Put the cow ahead of the plow

by
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College of Agriculture, University of Missouri, Columbia, Mo.

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Many breeders have manifest interest in Dr. Albrecht's thinking and subjects through articles he has prepared for the Polled Hereford World, and we are pleased to be able to present another article by him that has a title that should prove very interesting to the true cattleman.

Dr. Albrecht is widely known for his work with soils and related subjects at the University of Missouri College of Agriculture and has prepared a number of interesting writings.—Editor.

THE art of agriculture, that is, agriculture in practice, is old. The science of it, namely, the understanding of the principles underlying the practice is relatively new. The art has come to us slowly through the ages under guidance of the quiet but severe forces of evolution. Each long-lived practice is a case of survival by the strength of its recognized service. The science of agriculture has not been under test so long. It has often changed the art of agriculture. These changes were most pronounced where the natural resources, particularly the fertility of the soil, were ample to pay for, or cover, the costs of the mistakes connected with those changes.

Our westward march across the United States to deeper more fertile soils has perhaps not impressed you as a case in question. We have not realized that bountiful soil fertility may have covered the costs of our errors in understanding the fundamental scientific facts of agriculture. Too much plowing, when we once recognized what the plow can do, and the resulting dust bowl were only a temporary disturbance where the surface soil was so deep. A second dust bowl in the same place, however, might be a permanent disaster, if it should be the equal in severity of the first one.

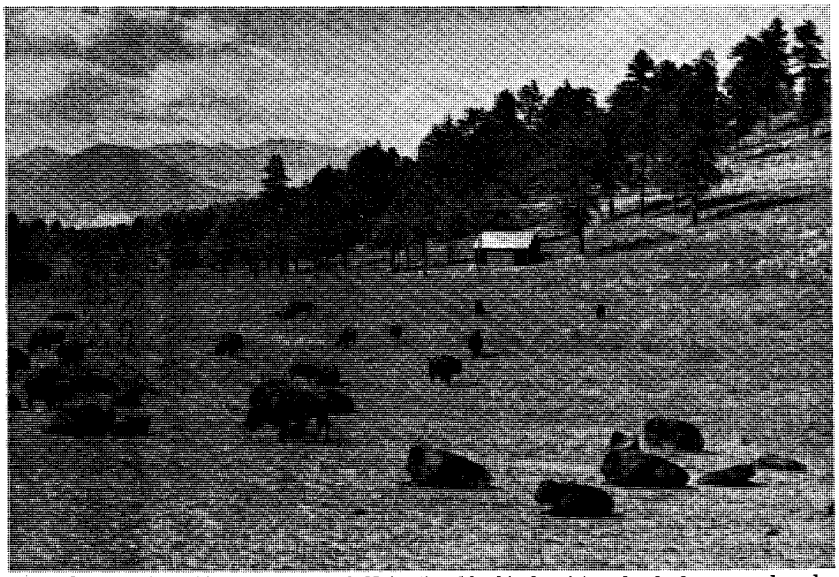
The costs cannot be paid repeatedly by losses of this natural resource, namely, the soil. A science of agriculture given to direction from one center, and under national emergencies—apt to be over-emphasized if not even propagandized—has left abandoned farms, and exhausted soils at the rate of one per family per generation in its wake of westward travel. The art of agriculture has been more permanent, and less "progressive," if those are the costs of such distinction. The slower **art** of agriculture put the **cow ahead of the plow.** The **science** of agriculture, given to more speed, put the **plow ahead of the cow. Cannot that science give more lasting profit to its agriculture by keeping the cow, our foster mother, ahead of us in our vision as the reason for having any plow?**

Primitive agriculture used the flocks and the herds, not the plow, as its symbol. Primitive agriculture was nomadic. It became a settled or a fixed one on those soils to which the cow had led the way. She served as the chemist assaying the soil fertility growing the forage that fed her and her owner. She had no fences to restrain her. She chose to graze on those soils fertile enough to make the satisfying feed of her contentment. She was not only ahead of the plow, she was ahead of the fence and other kinds of machinery that disregard her physiology and her nutrition in their designs according to the modern science of agriculture which is emphasizing economics, systems, politics, technology, and all else except the nutrition of animals and man for their good health.

Agriculture is concerned with life, not just with machines and materials.

