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SOIL AND PROTEINS

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RAINDROPS of the same size and shape are falling today with the same impacts and foot-pounds of energy for work in breaking down soil granules as they always have. But the chemical composition and other properties within the soil are significantly altered. A major but unappreciated change has been the decrease in the stability of the soil granules or in the stability of the soil structure. Soils that once retained well their loamy condition and plow-turned forms all through the winter, and through many rains after tillage, are now soon beaten down by only a few of them. As a result, much of the subsequent rainwater runs off and does not enter into the soil. We do less fall plowing. Our soils must be spring plowed if they are to remain granular and well aerated as a good seedbed through a significant part of the crop season.

This decreasing stability of the soil's granular structure is only another way of saying that the incidence of a weakened, if not a "sick", soil body should be taken as the major change in our soil and thereby the basic cause of the increase in erosion. Here is the big reason why water has not been going into our soil, but running off. It has been increasingly destroying the means by which food is created and agriculture is maintained.

Acid soils, soils that are highly saturated with hydrogen which is not a plant nutrient and therefore desaturated of calcium, magnesium, and all the other nutrients, do not granulate readily. Nor do they grow the nitrogenous crops to give calcium-rich, nitrogenous humus in the soil that brings about the stable granulation. Soils deficient in fertility are of weakened soil body. They are subject to severe erosion because that fertility deficiency is the weakness or the sickness. When surface soils lose their fertility to become similar to subsoils in this respect, they, of necessity, erode as badly and as rapidly as subsoils.

Soils deficient in fertility fail to grow cover quickly, or cover dense enough to be a mechanical aid against runoff and erosion. Barren soils erode because they are not fertile enough to feed the crop we grow on them and to have extra fertility kept in the cycle of going into organic combination as weeds and out again through their decay. In other words, our soils cannot take the impact of the rainfall because their fertility has declined too far to permit a stable soil structure, to grow cover quickly enough for prevention of excessive runoff and erosion, and to add organic matter.

To emphasize the decline of fertility in our soils may seem to be a mistake with our memory still strong (a) of the 1947 wheat crop in Kansas, the largest in our history, and (b) of the increasing yields of corn as the result of the scientists' application of hybrid vigor to this feed grain of high fattening power. Nevertheless, it is a fact that while the bushels per acre of both wheat and corn have been going upward, the concentration of the protein within each of these grains has been going downward. Because of the recent persistent decline in the concentration of protein in the wheat, the War Food Administration lowered the percentage figure which had long been the protein standard required of this food grain. Even though the total wheat crop has been increasing as bulk, the "hard" or high-protein wheat has been marching westward in the United States. The "soft" or low-protein, and therefore high-starch, wheat has been following in its wake. In like manner, the corn which had a protein concentration ten years ago of nearly 9.5 per cent, has the average figure of 8.5 per cent today.

While our crops have been yielding bushels per acre bountifully, those bushels have consisted mainly of the photosynthetic product, starch. At the same time those crops have been synthesizing for us less and less of their biosynthetic food products, particularly proteins. The soil that has been eroding more and more because of its declining fertility is the same soil which, for the same reason, has been giving us less and less protein, the food constituent so basic to reproduction and growth of all forms of life. Implied, then, in our conservation of the soil, is our struggle for food protein in order that we may survive.

"Yes," you may say, "we shall grant that the high yields in terms of both bulk and quality of our grain crops and the better reproductive capacities of their seeds may demand fertile soils. But there is still extensive room for a grass agriculture with less soil tillage in place of so much grain agriculture with its intensive stirring of the soil." However, one needs to be reminded that grasses are natural in that part of the ecological pattern where moderate rainfalls in the temperate zones have not weathered the rocks into the highly leached or nutrient deficient soils. They are growing on fertility laden soils.

Grasses are therefore feeds that are mineral-rich, and protein-rich. They are "grow" feeds rather than only fattening feeds for the herbivorous animals. They are therefore not to be juggled about from location to location merely as mechanical soil cover against erosion. They were native to soils of low rainfall or where cover was not the major part of their service in the great pattern. They were growing on soils granulated so deeply and so well as to take water readily to great depths. If the grasses are moved merely to give cover services in regions of high rainfalls, of leached soils, and of once-forested but now cleared areas, they cannot be protein producers for buffalo or beef cattle as we think of these in their prairie habitat. They may be soil cover, but are they capable of more than the photosynthetic performance of making wood by which their vegetative predecessors, the forests are characterized?

Grasses may well be considered as soil cover in our efforts for soil conservation, but when so used in soils naturally leached or exhausted of fertility by cropping, we must ask whether they can be feed for the animals by which this form of verdure must become an aid for human survival.

It was the virgin grasses that indicated the high level of fertility in the prairie soils. It was the reserve of both organic and inorganic fertility there which served to grow the crops and livestock in the mid-continent and gave us our American prosperity. While we have been prone to speak of the prairie soils and their grasses in the ecological pattern as though the grass controlled the soil and its high fertility, we have failed to appreciate the great fact that the fertility of the so-called "prairie" soils conforms to the climatic pattern of the development of the soil.

