RECONSTRUCTING THE SOILS OF THE WORLD TO MEET HUMAN NEEDS

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It is a distinct privilege - and no small responsibility - to participate in this the tenth annual institute on conservation, nutrition and health. We have had the corresponding privilege at some of the earlier institutes, some held far from the maddening crowds of the paved metropolitan streets and out in the quiet company of Nature herself. The varied turns taken in the succession of annual programs or institutes seem to tell us of a growing reliance on the eternal verities born of the soil. These turns indicate an integration of many fragmentary concepts of the earlier years as to what great purpose an organization known as the "Friends of the Land" might serve in the United States or even on the North American continent. With the dawn in the minds of many folks of the need for more conservative use and less exploitation of not only forests and waters but also of the soil - both in the United States and Canada - these programs are now of some international dimension. They suggest that we are crystallizing a philosophy of thriftiness toward our natural resources. We are now coming gradually "to support, increase and unify all the efforts for the conservation of soil, rain, and all the living products, especially Man."

Such a manifesto includes extensive territory. It now transcends the very general and simpler initial concept of conservation. With the word "Man" as the last one in that declaration of purpose, there is the suggestion that the various fluid states of thinking about conservation have passed. Its philosophy is definitely crystallized, at least in the minds of those guiding the programs of the annual institutes and of the leaders of the Friends of the Land as a whole. The theme of this, the tenth institute includes man in particular relation to the soil as it feeds or fails him. This is especially gratifying to one interested in soils as they serve in nutrition which service must be complete in terms of the fertility of the soil if there is to be health from the ground up for microbes, plants, animals and consequently also for man.

Man's lofty position at the top of the biotic pyramid is apt to give the impression that, since he is put over all other life, he would surely have an answer in the positive and would outline a *modus operandi* in detail for the question assigned to us for this occasion, namely, "Can we reconstruct the soils of the world in their productivity to meet human needs?" Unfortunately, even though the growth of conservation thinking has been phenomenal up to this moment, one of the features about it that emphasizes itself most is the fact that man has not yet demonstrated much success in the conservation of other life forms and living products below him in that pyramid. The loftiness of his position is not one of regality in which he may gloat. On the contrary, it is one of hazard because these life forms beneath him may readily refuse their support. The declining soil fertility below all life may topple him from it.

All too slowly is this great fact being recognized. While man may rightfully boast of this technologies of construction and reconstruction in engineering accomplishments, we can scarcely subscribe to the belief that man is capable of participating in the processes of creation to the extent of reconstruction of the soils of the world to meet human needs. Can man save himself? The subject under discussion here must be approached, then, mainly for the analysis of the problem but, as yet, for no plan guaranteeing the full and positive answer in favor of soil reconstruction for man unlimited. On the converse, Nature's great forces will, in all probability, reconstruct man to fit the soil.

NEEDS, NOT WANTS

As a partial clarification of the subject, let us note that the statement of it specifies human needs and not wants as the objective of soil reconstruction. "Need is a state of circumstances requiring something."(1)* If we consider only the needs, that is, the bare requirements for human survival, those are far below human wants. But when so much is said about the "standard of living" let us remind ourselves that when our soils must meet that requirement they must satisfy our wants, not our needs. Those wants include, so often, extensive phases of jealousy, greed, selfishness and similar attributes emphasizing man with disregard of all else.

Our wants are too often mistaken for our needs. They are readily interpreted as demands and come into the picture of economics matched against supply. Demands of such nature with their flow of dollars and other monetary equivalents submit to measurements by cash register recordings. It is by such specifications, then, that our standards of living are listed to include wants and desires but by no means according to the criterion of need. One needs, for example, only 70 grams of protein per day, according to the calculations of the scholars of nutrition. But any one of us may want a T-bone steak or a filet mignon of more than three times that many grams for consumption at one sitting. Wants and demands are not constants. Hence the common views of economics may well be laid aside. We shall do well even to think about rebuilding the world's soils for human needs. It was man's wants and not his needs that brought on the disastrous soil exploitation.