Some simple observations may prompt us to ask ouselves some questions and to stimulate our thinking about the soil as it provides all that the cow would need to have coming from it, and whether a soil needs to meet only the limited requirements of being just something to be plowed, or to be manipulated by other agricultural machinery. Forages grazed by the cow have been called "grass" and "hay." They have been something to be cut with a mower or chopped, ensiled, baled, stored in the barn, and measured as tons of dry matter. More machinery to reduce the labor requirements of the farmer has been guiding the production of grasses and hays, when, in our humble opinion, that effort should be guided with the concern for more fertility in the soil for better nutrition of the cow by means of those feeds. **The machinery has become primary in the agricultural picture. The cow has become secondary,** if one can judge by the growing tractor population in contrast to the cow population.

When the plants we call "weeds" grow tall in the pasture while others are grazed closely and seem to be growing shorter, this is regularly considered a call for the mowing machine or highly poisonous chemical sprays to fight the weeds. Instead, when weeds "take" the pasture, that ought to be viewed as a case in which the cow is giving a new definition for the word "weeds." Careful observations of her behavior should raise the question in our minds whether she would suggest "hormone" sprays for the fight on weeds on a national scale. She is apparently telling us that weeds are not so much a particular plant species of bad repute within the vegetable kingdom. Rather, **weeds are many plants making too little of nutri-**



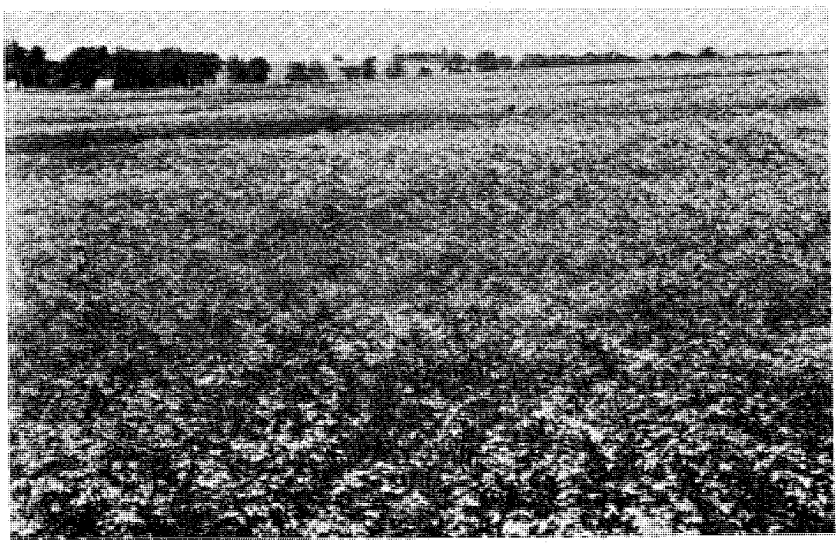
The American bison was one of Nature's able biochemists who had surveyed and mapped the soils of the United States for their protein producing capacity, but unfortunately we have paid little attention to his maps as suggestions for soils helping our beef cattle to be well located in their struggles for proteins. The bison (1) grew big bodies of muscle, not fat, (2) protected them from diseases, and (3) multiplied his kind by fecund reproduction in those climatic settings where the soils were only moderately developed and therefore high in the reserve mineral fertility guaranteeing quality rather than quantity of feed. *(Photot by Dean M. F. Miller, Missouri College of Agriculture)*

the plow

(Tractor Picture Courtesy Allis-Chalmers Co.)

tional value to tempt her to eat them for it. She lets them grow taller and tolerates the degree of her own starvation required to do so.

Recently a case came to our attention in which a herd of beef cattle was regularly going through kneedeep bluegrass and white clover on a virgin prairie—never fertilized and never plowed—to graze out the formerly well-fertilized, abandoned corn field of cockle burs, briars, nettles, and a host of plant species considered our worst weeds. Most of them were the kind that are under legislative bans against distribution of their seeds. Here the cows were contradicting our plant classifications. They were disregarding what we offered as supposedly good grazing in the form of the bluegrass, and were going the greater distance to consume the plants we have always called weeds, and even noxious ones under "legislative" ban. Such was their choice, though only when the weeds were growing on more fertile soil. These cows would scarcely recommend the use of hormone sprays to kill certain plant species which we classify as weeds. They would recommend more fertile soils instead. Then, apparently, no plant would be called "weeds" by them.



When the cattle graze the grass but allow the weeds (white top, Fleabane) to become so pronounced that "they ought to be mown" we forget that the soil fertility grows low-quality plants to big yields but only small yields of high-quality vegetation. The cow's refusal of the weeds is the reason for their prominence, and is her way of suggesting that we might well raise the fertility of the soil to raise better feed for her.

