PASTURES AND SOILS 1952

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Our grazing animals are gradually compelling us to credit them with an uncanny ability to judge the nutritional qualities of the forages they take. We are coming to realize also that the higher nutritional qualities of the forages are determined by the higher fertility of the soils growing them. We are looking at pastures then, not so much in terms of their acres, but according to the fertility of their soils and thereby the nutritional quality of their forages.

We can appreciate the unusual ability of our grazing cattle to assay the feed values of their forages more accurately than we can when we observe that they let the tall grass on the spot of their droppings grow taller, while they eat the short grass around it shorter. Then, too, they are always trying to get the grass on the other side of the fence, provided that other side of the fence is out on the highway or on the railroad right-of-way. They prefer such places because there the soil fertility has not been exhausted by excessive cropping. If, in grazing, they can "call" the nutritional qualities so accurately in their "dumb" way of telling us, shall we not come to see that by giving attention to better treatments of our soil with limestone and other fertilizers, we can very probably build the soils for better results with our herds?

Virgin Prairie Soils Suggest Patterns of Proper Fertility

"But just how shall we know what a soil must contain or what treatment should go on our soils in order to grow better cattle," you may already be asking.

Perhaps you have already had some answers to that question. Suppose we look at the fertility outlay in our virgin soils or what the soils contained in the days before they were tilled and cropped. Perhaps some of them can offer suggestions.

You will recall that westward from the Mississippi River, or even for some distance east of it, there were the prairie grasses on the prairie soils. These lands were not growing herds ot domestic cattle when the pioneer first ventured into that region.

The prairies were, however, producing those big-boned, well-muscled hulks of animal flesh of similar feeding habits, namely the bison. These animals were meat and hides for the Indians. They were entirely grass fed. They were grown without any purchased protein supplements and, apparently, must have found their native forage of the proper nutritive ratio. One needs to ask why buffaloes had chosen, and stayed on, a particular soil area. These meat producers wandered north and south over almost the same soil belt as that where we now grow hard wheat. This is the crop producing a grain which is recognized as good food, particularly in whole wheat bread, and a plant of which the young growth makes good pastures for lots of Herefords today.

There on the plains was the soil that was naturally built for better herds. There were the soil contents as nutrients that can be put through the modern chemical tests and bioassays to give us a good pattern soil for beef production. There was the fertility condition toward which we can build up the other soils by the necessary soil treatments. That is the kind of soil that we want to duplicate when we use lime, nitrogen, phosphate, potash, magnesium, and the less prominent, or "trace," elements as treatments to improve our soils.

Prairie and plains soils were fertile in calcium or lime. Streaks of this were found down in these soils within a few feet of the surface. They contained reserves of minerals supplying other nutrients. Those soils were acid enough to break down and make these nutrients available to plants. Legumes were growing naturally and thereby providing feeds that were growing young animals rather than merely fattening old ones. Soils were not as acid as those farther east. On the more eastern soils today we know that the difficulty in growing the mineral-rich, protein-producing crops for more efficient feeds is due to the absence of calcium and other fertility that went out when the high rainfall and heavy cropping put acidity there in exchange for them.

The prairie and plains soils were well supplied with nitrogen, because when once it was taken from the air by the legumes to construct their vegetative bulk and then either grazed off by the bison or left in the grass, this fertility element went back in humus form on the death of both. The soils' contents of phosphorus were assembled from the rock minerals by the searching plant roots. This element was left in bountiful quantities in the surface soil layer in the organic and highly available form by this cycle of growth, death and decay in place.

Large amounts of potash were also active in soils so heavily stocked with organic matter going down so deeply. Being in regions of moderate rainfalls and periodic droughts, and being traversed by rivers hauling unweathered mineral sediments eastward from the arid region to be blown as deposits over them, these soils had regular additions of inorganic nutrients. Surely then, the chances were running high here that even the "trace" elements, like manganese, cobalt, copper, iodine and others would be present in the soil and the vegetation. At any rate, all the nutrients were there in the quantities and in the territories sufficient for the bison. Those soil areas provide the fertility pattern toward which we can build our other soils today by our soil treatments.