It is man's needs and not his wants that must guide soil conservation and reconstruction. In this discrimination between the needs of the human and the wants claimed by him, there is much to clarify our thinking about conservation of our resources. According to our wants there can certainly be no hope in the face of mounting population. According to our needs, there remains at least a challenge to our thinking about the problem, the wish for its solution, and the effort at least by some of us, to cling to the faint hopes for the positive answer to it in limited localities.

*Numbers in parenthesis ( ) refer to numbers in "Literture Cited" at conclusion of the paper.

OUR MAJOR NEEDS

The human needs may be listed as numbering mainly three. When put in the order of increasing effort to obtain them in the struggle for survival as a human - reasonably sociable and amenable to the laws and behaviors of good society - they are (a) shelter and fuel, (b) raiment or clothing and (c) food. In considering the reconstruction of the soils of the world to meet these, the following three simple questions are posed. How much of a task will it be to have the soils of the world extensive enough and fertile enough to provide our needs for shelter? What must be done to assure that the soils will supply fiber crops sufficient for clothing and fabrics? Then finally, can we reconstruct our soils to grow the food in sufficient amount and of required nutritional quality for the mounting numbers of our world population?

THE SHELTER PROBLEM

The problem of shelter has commonly been disposed of either by facing and solving it or by escaping from it. The migration of many folks from the colder to the more moderate and warm climates is, and always has been, the escape from the needs for fuel and extensive shelter. In the past, the soil has been the productive source of most of our sheltering materials. The forests were plentiful. The pioneer's erection of the cabin was almost incidental to the removal of the trees in clearing the land for cultivation and food production. The call by Gifford Pinchot for conservation of the forests has not been heeded extensively because shelter can be had from many substitutes for wood in home construction. Even today the efforts in forest conservation and the program of reforestation are not so much a cry for means of shelter as they are a cry for pulp for paper and industrial uses other than for lumber in building houses.

The reconstruction of our soils for growing wood for shelter does not represent much of a problem for several reasons. In the first place the growing of wood, which as a chemical product is lignified cellulose, makes no call for a particularly fertile soil. Instead it is a call on the air and water for the major chemical elements of its construction. These are meteorological contributions. They are not soil-borne. They are fabricated into combustible products by sunshine energy. Consequently they give that energy or heat back on burning as fuel wood or as fossil wood in coal.

In the second place very little of soil fertility, or relatively small amounts of chemical essentials from the soil, enter into the wood. Those used to make the seasonal growth of a tree are returned to the soil annually to a large share in the regular drop of leaves. Even for the non-deciduous trees the growth is so scant that the drain on the soil's essentials is very small.

In the third place the growth of a tree so far as the soil is concerned is the result of continued root extension. This is one going not only horizontally over larger areas but also vertically through greater soil depths. As a consequence, wood as a shelter product is possible on soils of fertility level far below that required to meet other human needs.

The need for shelter is not a call so much for reconstruction of our soils but rather for a reallotment of soils now in no crops to trees for future crops of wood. It is a call for more abandoned areas to be planted to trees. Our foresters are demonstrating clearly that planting trees in the once forested but cleared and burned areas under abandon is still a great opportunity for large crops of wood. This will be good reconstruction of vegetation if we are only far-sighted enough for each of us to do more planting of this slowly ripening crop where it will be no competition for shorter-lived ones. More acres planted rather than more soil reconstruction is the solution. Growing our shelter does not invoke serious pessimism about the future. Trees require so little fertility that they are almost the first crop before the rocks are scarcely developed into a soil and are also near the last vegetation holding forth on soils developed so completely as to have been moved nearly into solution and on to the sea.

Even if we could not grow shelter, the soil itself and the rocks that might make it will serve as shelter. This was demonstrated by the sod houses of the western pioneers and the shelters of the cave dwelling primitives. Modern home construction has gone forward while the role of wood in it has almost passed out. We are making buildings completely fireproof. Soil scientists have not given much thought to reconstruction of the soil to meet the needs for growing our shelter. They have escaped that responsibility in the substitutes which do not call on the soil for their creation by growth. It would be no insurmountable difficulty to reconstruct our soils to meet the human needs if shelter were the only one in that category calling on the soil.

