesium and barium, but little or no effect was shown by methylene blue, and that when the calcium as a total amount was constant and the other three were variables.

The ratio of carbon to nitrogen is decidedly important as a factor in making soil microbes competitors with plants relative to amounts the latter contain of the nitrogen, potassium, phosphorus and other elements. Ratios of nitrogen to phosphorus, to potassium, magnesium and calcium, all provide variation in plant compositions. Shifts in the ratios of most any two of the trace elements demonstrate variation also in the plant's compositions as illustrated by the ratio of the iron to manganese, copper to molybdenum, copper to iron and many others. Then there are ratios between major elements and trace ones, as simple pairs, only to note that according as those ratios pass on to be more disturbing to the plant's chemical composition, then a third, and possibly more nutrient elements seem to enter the ratio. Hence, plant composition is the expected variable when the inorganic nutrients vary as components of the plant diet.

SOIL ORGANIC MATTER BUFFERS EFFECTS OF VARIED RATIOS OF INORGANIC NUTRIENTS

Contrariwise, however, as demonstrated by methylene blue as an organic cation in ratio to calcium, the variation of this organic cation on the clay was not a disturber when calcium was constant in total amount but varied in saturation degree on the clay. This suggests that varying ratios between inorganic cations and anions are more disturbing to final composition of the crop's nutritional values in the absence of soil organic matter. Also much organic matter in the soil buffers those disturbing effects of variable ratios in the nutrient elements. That seems logical when, in practice, the disturbing effects of salt fertilizers have been lowest on soils still high in natural organic matter. Soils with their high stock of inorganic matter may have kept variation of such in the virgin crop's nutritional values hidden even to animals now discriminating keenly after soils have been more highly exploited of their virgin organic reserves. But when we face recent experimental facts of variable nutritional values coming with variable ratios of nutrient elements in the soil, isn't it gross ignorance of things natural to believe "the quality of vegetation as nutrition is not influenced by the fertility of the soil?" (Illustration VI)



(Illustration VI)

When the highly active inorganic ions of the soil vary in their ratios, illustrated by increasing calcium *saturation and decreasing* hydrogen, or acidity (left to right, upper row), or by calcium similarly matched with potassium (middle row) then the plant growths varied widely in spite of a constant total exchangeable calcium by soil test.

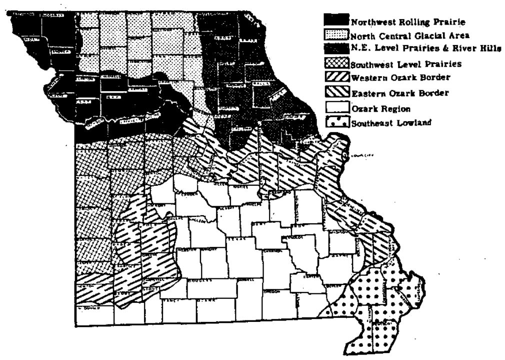
But when calcium was similarly matched with the large organic molecule, Methylene blue, then the latter buffered out the effects of variable saturation to make the effects of calcium a constant one according to the total available supply (lower row).

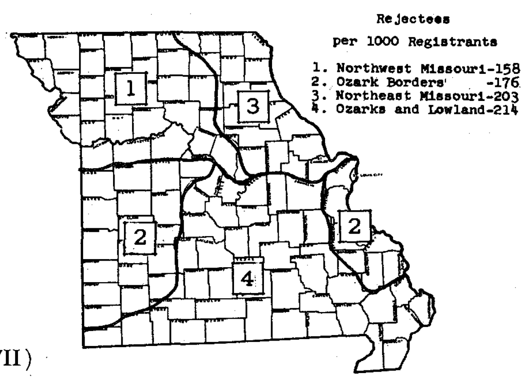
ECOLOGY OF OTHER DEGENERATIVE AILMENTS

Enough degenerative ailments, beside those of teeth, are now recognized, catalogued and mapped to let us see their ecological patterns connected with destructive weathering and man's exploitation of the soil. We need to be reminded that primitive man lived in areas of low rainfall, areas of constructive soil development or that in balance with the destructive, and areas of inwash of unweathered, pulverized rock or its delivery and sifting by winds to be the mineral assets for his survival. That says nothing of those for survival of his supporting herds and flocks, consisting mainly of ruminants.