When the cow breaks through the fence, is it her objective merely to get on the other side? A careful consideration of such cow behavior points out that she is not going from one of our fields to another one, both of which have had the fertility of the soil exhausted to a low level. Instead, she is going from one of those areas of our neglected soil fertility to the railroad right-of-way, or to the public highway. She is going to where the soils are still nearer the virgin, fertile condition. Those soils have not been mined of their nutrient stores. When as agricultural leaders, possibly agricultural scientists, we plea for better fences to save valuable meat or milk animals from violent traffic deaths, is this not a failure to see the cow ahead of the plow? Is it not a case of putting the plow too far ahead of the cow?

On the Coastal Plains soils of the South, the automobile tourist is constantly confronted with the hazard of colliding with cattle crossing the highway pavement. They are not casual inhabitants there. They must be regular highway grazers. There are permanent highway signs to give warning of "cattle at large." These animals come out of the "Piney Woods" seemingly for miles on either side to graze this "chosen" strip of forage.

In spite of the punishable offense of killing one of them, many cattle in the South are accidently destroyed annually by the traffic. The high death toll results because the cows insist on grazing, not at some distance from the pavement,

"Some of this stuff tastes so bad I only chew it once."

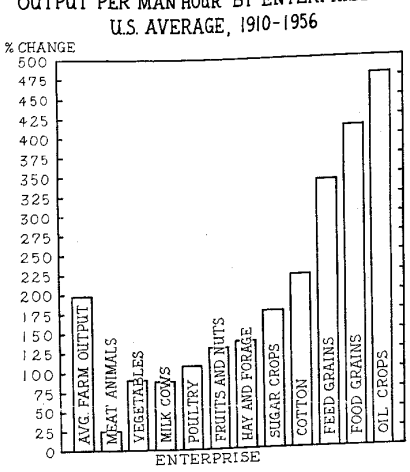
but right along its very edge on the grassy margin no wider than about one foot from the trafficway. There the calcium, possibly other plant nutrient elements, in the concrete mixture, diffusing through the adjacent soil or being taken by root contact of no more distant plants, apparently contributes a quality of feed the cows recognize and relish beyond that on any other part of the highway shoulder or the surrounding territory in the woods.

With the cow grazing so close to the pavement's edge, and crossing so often to the other edge or side, she certainly is a serious hazard to the motorist. But she is a much larger hazard to herself. The larger number of fatalities to the cows as one of the two parties involved testifies accordingly. Here the mechanics of our well-developed system of transportation run not only ahead of, but counter to and in conflict with, the ancient agricultural art of letting this beast go out to select her own grazing under her judgment of its nutritional values reflecting the fertility of the soil growing it. **While the machinery** (the automobile more than the plow, in this case) **is going ahead, the cow is not necessarily following it. She is being exterminated more often than the motorist, uninformed as he is of the forces responsible for bringing the dumb beast as well as himself into this death-dealing situation.**

AN ARABLE AND EXPLOITIVE AGRICULTURE WAS INVITED BY EXTENSIVE, FERTILE SOILS. SHRINKING SOIL FERTILITY PROMPTS INTEREST NOW IN MORE PASTORAL FARMING.

We have been prone to ridicule the simpler arts of agriculture in the older countries, and the older civilizations where the plow and other modern agricultural machinery followed rather than preceded the cow. Just now we are engaged—on an almost international scale —in educational activities, savoring of a missionary nature, and aimed to bring these ancient agricultures up-to-date, at least in agricultural mechanics for mining their soil fertility. We are unmindful of the fact that in these older countries the agriculture was always highly pastoral. The arable agriculture never dominated so highly as we knew it here, if the European manure pile in the front yard or the tank wagon flowing its liquid manure on the pastures and meadows dare to be considered as reliable indicators.

For us in the United States the plow has always been ahead of the cow. The plow has been agriculture's emblem. Arable and not pastoral agriculture has regularly been dominant. This was not so unexpectable in the age of development of farm machinery, or more in-