FIBER CROPS POSE SERIOUS SOIL PROBLEMS

Division of our fiber needs into those of vegetable, animal and technological origins makes the problem of soil responsibility for their provision less complex. By no means, however, can one escape the necessity for soils and their reconstruction to meet these needs. Technology has exhibited what may be some of the most outstanding applied research in giving us the synthetic fibers. Even then, of those still in the minds of the research men and in the prospect of creation, there is a good member. However, in seeing the metallic spineret replace the corresponding anatomical equivalent of the silk worm, we must remind ourselves that both are fed by digestion of vegetable matter grown on the soil, either recently or in the distant past. But here again, as in the case of shelter, the chemical composition of synthetic fibers calls for mainly carbon, hydrogen and oxygen which are delivered gratis as air and water over extensive land areas. Then too, with cellulose serving as the raw materials for the synthetic chemist, such fiber production does not demand the most fertile soils on the list of those serving human needs. Technological creations of fibers for clothing and plastics offer consolation in the problem of growing fibers, skins, etc., as body cover and comfort. While such helps in fiber production lessen the soils responsibilities and push the day of soil exhaustion under this need into the distant future, nevertheless, we must not forget that the carbon and the nitrogen in the coal come from what is now fossil crops but grown once upon a time by means of soil fertility before it escaped to the sea.

More significant in relation to soil is the observation that our choice synthetic fibers are not those consisting wholly of the carbohydrate equivalents, namely carbon, hydrogen and oxygen. The cellulose-acetate fabrics were originally a welcome creation and fill a significant human need. But the more purposeful fibers coming later at more cost and greater synthetic complications approach the proteins in chemical composition. They must have nitrogen in their molecular structure as well as the more common constituent elements of vegetable matter. Nylon, Vicara, Orlon and other fibers, perhaps not yet commercially born, suggest that, like the proteins in agricultural production, they are the deficiency in supply and are hard to produce or grow except under the complex chemical combinations composing the most fertile soils. This is quite in contrast to the rayon fibers, suggesting carbohydrates, which are a crop that is easy to grow, and is plentiful. They give us big yields on acres which are still equal to that production load from the remnants of their original fertility supply.

GROWING FIBER CROPS DEMANDS THAT WE GROW PROTEIN SEED CROPS TOO

Vegetable fibers like cotton, flax, hemp and others, commonly considered for fabric use, bring the soil problem more sharply into focus. These crops cannot be grown in disregard of the level of fertility in the soil. Abandoned acres are numerous which these crops have exhausted of fertility. Growing the cotton fiber is a matter of growing also the seed to which the fiber is attached. It is a matter of a soil fertile enough to produce first the proteins in the seed and then the fibrous, cellulosic cover enshrouding it. Growing a cotton crop calls for the high level of fertility needed for production of any seed, or any protein-rich crop. In the case of fibers taken from the plant stems, the maturation of the seed is a part of the plants' total performances of making the fiber. The making of the cellulosic fibers, even if they themselves contain little that was brought up from the soil, cannot result unless the plant also carries forward the physiological load of producing the proteins. It is that latter performance which makes heavy demands on the soil for liberal production of them.

The growing of cellulose for fibers calls for more soil construction and reconstruction than the growing of cellulose as wood for shelter. In the coniferous trees, the physiological load of seed production is reduced to the very low level of a fungus spore. In the fiber crops the corresponding physiological demand is much higher, calling on the soil for more help. Fiber crop production is production of cellulose but also of protein along with it. This is possible only on soils fertile according to the protein output rather than the delivery of cellulose.

Soils for fiber crops need not be as highly fertile as soils for production of protein in foods and feeds when we recall that cotton seeds are protein but one not complete enough to serve all our domestic animals. They serve the cow. Her safety factor in this connection lies apparently in the cooperating help of the microbial flora in her paunch through which she can use cottonseed proteins, insufficient as they are for other domestic animals. Soils growing cotton fibers and the proteins associated with them call for reconstruction in their fertility if those soils are asked to grow the more complete proteins for human consumption.