Forest Soils Present Soil Problems for Livestock Production

While the prairie and plains soils of our mid-continent still support herds today, they do so less effectively according to the proportion in which we are depleting the soil fertility by moving it off the farm in the grain and the livestock. Our declining soil fertility has been pushing beef cattle westward. This movement, some might say, is due to economics. But when the "hard" wheat, or high-protein wheat, is also marching westward with low-protein wheat following, it may not be erroneous to see the animals as the protein manufacturing part of agriculture, going west when the protein-producing plants go out there, because the needs for lime and other fertilizers for them on our soils are constantly growing more serious.

Perhaps you will grant that the exhaustion of soil fertility caused the movement of the big beef cattle market from the East to Chicago years ago and its movement lately from there to Kansas City. When we remember that the soils of the eastern and southeastern United States were originally low in their fertility because this was washed out by high rainfalls, we can readily

understand why our beef animals can reproduce and be grown more efficiently after those soils are treated with limestone and other fertilizers to correct the fertility deficiencies. Such treatments make better herds. These result because soil treatments make the once-forested soils and their forages more nearly like those of the original prairies and plains, where protein production as well as carbohydrate production was more readily possible.

If the soils were originally forested, they were then already relatively low in fertility even before we cleared them. They were providing potash, which helps the plants use the air and rain water to build carbohydrates, that is sugar, starch, and cellulose to make their wood. But potash is rather badly out of balance with other less prevalent elements for the plant diet that would enable the plants to make protein and big seed crops. The diet for the vegetation was already too low in calcium or lime, which is the soil requisite that we in the eastern United States associate with protein production, for example, by legumes and with good bone development and body growth in young animals. The plants' diet is out of balance for the manufacture of very much protein when that diet is growing only forests naturally. Soils in forested areas are deficient in one or more of the essential inorganic elements, and thereby deficient in furnishing a complete list of the fertility elements.

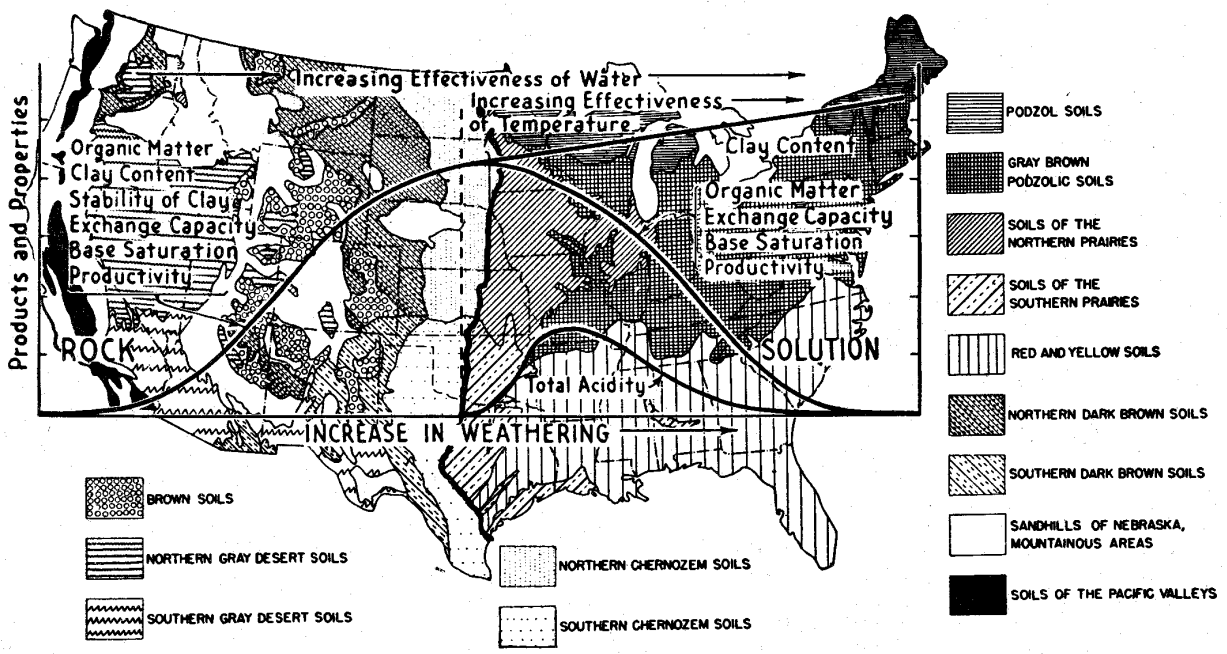
Soil Treatments Make Bigger and Better Animals

That we can apply lime, phosphate and other fertilizers and then get response by the animals has been shown: (a) by their choices in grazing of the treated soils first; (b) by their greater gains or young animal growth on forages from fertilized soils; and (c) by better reproduction on treated soils.