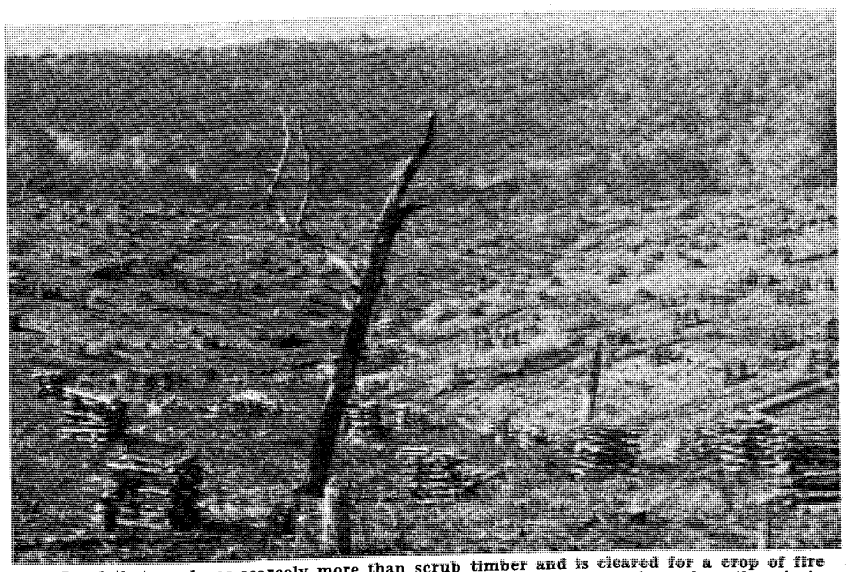


Agricultural economics emphasizes the profitable enterprises of grain-growing and grass-farming because of their high output per man hour (low cost per unit of bulk produced by soil and sunshine). But the conversion of feeds into meat represents a low output per man hour (emphasizing the output by the cow, not by the man).

ternal combusion engines, and of labor-relieving devices. It was the most expectable on soils containing great stores of reserve fertility. Our soils were of most extensive areas, very level topography, silty texture coming with wind-blown origins, high fertility in terms of its exchangeable forms on the clay, and rich in ready reserves of nutrients in the silt minerals brought as ample varieties from the arid West. Such soils naturally invited the plow and all kinds of machinery. Soil conditions of this type are natural temptations to convert them into cash crops, even for city suitcase farmers who would gladly escape the routine and daily work of feeding cows and hauling manure.

Now that (a) the seriousness of erosion is being recognized; (b) the areas of fertile soils to be so easily exploited are gone; (c) the fertility decline is becoming apparent after being hidden so long under "crop juggling"; (d) the problem of protein supplements as animal feed and many of the troubles in animal production are being traced back to the soil and not alone to the feed store, and the veterinarian and (e) we are saddled with the responsibility of being Santa Claus for a much more inflated and hungrier world; we are coming to talk about **less plow** and **more cow** as means to save the soil and **to give us more meat and more milk.**

While all these problems are too readily attributed to possible irregularities, in economic and social arrangements, we are reluctantly coming to see the fertility of the soil underneath the whole picture. It was through the plow that we led the cow to soils contrary to her choice of the fertility there. The plow held her there just as the fence confines her to the deficient fertility in the pastures which are growing weeds in place of feed. In similar manner, our technologies of engineering have extended agriculture in its many forms of so-called "crop specialization" that are in reality cropping limitations because of limited soil fertility. Cotton farming is a case, sugar cane farming is another, forestry



Land that produces scarcely more than scrub timber and is cleared for a crop of fire wood can scarcely become grassland of high protein value as grazing when the virgin crop was only wood under annual return of fertility. The fertility of the soil is reflected in the natural crops growing on it.

another, all of which are special kinds of farming that occur on soils of which the fertility would not entice the cow, and of which her assay would declare them too deficient to support her with good nourishment.

It was the **plow ahead of the cow** that took both of them to the one-forested soils in our eastern United States. It certainly would not have been the **cow ahead of the plow. Would she select a forest site, clear it, and expect the crops to be a good nutrition, when originally the Creator himself could grow only wood there, and that only by the return annually to the soil of all the fertility in the leaves?** We have allowed the mechanics of growing grass and feeding the cow to dominate our thinking so completely that the physiology of the cow eating them has had little consideration. By way of the soil fertility we must be reminded that the cow is more than a mowing machine or a hay baler. **Her physiology, and not just those mechanics, are connected with and dependent on, the fertility of the soil.** She is not calling for merely tons of feed, and acres of grazing. She is calling for complete nutrition to undergird the reproduction of herself and for the establishment of the subsequent milk flow of high nutritional values for her calf. She is not aiming at establishing records of gallons of milky liquid and pounds of butter fat.

NEW CRITERIA FOR AGRICULTURE WILL ESTABLISH IT AS A CREATIVE BUSINESS PREMISED ON THE FERTILITY OF THE SOIL.