If we are to grow more fiber crops for more folks, such crops are no escape from the necessity of either finding more soils inherently fertile in certain specific respects, or reconstructing soils accordingly by means of added fertility materials. Fortunately, fibers are not a perishable crop. Also their services are long lasting and would be much more so were we not such addicts to fashions, changing with the season's demands rather that remaining undisturbed according to human needs.

WOOL IS A PROTEIN CROP

When we consider soils in relation to wool, our favorite fiber of animal origin, the problem of reconstructing soils to grow the sheep to make the wool incidentally, is far more complex than at this moment we appreciate. The wool fiber itself is a protein. It is bathed in a particular fat during its production by the sheep. Wool production is a physiological performance of high order. It calls for the provision of proteins in the feed which the sheep eats. Proteins grown into the feeds are a call for soils fertile to degrees much higher than required for a plant's production of cellulose and other carbohydrates.

Animals cannot synthesize proteins from the elements. They only assemble them from the amino acids as parts of the protein synthesized by the microbes and the plants, and in completeness of all those required only as the fertility of the soil supports the conversion by the plant of its carbohydrates into amino acids. Wool production is a question of soils fertile enough for protein production to build sheep bodies. Is it too much stretch of the imagination to see human bodies of highly similar physiology in the same picture? Protein production is the major call for the reconstruction of many soils too low for that. If we are to produce wool, this demands regular maintenance of the fertility of any soil, too long taken for granted when after exploitation in one generation we escaped the responsibilities of soil reconstruction by going West. When the nutrition and the physiology of the sheep approach those of the human so closely, any consideration of soil reconstruction for feeding sheep for wool and meat may well carry its implications for the nutrition of man, too. In thinking of feed for the sheep we are then thinking simultaneously about reconstruction of the soil for food for ourselves.

We trust you will not deem it unkind to the sheep-loving flockmasters when we believe that wool production (and mutton production) in the past may have resulted more from the instincts of the sheep than from the knowledge of animal nutrition and physiology - much less in relation to the soil fertility - on the part of the shepherds. For the pioneer, the sheep were the chemists that went ahead of him and assayed the vegetation for its quality of protein to make wool and to support reproduction of the flock. This bio-assay for good sheep nutrition was cataloging simultaneously those more fertile soils into which the plow could be put for good crops as nutrition for man. Sheep have spread over the land and multiplied because they do so with a fuller knowledge of their soil security under them than can be said of their owners. Along the same line of thought, we must acknowledge the fact that sheep have become of major importance, not under closer

domestication but out on the range where they search out their feed from the native and virgin vegetation. We have not yet set up the complete fertility inventory required of a soil to grow forages that will produce sheep of good health, prolific lamb crops and incidentally big weights of wool. So far, the soil has not come into the picture for its fuller significance in wool production. This crop of protein (and fat) is still much a matter controlled by those supposedly weak animals or dumb beasts themselves. To date the growth of our protein crops, whether in wool fiber, in the carcass of the sheep and in the bodies of our other animals as meat and choice food, has been mainly at the expense of ravaged soils, and not reconstructed ones.

PROTEIN-PRODUCING SOIL AREAS ARE LIMITED

Consideration of the two preceding human needs, shelter and raiment, in regard to reconstruction of soils has already separated out the two parts into which the third need, namely, food for any living body, divides itself. Foods serve (a) to provide the body with energy and (b) to build the body, i.e. to be parts of the construction or to be tools in this process. Carbohydrates, of photosynthetic and meteorological origin illustrate the former. Proteins and all that is associated with their fabrication make up the latter. For our crops' delivery of carbohydrates in sugars, starches and cellulosic bulk of large yields per acre little soil fertility and thereby little soil reconstruction is required. Merely going forth to sow with unbounded faith in the pedigree of the seed but with no attention to the good ground on which it must fall is about all one requires. Natural cover on most any soil illustrates this contention. But for the production of cell-multiplying, body-building, species-reproducing proteins along with those carbohydrates, the areas of fertile soils have always been limited. Soil surveys have measured acres, not fertility, much less protein production. Statistics of crop yields represent bulk as the criterion for agricultural output. Delivery of nutritional values has not yet been included in that category.