But man's later emphasis on economics and technology moved him to soils under higher rainfall, inviting, of course, for higher crop yields under cultivation but mainly a carbonaceous production demanding lifelines to constructively

Major Soil Areas of Missouri





(Illustration VII)

Draftee rejections in Missouri (lower map) exhibit an ecological pattern duplicating the major soil regions of the state (upper map).

developed soils for their crops as mineral and protein supplements. Cereal grains became major crops with values for fattening, but declining nutritional values for survival. Since man's exploitation of the soil fertility duplicates the shifts in ratios of fertility elements to increase carbohydrates but to reduce proteins, inorganics, vitamins, enzymes, etc., for healthy bodies, our management without due conservation, as nature practiced it, is abetting the increasing degenerative ailments in place of improving the survival of the fit.

Man's move to the tropics demonstrates the ecology of "Kwashiorkor" or "Red Boy," a recently recognized degeneration through protein deficiencies and a baffling problem so long because of its symptoms too varied to be classified as a disease. It was more common when babies were nursed for only one year instead of for two before being put almost wholly on cornmeal gruel.

Ecology of berri-berri was connected with the ecology of another cereal crop, viz. rice as early as 1885 in case of the Japanese sailors. Corn (maize) in the diet brought on pellagra, another case mainly of protein deficiency and of supplements to accompany it. Ricketts, too, while more closely connected with calcium and its metabolism to include phosphorus and sunlight in bone-building, are not so common where protein-rich plants requiring calcareous soils are the common crop. The shift to cereals because of the destructive soil weathering and our exploitive soil use in regions of higher rainfall, represented more cereals, more yields of carbohydrates per acre but less of quality in nutrition for survival and more demands for protein supplements.

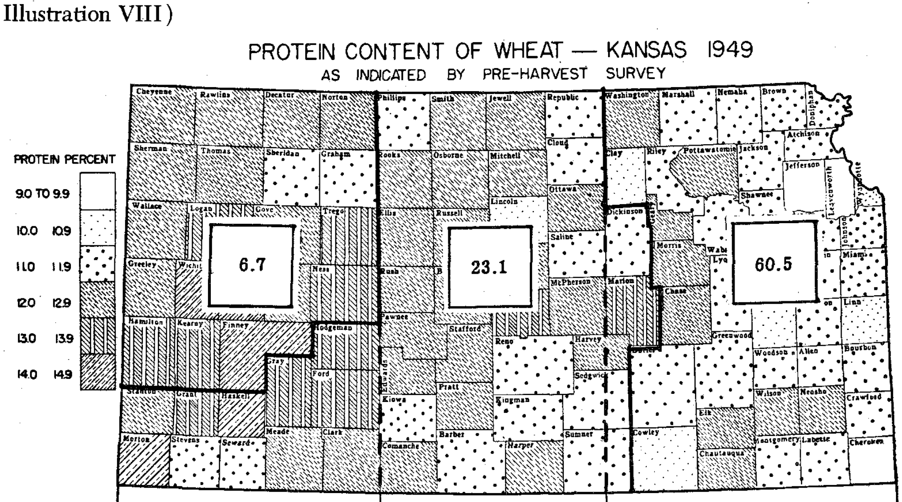
Draftee rejections demonstrate their ecological patterns in relation to the soil fertility pattern in areas no larger than a single state when in Missouri, for example, the medical data and soil divisions are carefully studied. For the four major soil areas and the last world war, the ratios of rejectees were 5, 7, 8, 9, respectively, in going from lower to higher rainfalls, or from equilibrium to above such between precipitation and evaporation. (Illustration VII)

The ecology of histoplasmosis of Kansas, another single state, shows its range from an area of low incidence under lower rainfall but high-protein wheat

PERCENTAGES OF HISTOPLASMIN REACTORS

- **AMONG 3600 STUDENTS, LIFETIME RESIDENTS OF RESPECTIVE AREAS. (SOLID LINES)**
- **AMONG COWS IN THE THREE SECTIONS OF THE STATE. (BROKEN AND SOLID LINES)**