These visions and appreciation of the plants as physiological processes creating good nutrition for us and our animals, do not come to us as readily as do our concepts of crop yields in terms of bushels of grain and tons, or bales, of hay. The crop yields per acre as criteria of how well we are farming are the mechanical phase of farming, the **plow part.** The hays as good feed, rich in the vitamins, the minerals, and the proteins to grow healthy cows giving healthy calves and much milk are the physiological phase of agriculture creation, or the **cow part.** As these mechanical aspects became more and more prominent in our thinking, the physiological aspects were of less concern. By that token, **the soil fertility as the foundation of agricultural creation has been disregarded and neglected.**

Under the prevailing agricultural criterion of more bushels and more tons, we have taken to searching for new crops, whenever a tried one began to fail. Instead, we should have been building up the soil fertility to nourish the failing one. The cow has never judged crop values according to plant pedigrees. She has been telling us by her choices of the same plant in different places that the crop pedigree does not determine its chemical composition or its nutritional values for her. She does not follow the textbooks on feeds and feeding, accepting average values of chemical composition and digestibility per plant species with no mention of the wide variation in these respects within the same species. She, more than the textbook, is reminding us that variations in composition mount to as much as a thousand or two thousand per cent, according as the crop is grown on soils of differing fertility. Surely the cow that is eating these variable samples of the same crop isn't taking them all at the same nutritional value. She hasn't ever heard of the mathematical mean or the average. She is given to marking out the differences and exercising her choice according to those variations. Hers is not the acceptance of the lot in terms of the average. With the **cow going ahead, we too see the variations in chemical composition.** But, with the **plow going ahead, we see only the average figure.**

That the soil fertility makes a tremendous difference in the chemical composition of a single grass species, and one considered high in the scale of nutritious grazing, was shown recently by the research of the Soil Conservation Service of the USDA, in their analysis of little bluestem of the Western Gulf Region. Samples of this choice feed of the once-prevalent American bison were collected in close proximity. They showed a range in protein from 1.5 to 16 per cent; in phosphorus from .03 to .31 per cent; in calcium from .07 to 1.58 per cent, and in potassium from .10 to 2.17 per cent of the dry matter. The higher values were as much as 10 times the lower ones in the cases of protein and phosphorus, 20 times for the calcium, and 21 times in the case of the potassium.

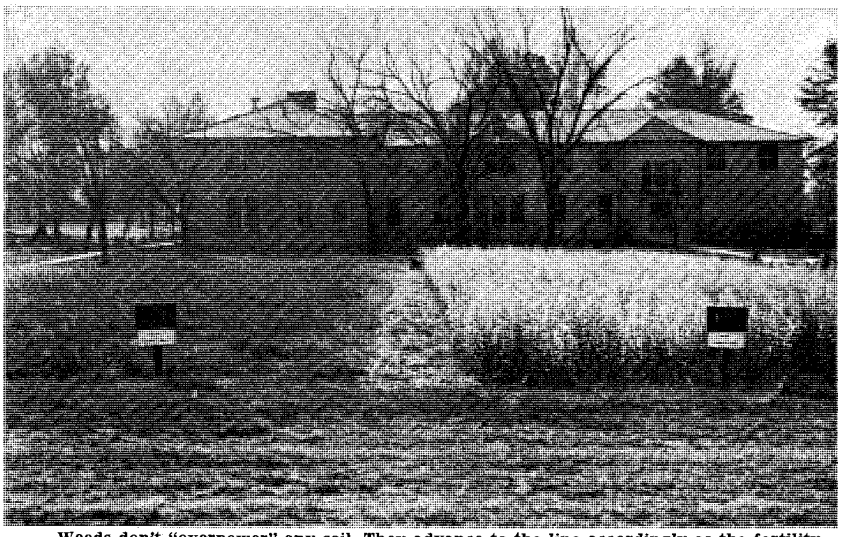
These were differences after the organic combinations influenced by, or containing, them had been destroyed by the ignition of the sample to leave only the ash. It says nothing about how widely the samples varied on the list of their organic compounds, like carbohydrates, proteins and specific amino acids connected with the creative services these ash elements rendered. It is significant that these widest variations occurred in calcium and potassium, which are only recently coming into consideration because of their deficiencies in the soil. **Calcium has long been ammunition in the fight on soil acidity when during all that time it should have been at the head of the list of needed nutrient elements on most humid soils for the nourishment of plants, animals, and man.**

PROBLEM OF PROVIDING PLENTY PASTURE IS ONE OF PROVIDING PLENTY FERTILITY IN THE SOIL TO KEEP GRASSES GROWING.