Our sheep and other animals ahead of us, while we were trailing them for benefits unappreciated, have been going west to more proteins but with exploited soils in our wake. We are now being turned back in this journey by the soils under us, and by our animals too. We prefer to dodge the responsibility of reconstructing our soils to produced sufficient protein. We are content with a superficial thinking that has not yet come to believe that shortages of proteins find their causes in failing soil fertility. It is instead a contentment with legislation that will roll back the prices on meat to please the majority and disregard the food-producing minority. Great facts are not necessarily established by majority votes.

With reference to protein as feed and food coming from our soils the sheep population deserves the same critical consideration we are about to give to human population. Sheep population has given its curves of increasing numbers from the earliest records until the maximum was reached in 1942. Since then the numbers

have declined so sharply that today they are below the figure of the first count taken. No reason can be found in the economic demands for such a decrease, when wool prices and meat prices, offered by those able to pay them, are also the highest in history by several times. We may well ask whether it is not the decreasing soil fertility that is rolling the sheep population back in spite of increasing demands for wool and mutton as the economist uses them? Isn't the human population apt to be rolled back too, eventually, in relation to the soil fertility that must feed it?

An interesting correlation, suggesting failing nutrition of the sheep because of a deficiency in the soil fertility's trace element copper, deserves mention in this connection. (2) It was in 1942 when phenothiazine, the organic compound for killing worms in sheep, (one of the many deadly ring compounds) was announced as replacement for the inorganic copper sulfate that had formerly been used. Might it not have been possible that by drenching the sheep with copper salts regularly under the guise of killing internal parasites of an undernourished animal we were feeding copper to cover a deficiency in the soil and were making well nourished, healthy animals within which even worms do not survive? Such hypothetical consideration of what may seem to be only a correlation ought to push research farther. When it does we may discover that it only magnifies the task of reconstructing our soils with copper to the sheep's needs for feed, to say nothing of the magnitude for the human needs of foods with respect to all the other trace elements known and still unknown.

SOIL FERTILITY PATTERN SUGGESTS RECONSTRUCTION PATTERN

In the soil pattern of the United States, the major production of proteins along with the carbohydrates to make these more nearly a balanced diet for healthy bodies of animals and man has been on the soils in the climatic region of moderate to low rainfall in the narrow longitutinal belt bordering the 97th meridian. (3) That is where our high-protein wheat is grown. When our meat and wool animals range and rustle for themselves out there they are healthiest, longest-lived, and most fecund in reproduction. Protein production is favored by the less weathered soils where wood and water were not so plentiful for the pioneer. Soils too dry for massive annual crops are still rich in their stores of inorganic essential nutrients. We speak of them as soils of the prairies and the plains with grass as good feed for growing (but not for fattening) animals. We then conclude that grass must always be good feed for growing our meat - and milk-producing animals because of its pedigree. We fail to realize that grass is good feed (when grown out there) because of its high protein content, its high concentration of inorganic bioelements and its location where the periodic droughts prohibit forests but permit grass that can grow by stops and starts during the season according as the rainfall moisture in the soil permits. Soils developed under such a climatic setting are fertile. They grow protein-rich grass. They grow their own nitrogen-fixing, protein-rich legumes naturally. They make every mouthful of forage going into the animal a case of real feeding and not one of merely filling and nutritional fooling. The choice of the sheep and cattle for their best health from this ground up in the mid-continent was previously confirmed by the numbers of bison

delineating the same soils for his high production of bone and brawn, to say nothing of prolific reproduction.