Our prairies represent the maximum of soil construction from the rocks by the climatic forces of rainfall and temperature, and also the minimum of destruction in terms of the capacity of those soils for growing protein-rich and mineral-rich foods and feeds for man and other higher animals. It was the prairie soils which, in their virgin conditions, were producing the bison, the large, well muscled, heavily boned, and herbivorous animals in large numbers. Those same soils today are producing domestic animals not so widely different from the bison in feed requirements, particularly beef cattle. These cattle are more highly concentrated in those soil areas than they are farther west, or farther east, where the hogs and their fat-producing power predominate. It is the cattle that are appreciated as providers of protein for the provision of which the nitrogenous and mineral-containing feeds are required, and widely grown there. They are not so deficient there as to necessitate importing them as supplements, as is the case on the more highly weathered soils in the East and its exhausted soils, or to the West with its undeveloped and rocky ones.

With the increasing rainfall in going across the United States from West to East, the maximum of protein production does not rest on the soils highly developed under high rainfall with maximum production of vegetative bulk. This food producing capacity rests on soils with a moderate degree of development under moderate amounts of rainfall in the temperate zone. These soils give production of less bulk as found in our mid-continental belt. In the less developed, highly calcareous soils to the west of this area and in the more highly developed, hydrogen-saturated soils to the east of it, the fertility fails to support our crops as effectively in synthesizing those combinations of the amino acids representing the complete proteins required for maximum of human and animal health. It is in this limited, mid-continental belt where the soil fertility combinations permit plants to carry on both photosynthetic and biosynthetic activities to produce both carbohydrates and proteins. This is in decided contrast to the more highly developed soils of the East and South where carbohydrates are the main agricultural output.

It is the fertility pattern of the soil according to the climatic pattern that determines whether we have largely calories in carbohydrates or whether we have also proteins, minerals, vitamins and all the other essentials of good nutrition for man and his animals. That same fertility pattern gives us the corresponding ecological pattern, or the distribution of all life. It carries deepseated and powerful implications in the solution of our problems of soil conservation. In attempting to conserve the surface layer of the earth's crust one dare not disregard or run afoul of the climatic forces in control of the development of the soil. They are in control of the assembly lines of agricultural production and all creation originating in the soil minerals and soil organic matter. Either they supply us or they deny us the nutrients serving as the foundation of the entire biotic pyramid with man at the top.

Soil conservation is not the application, on a national scale, of any single practice. It is the use of many practices according to the conditions of the soils. In the humid regions, for example, where shallow surface soils are underlain by infertile subsoils, erosion is cutting away the very basis of agriculture. It is inviting drought damage. But such damage is disaster, not because the plants are failing to find water, but rather because the roots are going into the subsoil to escape the desiccation of the shallow surface soil. They are making a transition from the source of both water and fertility to a source of water only.

Drought damage to Missouri corn in the summer of 1947 represented a shortage of fertility because of dried, shallow surface soils overlying infertile clay subsoils and not because of a shortage of water for this crop. These facts were demonstrated by the absence of drought damage on the experimental plots given enough extra surface soil to double the normal depth of the soil. There was likewise no drought damage to the corn crop where liberal applications of nitrogen and other fertilizers were put down into the subsoil a few inches below the surface soil by means of the subsoiler on a TNT plow.

Soil conservation in the humid area calls for attention to fertility and for building the shallow soils deeper in these nutritional respects. It demands improvements in both the physical and fertility conditions of the subsoil as well as topographic rearrangements. Conservation calls not only for prevention of erosion, but also for efforts in building up the soil in its fertility supply by building downward. Such soils call for conservation practices quite different than do the deeper soils of the semi-arid area in Western Kansas, for example, where once was the dust bowl and where last year those remnant soils produced the maximum wheat yields in the history of that state.

Soil conservation implies a need for reduction in the economic pressure on the soil. Reports by the Federal Land Bank on the management of farms obtained through foreclosures tell us that only those farms with the more fertile soils could be managed by the Bank without loss. As the soils were less fertile, the farms failed by larger amounts to be safe investments. If poor lands cannot pay for maintenance of their fertility, as is shown by these data, it is evident that the better lands are listed in a favorable economic classification because they have enough fertility to be mined to keep them under that category. Future generations are therefore already in jeopardy not only as concerns the economics of agriculture, but also as concerns food production for survival. Economic pressure, which the farmer can pass on to no one else but which must be passed by him to the soil, has brought our agricultural economics to the point where we are liquidating the capital assets (which is our natural food resource) and calling it profit.

One needs only to look at the soil map of the world to see the rather limited areas where the fertility is sufficient to produce hard wheat or to grow protein. These areas are in central United States, in Soviet Russia and in most of the British possessions. There are none mapped as such in Germany and Italy. When foods of more than mere caloric values are required to win a war, there are suggestions that it was reasons residing in the soils of the different countries that classified them as the victors or the vanquished. It is no great stretch of the imagination to see who the present great powers are in terms of soils that produce protein-rich foods. Can it be beyond the elastic limit of the imagination to see the world problem as mainly a food problem when once the soil fertility pattern is understood and when we remember that more than only calories and bulk are required of the foods that really dispel hunger? If we are to carry the major part in providing proteins for war-torn peoples whose older soils have dwindled in their capacity to grow such quality foods or even to provide oils and fats, shall we not approach that responsibility cautiously and raise the question whether we do not need conservation of our own soils in a degree never yet contemplated?

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