One of the major problems of the cattleman is that of providing throughout the season, plenty of pasture in which the young grass growing vigorously is regularly available. For this, various successions of different crops of different pastures have been combined into so-called "systems" by which the cow is put on each pasture at the particular time when the young plants are growing rapidly. For example, one such system pastures bluegrass from April to June, Korean lespedeza from June to September, rye or winter barley from October to December, and then the dry bluegrass supplemented by cornstalks and hay during the rest of the year.

Such a "system" apparently disregards all that can be done by treating the soil as a help in feeding the crops to keep them growing. Bluegrass on fertile, well-watered soil permits regular cutting back to give new growth continually. But this regular recovery of growth after grazing, or cutting it back, calls for a continued and generous delivery of soil fertility. Timothy on Sanborn Field given fertility has been growing during the entire season from almost the last snow of late winter through the summer and until the first snow of early winter. Regrowth by any crop cut back makes a demand on the soil fertility not commonly appreciated.

All of these facts ought to remind us that when our first pastures were established in this country, the soils were fertile enough to keep the crops growing under continual grazing through out the year. The physiology of the plant calling for soil fertility is forgotten, as we mechanically juggle the cow from one pasture to another in such "pasture systems." **Soil fertility must come in to lengthen the grazing season of any crop not only for more grazing of bulk, but also for the delivery of more nutrition in it.**

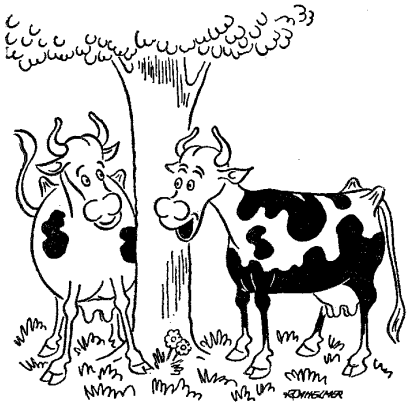


Weeds don't "overpower" any soil. They advance to the line accordingly as the fertility suits their nutrition. This fact is illustrated by plots in continuous timothy since 1888, on Sanborn Field, of the Missouri Experiment Station. On the left the continuous timothy has been given six tons of barnyard manure per acre annually and is free of the broomsedge (old Man's beard, Andropogon virginicus) in full seed on the adjoining plot (no treatment) completely "taken" by this weed. There is a straight line between the two plots across which this "weed" has not gone, (an October scene).

SYNTHETIC CREATION OF PROTEINS BY PLANTS CALLS FOR SOIL FERTILITY BALANCED FOR THAT FUNCTION.

While the idea of a balanced ration for the beef cow in terms of proper amounts of carbohydrates, proteins, vitamins, minerals, etc., has been commonly accepted, too few cattlemen are yet talking about fertilizing their pasture areas to provide a balanced nourishment for the grasses according to the feed values those plants are expected to put out. The dairyman feeds the cow according to the milk she puts out. If he feeds his growing grasses so they can regrow for the next grazing he may well visualize the fertilizer as a balanced plant diet in the same way as he considers the feeds for the cow a balanced ration.

Unfortunately for our crops, the seeding of many of them has literally been a case of turning them out to rustle for themselves. Our soils have become so low in fertility that many fields are merely an empty feed lot, to which rainwater, air, and sunshine are delivered by the weather. Consequently, these meteoric contributions of carbon, hydrogen, and oxygen help the crops to produce carbohydrate bulk, but little more. Even legume crops are turned out similarly in the false hope, or poorly founded belief, that since they are credited with the use of gaseous nitrogen, the nodular microbes on their roots will help them make proteins from the same atmospheric source. In all of this thinking, the fertility required from the soil is completely forgotten.



"Let's go see if there are any gates open!"

Under such disregard of the soil factor controlling the feed grown for our animals, the problem of providing proteins has become a severe one. Plants make their carbohydrates first. These construct the plant as a kind of factory consisting of roots searching through the soil, and of branches holding out the leaves within which carbohydrates are made from air and water under sunshine power. Every plant must be making carbohydrates if it is growing. It is also making some protein at the same time. But unless the soil fertility is generously available as help for the plant's bio-chemical conversion of some extra carbohydrates into proteins, there will not be much of these growth-promoters coming along with the carbohydrates to make good feed for the cow. Only as the complete fertility outlay is in the soil for protein production by the plant, will that plant provide sufficient protein to balance its carbohydrates as a good ration for the cow. **It is the shortage of soil fertility under the chosen crop that brings the need for purchased protein supplements.**

Cows take close chances when they can graze the same plant species growing more nutritional quality because of soil tillage and fertilization. (By courtesy of Jerome Waxler, Wallinford, Conn.)