PRODUCTION OF FOOD PROTEIN POSES STILL BIGGER SOIL PROBLEMS

The provision of complete proteins is the major food problem for both man and beast. It is more serious in other parts of the world than in parts of the United States, of Argentina, of Australia, of Canada and of South Africa, for example. This is a problem for which nothing but more acres of more fertile soils can offer a solution. Technologies cannot be called upon to deliver synthetic proteins. Unlike fossil energy compounds, no fossil protein compounds, except for a little nitrogen in coal, have been unearthed. Animals of prehistoric times may have needed protein supplements much as our domestic and wild animals demonstrate their needs for them when they break through the fences and become marauders in their struggle for them. Now that we have had man's nomadism, undergirded by technologies overcoming distance to cover the earth with his population, we are face to face with the problem of peacefully feeding that mounting crowd on decreasing acreages under tillage and dwindling fertility in those shrinking volumes of soil.

Perhaps it will be sufficient to consider the protein problem (or the meat problem) by matching the human needs for this food portion against the possibilities of reconstructing the soils to meet them. This is no new mental pass-time. Thomas Robert Malthus of England indulged in it as early as 1798. He discussed "The principle of population as it affects the future improvement of society." He pointed to the fact that the increase of population is a geometric function in which the number doubles every 25 years. The rate of increase in the earth's production is an arithmetic function which could never keep pace with the geometric rise of numbers of people to be fed. But while folks laughed at Malthus' idea because the day of doom he predicted was delayed by man's migration to the Western world for increased food by soil exploitation of new acres there, Malthus spirit is now coming back to enjoy a chuckle as he says "I told you so long ago".

We have now moved over just about the entire potential world's surface for the purpose of mining the soil's resources, for seining the possible proteins out of the seven seas from pole to pole, and for collecting Nature's savings from the deeps everywhere. Technology has lengthened the food life lines beyond their elastic limit. Many of them are breaking. Most of them are being shortened. Man's reaching hand is being cut off by the failure of other life forms which he robs by his reach. We have not yet come to think in terms of our individual land allotments, their limitations and our responsibilities in their conservation.

According to recent figures, our world population is about 2.2 billion people. The usable land for food production is 2.4 billion acres. As a mathematical mean, this is slightly more than one acre for each of us. In the United States the recent population figure is 151 million people. We had 345 million acres under cultivation in that census year. For purposes here in the

U. S. you can imagine, then, that you are managing a bit more than two acres of agriculture to guarantee your keep. On a world bases you are limited to farming only one acre.

In order to simplify the problem, let us remind you that your protein food requirements are 70 grams per day, so with your allowances of food fats near the ratio approaching that of protein and fat in beef steak, your annual needs in only these two as beef would call for 320 pounds of this meat. At a dressing percentage of 56 percent, this requirement put into beef alone is the equivalent of 570 pounds of live beef weight that you must grow on your land allotment.

One acre of good soil in grass for a season will produce 300 pounds of beef. Hence one and one half acres are needed to grow the protein(meat) and fat. A half acre remains in your allotment in the U. S. for the production of 200 pounds of cereals, 250 pounds of potatoes, 50 pounds of sugar, to say nothing of fruits for other carbohydrates and accessory foods you might desire to produce on that limited area. It is immediately evident why the world as a whole is not on beef steak, and why our growing population in relation to soil acreage and productivity in protein potentials is rapidly taking many of us off that excellent diet and desired high standard of living.

That we dare not assume continuation of the past increases in production into the future so far as protein is concerned, is as suggested by the records before us. The crop acreage of the U. S. in 1930 was 359 million. In 1950 it was only 345 million in the face of higher prices. (4) Increased acreage without costly reconstruction of the soil is out of the question. Decreased acreage is the inevitable prospect when erosion is cutting it so rapidly that within 100 years they tell us we shall have a total of only 100 million acres left for crops. (5) That area for even our pre present population would cut down your allotment from two acres to two-thirds of an acre. Your allowance of all protein as beef equivalent would be cut from 70 grams per day to but 25 grams. It would leave no acreage for growing other foods. That situation shifts our standard of living downward seriously when it suggests that we like Nebuchadnezzar shall eat the grass like the ox (in place of eating the ox) knowing that our soil fertility kingdom is departing from us.