On many so-called "acid" soils one needs only to apply limestone, gypsum, old plaster, cement, acetylene waste or other calcium fertilizers as a streak across the pasture to see how the cattle will keep this grazed closely in contrast to the taller grass in the rest of the pasture. Such demonstrations have been numerous by the Missouri farmers, already well given to feeding their animals better by treating their soils.

Areas given phosphates and more complete fertilizers carrying nitrogen, phosphorous and potash are also similarly selected first for grazing. Barley to be grazed was fertilized at a double rate where, by drilling out the corners, the turn was made over parts already seeded and fertilized. The doubly treated spots were taken first by the Herefords when put into the field to graze it. The cattle select not only the first crop after the soil treatment, but they keep selecting for successive crops. One Missouri farmer observed his cattle selecting one of the four haystacks each year regularly for eight years after only one single treatment was put on the surface of this virgin prairie soil. This occurred when less than five acres of the produce of the 25 in the haystack were grown on the fertilized part of the hundred acres.

Most any soil treatment that makes up a deficiency in the fertility of the soil to balance the plants' needs more completely, seems to make forage of greater preference by the grazing livestock. When the cattle exercised a choice of forage in the field, can we not expect their growth rate to be higher from it, just as we know it is



The American bison was limited to the pastures along the line of maximum soil fertility construction and its minimum of soil destruction. Those were the **good** pastures because of the **good** soils for protein production. (Soil map with the climatic curve of soil development superimposed.)

for the hog exercising its choice at the self-feeder?

That building better soils also builds better herds was demonstrated forcefully by one of our Missouri Hereford breeders. Several years ago, as a beginner in growing Whitefaces on the acid soils on his farm, he decided to build up the soil as well as his herd. He has been testing his soils, liming, plowing down fertilizers, using legumes, and, while he has been building his soil deeper, he has been highly satisfied to see that he was building the quality, health, and reproductive powers of his herd much higher. His herd is much improved over that of the nearby herd from which his was established, and which is on the originally similar soil type that has not been built up as his had.

Soil treatments using phosphate are proving to us that this element is put into the soil to come up through the crops, and to bring with it some synthetic effects from the plants which, like those from calcium, cannot be duplicated by putting inorganic forms of these into the mineral feed box.

Other elements are doing likewise. Copper put on the soil as only a few pounds per acre in South Australia has "cured" sheep that were producing the undesirable, so-called "steely" wool. As little as two pounds of cobalt per acre used in Scotland "cured" sheep troubles known and feared for a long time. Perhaps manganese, used as a cure for perosis in chickens when added along with these other "trace" elements as soil treatments, may soon demonstrate its value in this way also. If it, along with these others, should reduce a baffling disease like Brucellosis as may be suggested from some effects thereby on undulant fever, then better nutrition resulting in particular blood and body proteins, and coming via the soil becomes protection against a baffling disease, and one supposedly transmitted from the animals to the man. This protection would be obtained by humans according to the degree in which the animal is first protected by specific fertility additions as soil treatments.

If the Plant Proteins are to be Complete in the Required Amino Acids, the Soil Fertility Must be Complete in all the Required Nutrient Elements.

The importance of the soil fertility in relation to the nutritional quality of the proteins has not yet had much attention. In this relation there seems to be much that spells deficiencies in nutrition going back more directly to the soil. In the humid soils of eastern United States we can grow corn in abundance. We are now considering a hundred bushels of this grain per acre as commonplace production. That has happened since we are growing a hybrid grain, the poor reproducing capacity of which is not recognized because it is not used as seed for the succeeding crop. The size of the corn germ has been dwindling. Consequently the percentage of even "crude" protein in corn has been falling while at the same time the bushels per acre have been mounting. Protein production per stalk has become less and carbohydrate per stalk has become more. Capacity to help the animal make fat remains, but capacity for body growth and reproduction of the animal has fallen. We have more "go" food but less "grow" food.