(Illustration VIII)



CATTLE TESTED	419	136	1319
PERCENT REACTORS	0	1.5	4.2

Histoplasmosis of students and cows in Kansas exhibits an ecological pattern duplicating the decreasing protein concentration in wheat according as the soils are more highly developed in going from the West to the East.

to one of a high incidence under higher rainfall but low-protein wheat. The percentage positives by tests of native college students in three sections from west to east of Kansas were 6.7, 23.1, and 60.5, respectively. For tests of cattle in those corresponding areas, the percentage positives were 0.0, 1.5, and 4.2, respectively. *Histoplasmosis*, an infection by a fungus with symptoms closely similar to those of tuberculosis, demonstrated higher self-protection or less degeneration but higher resistance as the soils were more fertile and less exploited for producing the higher protein values in the cereal grain, wheat. (Illustration VIII)

MAN'S MANAGEMENT IN CONFLICT WITH NATURE'S

The lengthening lifelines for importing food supplements to any local area are also correlated positively with the lessening soil fertility for survival. That is apt to be called "extending the market." Longer lifelines and extending markets encourage food management in ways abetting degeneration of health via lowered qualities of nutrition. Lengthened lifelines go with lengthened "shelflife," of food undergoing an unrecognized death which delays decay and decomposition. But when food of that type does not tempt the microbes to eat it, should it tempt us?

Our management of food and its production in the case of increased crop yield by plant hybridization make much of "hybrid vigor." But that vigor does not increase specie s survival when most hybrids do not contribute to the specie s healthy multiplication. Hybridization, too, often spells sterilization so well illustrated by crossing the male donkey on the female horse to give the resulting mule, the slave that has been characterized as having "no pride in ancestry and no hope for posterity." Hybridization of cereal grains increased the output of starch, but lowered the protein concentration and reduced species survival to bring threatening extinction. Accordingly, are we not bringing on degenerative ailments by our own disruptions of nature's struggle for survival when we take over the management that in evolution was her domain?

Unfortunately, in our prevailing soil management we disregard the ecological patterns as nature's suggestions for creating different life forms according as (a) the climatic forces mix the broken rocks to supply the mineral requisites; (b) those are kept weathering in surface soils to produce active nutrient elements and less active clay to retain the former against leaching and as balanced diets for healthy plant growth, and (c) the vegetation is returned most completely to the soil for microbial decomposition and maintenance of the energy supplies and fertility requisites for *a living soil* according to the life it can support.

Under nature's management the virgin soils were growing climax crops of different plants, and all the associated life forms supported by them, in any particular climatic setting. Only two requisite phases of soil management were practiced. First, there was a reserve supply of pulverized minerals (replenished periodically by surface additions of them from wind and water) weathering in the surface soil. Second, the organic matter grown thereby was regularly returned to the surface soil in place. The fact that primitive man's evolution occurred successfully by no more complex soil management than the simplest practices of (a) supplying pulverized minerals, and (b) returning the organic matter produced, has not been widely accepted as a wise means, of healthy survival today. Yet the isolated, healthy Hunzas, a climax human crop, are an example, par excellence, of having been long-lived for having practiced just such simple, natural, principles of soil management on their stair-step soils for the past twenty centuries.*

The earliest science of agriculture started in cooperation with nature's management of the creative soil for healthy survival. But with increasing applications of science to give us labor-saving technology and economic advantages, man's extra power applied in various categories moved his management of the soil and much else in agriculture, and him, in general, to disregard, disrupt and even displace that by nature.

The penalty for that disregard and disruption of the soil as proper nutrition is dawning slowly when the resulting degenerative ailments are crashing down with major threats to survival. Instead of looking to our working from the ground up, and from pre-conception forward, by proper nutrition in healthy environment; we are crying for more scientific research and preying on mutual sympathy for more funds to carry forward with more technilogy for more economic advantages. The appreciation of ecology according to nature's soil fertility pattern for survival of the fit has much to add as help in our national health problems via both additions to and deletions of our past management practices.

*William A. Albrecht. The Healthy Hunzas. A Climax Human Crop. Journ. of Appl. Nutrition 15:171-179, 1962.

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