Not only the shrinking acreage but the declining fertility in any acre comes into consideration for soil reconstruction as experiment fields at Missouri and Illinois emphasize it. They tell us that even in the Corn Belt and its glacial soils, a time longer than 50 years of cultivation will exhaust the fertility below the point of paying the costs of working them, much less paying the taxes on them. But you say "We can replace the fertility taken out in the produce by means of fertilizers." Already these inorganic mineral resources were producing 25 percent of our crops in the year 1950 with a maximum mixed fertilizer consumption of 18 and 1/3 million tons. This was an increase by 12 percent over 1949 when the increases in yields per acre in none of our crops were equally large. In the last ten years the fertilizers' share in crop

production, in contrast to that of virgin fertility, increased from 20 to 25 percent. (4) This says nothing of the thousands of tons of fertilizer materials beside the mixed fertilizers used on our soils. Even then the total food production has not increased since 1944. (6)

Here is the evidence that our food curve is no longer going up. The curve of population is. With such increased reconstruction of our soil fertility but with no corresponding increase in yields per acre and with no more than "holding our own" in total yields for the cultivated acreage of the country as a whole from such fertilizer increase, certainly these artificials on the soil will not offset the food needs of the population increase by 13 million people during that same period when production was already a constant. Soil construction cannot meet the mounting needs of such population increase. The falling curve of soil resources for protein food production under all efforts is coming to cross the rising curve of food needs by more people. "It is estimated we shall this year consume 148 pounds of meat per person but that the effective demand at parity prices would be 160 pounds. It is estimated that (in 1951) we will grow enough feed grains to produce 138 pounds of meat per person. We will draw om our feed grain reserve for 10 million tons of grain necessary to bring our 1951 meat supply up to 148 pounds per person." (7)

"To produce these 10 million tons of feed grains which we are drawing from reserve this year we would need another seven million acres of land. If we produced enough feed to equal the demand for meat, it would require 20 million more acres of land. To meet our increase in population and to maintain only our meat supply * * * we would need to add three million acres annually. In this next decade we would need to find 30 million acres, * * * another state like Iowa."

As partial relief from the problem of finding more acres, we can turn to the alternative of fertilizers to make the present number of acres produce more proteins. "One ton of nitrogen in fertilizers equals 14 acres of good farm land. * * * * We use an average of seven pounds per cultivated acre. In Holland the average application is 50 pounds. We will need to balance the nitrogen with phosphate and potash." In terms of nitrogen, then, * * * "to get our emergency need of seven million more acres of feed grains we must produce 500,000 more tons of nitrogen as fertilizers. * * * * We are producing over twice that amount now to get our present production. Even if we get this 500,000 tons (more nitrogen) to solve our (present) emergency in 1951, we must add 100,000 additional tons every year to keep up with our population." What, then, can we hope for from more soil construction when the curve of productivity is levelling off (if not falling) under even so much present soil building? What hope is there when during the last two decades tractors using fossil crops as fuel have replaced the feed crops in the protein of 20 million horses displaced, and when the protein produced in soybeans was increased from 28 to 280 million bushels of these, both of which cannot be repeated?

Attention to soil building on its broader scale can be relief to needs in limited localities. Any discovery of new fertilizer resources brings the world to pounce on it immediately. This occurred for Gafsa in North Africa, and for Nauru, an island in the Pacific, both phosphate fertilizer suppliers, but objectives of whole armies in World War II, or as occurred for the fixed nitrogen on the market today. Technologies have put us on a world war basis. They put us into a United Nations with scarcely no nation any longer independent but submerged into the group and held there by the veto. Onnsuch great dimension and under such world political pattern some folks would boast of our opportunity for world leadership in it. But they are failing to see that we have taken over the responsibility - and the attending dangers - of world leadership.