When the farmer has been telling us that legumes are "hard to grow," he has merely been confessing the fact that if the legume crops are to synthesize proteins while growing in the eastern half of the United States, some extra nourishment for them must be put into the soil in the form of lime and other fertilizers. Under the propaganda of fighting soil acidity, he was told that lime helped the legume crops because the carbonate of lime neutralized the soil acids. He should have been told that lime supplies the legume with calcium, possibly magnesium, as nutrient elements needed for protein building by plants even if no calcium is contained in the finished protein molecule.

It is on the highly weathered, fertility-depleted and thereby acid soils of the United States that the dairy cow, for example, is expected to provide us our daily needs of calcium in a quart of milk. Along with that calcium, there comes the protein portion of the milk. This fact points out that there is a close association between this inorganic element, contributed by the soil, and the big organic protein molecule assembled by the cow according as the plants have synthesized from the elements the constituent amino acids of it. **Protein assemblage by the cow is merely the reflection of the synthesis of the amino acids by the plants according to the many elements of fertility in the soil. The weather may make carbohydrates, but the soil fertility determines the amounts of proteins, and their quality according to their completeness for nutrition in terms of required amino acids.**

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 produced by the crops 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 bushels per acre have been mounting. Protein production per stalk has become less and carborhydrate 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 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.

TRACE ELEMENTS MAY BE TOOLS FOR PLANTS' PRODUCTION OF COMPLETE PROTEINS.

It is significant to note that it was in connection with the increased concentration of these commonly deficient amino acids that soil treatments with the trace elements have been influential on alfalfa. Yet the trace elements are not component parts of the molecules of these protein constituents. Tryptophane contains the chemical structure known as the indole ring. This ring is not broken down by the digestive activities of either the human body, or of the microbes, according to most late information. Can this fact possibly be connected in some way with the more common deficiency in forages and feeds of tryptophane.

Methionine, another commonly deficient part of the proteins militating against their completeness, contains sulfur. This is an element not emphasized in fertility treatments of soil, though we have been unwittingly adding it through superphosphate, ammonium sulfate, and other sulfur-carrying fertilizers to say nothing of burning sulfur-rich coal. Sulfur was recently demonstrated as a beneficial fertility addition to some of our Missouri soils for bigger output of vegetation. It was shown beneficial, also, in terms of more methionine in the crop growth.

Shall we not give at least theoretical consideration then to the trace elements, not yet as known constituents of specific compounds in the body structure but possibly as tools in the fabrication of essential compounds by processes still unknown and still not recognized? As tools, then, we cannot expect to find their amounts directly correlated with the magnitude of the products they affect, any more than one would expect the number of milk pails to be an index of the number of cows being milked. Counted milk pails of a dairy are no measure of how much milk it produces per day. **Only by means of more refined research, and much of it through the animals used more directly to assay the services by the soil, can the nutritional services of the trace elements be elucidated.** In this the cow must go ahead of the research machinery than which even she is seemingly a more refined detector, including some of the finest of research tools, even the spectrograph.

UNDUE EMPHASIS ON THE PLOW THREATENS COMPLETE DISREGARD OF THE COW.

We are slow to appreciate the cow as the symbol of the physiological requirements of all life that can be properly nourished by agriculture only when the soil is properly plowed, that is, treated for supplying via the plant all the essential elements and compounds that are food for growth and reproduction. Modern agriculture is threatening to put the plow so far ahead of the cow that crops will be grown for little more than their bulk of vegetative delivery. Even that is more and more under neglected soil fertility so that she can scarcely find enough nutritional values in her feed to survive. Machinery of many kinds seems to be conniving with the plow to have us forget the cow entirely. In place of drinking milk we seem to persist in the unweaned habit on a national and even international scale, of sucking continually on the carbonated drink bottle. Fats from all sources are replacing butter by the help of machines that make hard fats soft and soft fats hard, and give us chemicals for artificial colorings that rival the carotenes themselves. Cheese, that once spoke with masculine accents and strength of its own, is now being replaced by the many "cheese foods." These are too effeminate to be sandwiched with rye bread and accompanied by the customary drink once gulped down with it in quarters not commonly frequented by women. Some twenty-five years ago we took to plowing under prenatal pigs. That performance has apparently become such a habit that it has moved the plow to cover the cow too. **While machinery is always a helpful tool under good mental guidance, still that contribution by the mind dare not be too small a part in that partnership of mind and machine, as auto fatalities tell us.** Surely we must provide some knowledge of the soil as nutrition if the cow is not to be deleted completely by the machinery that ought to follow behind rather than go too far ahead of her.