When the seed of this major grass, i.e. corn, is failing in its delivery of protein within itself, shall we not expect the corresponding failure in protein delivery in the other grasses grown in the same Cornbelt and harvested at near maturity as hay? Is it possible that we are moving toward a pasture system of livestock farming because only the **young** grass is concentrated enough or complete enough in the proteins and all the nutrient substances associated with them to nourish our animals, and keep them reproducing? Then, too, are we not compelled to depend more on growing our own proteins because the once more common protein supplements are required for feed nearer to the points of their origin?

All these questions should bring us to connect proteins more closely with the soil under the animal rather than with only the animal itself. The cow cannot deliver proteins except as they are provided for her in the feed, save for the supplementary synthetic helps she can get from the microbial flora in her intestinal tract. The corn plant as a producer of the more complete array of the amino acids essential for the white rat and thereby presumably for the cow, suggests its capacity for delivery of such quality of nutrition limited to the germ of the corn grain. Complete nutritional service does not include the endosperm of that grain. One needs only to feed the whole corn grain to Guinea pigs or rats to see how they eat out the germ first and no more, if the grain is plentifully supplied. The complete grain is deficient in the amino acids, tryptophane, methionine and even lysine. It is for the provision of these few deficient amino acids, then, that so-called protein supplements have always been, and must still be, supplied where the soil keeps plants from producing them.

Any other grass, like the corn plant and the grain it makes, cannot create the complete proteins required to nourish animals unless the soils growing it provide all the fertility elements and compounds the plant needs in its creative operations. Any plant is making carbohydrates when it grows. It is also making some proteins, but not necessarily these in terms of all the constituent amino acids the cattle must have to make muscle and to reproduce. It is the relief in the animal's struggle for proteins that connects good pastures with fertile soils so definitely.

The Protein Problem is a World Food Problem According to Soil Fertility

Two world wars that were fought under the slogan that "Food Will Win the War and Write the Peace," ought to encourage our inventory of the soil resources that were the food resources by which one group of the fighting nations became the victors while another became the vanquished. We may well look to the soil fertility supplies by which the Three Great Powers emerged in the category of that distinction and only by which they will stay there.

One needs to look at the soil map of the world and to remember that proteins of high food value as found in hard wheat, beef, and mutton, for example, are the products of soils that are only moderately weathered. Such soils and such protein products, then, must occur under moderate rainfalls and in the temperate zone. Such soils with extensive areas of hard wheat and animal herds in large numbers occur in the mid-continental United States. Likewise there are similar extensive areas in the Soviet Republic. It is these soil fertility resources in terms of protein production that give strong suggestions why these two nations are listed among the Great Powers. As for England in this category with them, the British Isles do not have extensive areas of soils that produce hard wheat. But when Canadian soils represent high protein-producing powers, and corresponding soils are extensive in Australia and South Africa—all parts of the British Em-

pire—there is ample suggestion that ships on the sea represent the strength of this third one of the Three Great Powers.

The strength of any nation—in what is too readily considered as a political strength—depends on high levels of fertility of the soils that represent protein production as food. The weak powers, under the analysis for their soil resources, all reflect very clearly their insufficiency as producers of food proteins. It is in terms of soil fertility resources and not of international politics that the world must be inventoried if we are to understand and solve the international food problem. We must realize that it is very acutely a protein problem rather than one of only calories.

Good Meat Grows Only on Good Soil

Seemingly we are still nomadic in our hopes and in our thinking about our future food supplies. We are delayed in realizing that about all the land areas of significant protein power have been taken over and put into production. We are still more delayed in appreciating the problem of maintaining in the future the capacity to produce protein where such was a simple matter in the past. We need careful inventories of the fertility resources in our soils, and of the supplies of minerals that can serve as fertilizers in soil fertility restoration. Those of us living in cities, those managing big industries, and all in the congested food-consuming rather than food-producing centers need to understand and appreciate the rate at which our soils are being exploited and not rebuilt. All of us need to aid and encourage soil restoration in terms of those nutrient elements serving in the struggle for protein (a) in the life of the microbe in the soil, (b) in the life of the crops in the field, (c) in the life of the animals, and (d) in our own human lives. We need to realize that T-bone steaks are not grown on city pavements, but only where the fertility of the soil keeps the assembly lines filled with the raw materials on which all agricultural production, and thereby food production, depends.

Good beef as good protein for excellent nutrition of ourselves will come from a grass agriculture only when the pastures are on fertile soils.

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Vol. 4—No. 10. July, 1952