The virgin soils of the western hemisphere were a relief to human needs for the interval extending from Malthus' day to our recent time. Technologies made relief from population pressure on the soil resources most extensive, as man overran to consume what he could and to to collect from everywhere. By such means of feeding itself, the population shifted its curve from what then was near a straight line, either level or slowly rising, to one rising geometrically with populations doubling every 25 years.

But as we look ahead there are handwritings on the wall again like those of Malthus, to say that the curve of population will take a fall since the curve of support, coming from the soil or the sea (into which soil has washed), are not only failing to rise commensurately, but are turning to a relative decline. Even food as bulk per person cannot be increased at rates of present population increase. The human needs as outlined by FAO and matched against world crops show the wide disparity of those two sets of figures. More significant is the fact that in such data the needs as food protein show still greater disparity between these and the supplies of them.

In the older parts of the world, the population pressures on the fertility-exhausted soils have been so heavy and already for so long a time that our imagination cannot picture this as reason behind (a) seven Nazi generals, recently hanged at Landberg, Germany, for the crime of exterminating near hundreds of thousands of folks by starvation, (b) thousands of anti-communists recently eliminated in ever hungry China through what we call a "communist purge", and (c) thousands of communist soldiers thrown into the murderous cannon fire of the United Nations armies. Technologies once pushing the world population upward are now turned to slaughter, apparently to pull the population downward to fit the food resources of the soil. Is it beyond belief, that underneath all these disturbing manifestations there is the soil and with it the controlling factor of insufficient fertility as food?

WE MUST STILL HOPE

Perhaps just at this moment our despondency might overwhelm us and shake severely our faith in the soil sciences. But the human species is quickly reduced from social stature to animal nature by hunger. The hidden hungers as an earlier stage in that reduction procedure are the most dangerous. It would appear as if the major pattern of the world's population is suffering mainly from this hidden form of hunger which represents our living in a mental health too poor to exercise noble human judgement, but in a body condition still well enough to fight brutally to survive. It suggests that we are not yet starved down to the degree of resignation to the forces of fate.

Soil reconstruction may be a part of the struggle under goad of hidden hungers for protein. In our humble opinion, soil construction cannot hold up the world's multiplying population. Those numbers will eventually be pulled down until they are balanced against the fertility flowing as food from the land and from the sea.

Such is the world picture as we see it. Fortunately none of us as a single individual needs assume that world responsibility. There is the place yet for each of us to make his own local soil support him the best he can. We need not be swept with the indifferent horde, made up of those unwilling to struggle independently. Soil conservation is still an individual responsibility. Soil conservation is still an individual opportunity. By multiplying the individual soil conservationists, we can meet the hunger needs in this segment of population, at least, yet for a while.

Only in a struggle on such a democratic basis can a democracy survive. We shall survive only according as our needs are reduced to come into balance with the possible reconstruction of the soil. This view of the future for each of us, puts real meaning into the words "Soil Conservation" and calls for more folks to become Friends of the Land in the fullest significance of that title.

REFERENCES CITED

(1) John D. Detweiler

News Letter, Canadian Conservation Association
No. 14 May 18, 1951

(2) Wm. A. Albrecht

"Soil Scientist Theorizes on Reasons for Cut Back in Sheep"
Kansas City Weekly Star, July 26, 1950

(3) Wm. A. Albrecht

Nutrition Via Soil Fertility, According to the Climatic Pattern
British Commonwealth Scientific Official Conference, Australia
1949, Commonwealth Scientific and Industrial Research Organization
Melbourne, Australia, May, 1949

(4) "Fertilizer Consumption for 1950 Soars to a New Record"

Fertilizer Review, The National Fertilizer Association,
Washington, D. C., April - May - June 1951, pp 8 - 11

(5) H. H. Bennett

Soil Conservation, McGraw Hill, 1939

(6) Editorial, "Food Needs and Price Controls"

The Nations Agriculture 26: p 5, 1951

(7) Correspondence by Jonathan Garst to H. L. Bracey, P.M.A.

"Report by Jonathan Garst, Asst. to the Sec'y. to the
Secretary of Agriculture"
Columbia, Missouri, June 1, 1951