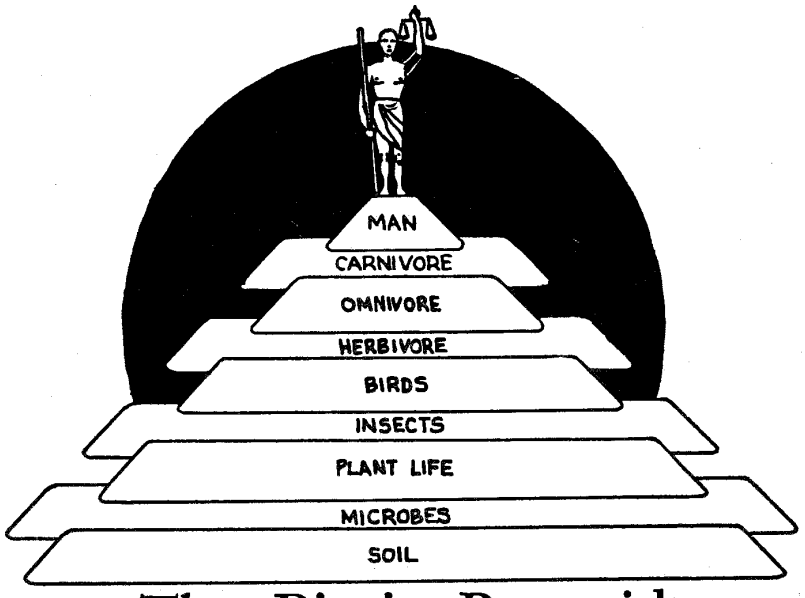
RESEARCH FOR QUALITY AS WELL AS QUANTITY OFFERS HOPE.

Unfortunately, as soon as research helps us gain a bit of physiological knowledge of Nature's activities of agricultural significance, we make machines to capitalize on it. We become so engrossed with the running of those machines that we cease to search out more knowledge of more physiology. The young scientist who made the discovery no longer continues his research. Instead he becomes an administrator, a director, or a business manager in the commercial development of his discovery. He **leaves the cow,** but he **takes to the plow.**

The cow, whether the beef or the dairy variety, has served in this discussion as the symbol of all the life forms with the creation of which agriculture deals. She represents the science, the organized knowledge of that life. Only as we understand the physiology of the microbes, the plants, the animals, and ourselves, can we fit all of these life forms on the foundation of their nutrition and thereby of their creation, which is none other than the soil.

The plow has served as the symbol of the inclination to move to mass production, or to set agriculture going mechanically, and let it run by itself under no more serious criterion than the collection of big monetary values by means of it. That philosophy of agriculture is threatening to be the Frankenstein about to kill agriculture itself when it starves out all the life forms on which agriculture depends. It is about to leave us hungry, with only eroded and barren soils because their fertility has been neither restored nor maintained.

The Experiment Station's research must be challenged by some of the fundamentals that are not measured completely by criteria including no more than yields as bushels or cash returns. **Qualities that deal with life, not quantities of materials alone, must be emphasized.** In that research the farmer too must share some of the thinking responsibilities. He must do more than just ask the Experiment Station his many



The Biotic Pyramid

The cow-an herbivore-has her place, too, in the pyramid of the many kinds of life. All of these, resting on a fertile soil, support man by their contributions in building more complex organic compounds, as their products or their bodies. By these, man, the topmost in complexity of organic requirements, is nourished. His place at the top is the most hazardous position if he does not conserve the well-being of all the life forms below him, and also the fertility of the soil, on which all life depends. (Courtesy Lady Eve Balfour)

questions, and expect a practicable answer merely for the cost of inquiry. The Experiment Station cannot, and dare not, in terms of democratic principles **think for the farmer.** But any researcher with better agriculture as his objective should take delight in any opportunity to **think with him.** As more farmers think about the fundamental processes of creation by which all that we call agriculture is supported, our thinking will not be contented with the machinery, the costs, the prices, and the speculative aspects of agriculture alone. It will invest itself more in the understanding of production that depends on the fertility of the soil. It will not be disturbed by talk of surpluses, that are only surpluses in quantity. But it will be seriously disturbed by shortages in quality, especially of foods so closely associated with reproduction of life as eggs, meat, and milk are. IT WILL KEEP THE COW AHEAD OF THE PLOW.

Reprinted from The POLLED HEREFORD WORLD Magazine, July 1, 1959 Herd Book, published by Polled Hereford Publications, Inc., 720 Delaware St., Kansas City 5, Mo.