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Part I

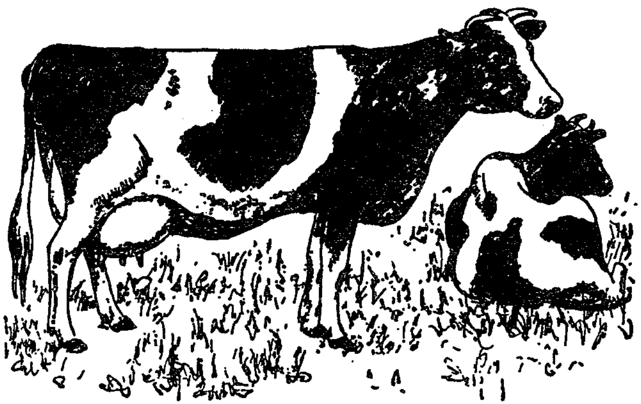
Earth's Labor Lost

Two kinds of Millet
Hungarian Grass and Broomcorn (common) Millet

WHEN YOUR MOTHER told you to eat everything on your plate because people were starving in India, you thought it was pretty silly. You knew that the family dog would be the only one affected by what you did or didn't waste. Since then you've probably continued to think that making any sort of *ethical* issue about eating is absurd. You eat what your family always ate, altered only perhaps by proddings from the food industry. It's probably a pretty unconscious affair, and you like it that way. But eating habits can have a meaning, a meaning that not only feels closer to you than an abstract ethic but brings you pleasure too. What I am about to describe to you may sound at first like just another ethical rule for eating, but to me it feels like common sense far removed from the abstract.

The act of putting into your mouth what the earth has grown is perhaps your most direct interaction with the earth. But, depending on the eating habits of a culture, this interaction can have very different consequences—for mankind, and for the earth. What I will be suggesting in this book is a guideline for eating from the earth that both maximizes the earth's potential to meet man's nutritional needs and, at the same time, minimizes the disruption of the earth necessary to sustain him. It's as simple as that.

In order to understand this very simple idea of making the most of the earth's productivity while doing the least damage, we must have a clear picture of our present practices and their consequences. Since the eating habits of this culture center so heavily on meat, the best place to start is with the United States livestock production.



Cows

A. A Protein Factory in Reverse

Think for a moment of a cow grazing. We see the cow as one link in a food chain of which man is the last link. Man is, therefore, the obvious beneficiary. The cow eats grass and we get steak. What could be a better arrangement! But before we acclaim our good fortune let's examine just how the conversion of plants to meat occurs in practice. You will see that in this country we have drastically altered this simple grass-to-meat equation.

Livestock could very well serve man as a "protein factory," converting humanly inedible substances, like cellulose, and low-quality protein in plants into high-quality protein for our benefit. Grazing livestock on rangeland of little agricultural value is clearly fulfilling this function. And, as we shall see later, some livestock can even produce protein with a diet based on as simple a molecule as urea!

The President's Science Advisory Committee believes that livestock "protein factories" are, in fact, operating primarily to turn humanly unusable nutrients into foodstuffs for man. In the mammoth report entitled *The World Food Problem,* they emphasize that:

> The use of *small* quantities of cereal grains as livestock feed in modern nations makes it possible to use, at *low* cost in terms of food that could be consumed by people, large quantities of forages and by-products that might not be used otherwise. (*Emphasis added.*)[1]

Unfortunately, this ideal arrangement is simply not realized. Relatively little advantage is actually made of the ability of livestock to convert inedible and low-quality material into high-quality human food in this and other highly industrialized countries. On the contrary, *enormous* quantities of the *highest*-quality food sources are fed to animals.

Fully *one-half* of the harvested agricultural land in the U.S. is planted with feed crops.[2] We feed 78 percent of all our grain to animals. This is the largest percentage of any country in the world. In Russia, 28 percent of grains are fed to animals,* while in developing countries, the percentage ranges from 10 to *0*.[3]

Converted into protein these statistics mean that in

* Note that the Russian diet has about the same amount of total protein as the American diet. (Based on protein availability statistics.)

1968 U.S. livestock (minus dairy cows) were fed *20 million tons of protein primarily from sources that could be eaten directly by man.*[4] Cattle and hogs alone accounted for one-half of the total protein consumed. This figure is minimal in that it excludes protein from alfalfa, hay, and low-grade by-product feeds.† It *does* include the protein from most of our domestically used grains, specifically: 89 percent of our corn crop, 98 percent of our grain sorghum crop,‡ 87 percent of our oat crop, 64 percent of our barley crop,[5] as well as 95 percent of our unexported soybean crop,[6] and a significant portion of the wheat and rye harvest. In addition, this 20 million tons of protein include about 950,000 tons of fish products fed to American livestock in 1968.[7]

But these figures acquire real meaning only when we take into account the efficiency of livestock in the conversion of "feed" into protein for us. It is widely accepted that the ratio of nutrients put into an animal to the nutrients recovered for human consumption is high. For example, the protein production ratio for beef and veal in North America is 21 to 1. This means that a cow must be fed 21 pounds of protein in order to produce 1 pound of protein for human consumption. Other types of animal protein conversion are somewhat more efficient. Chart I shows how they compare.[8]

Considering all classes of livestock in the U.S., the average ratio of protein conversion is 8 to 1.[9]

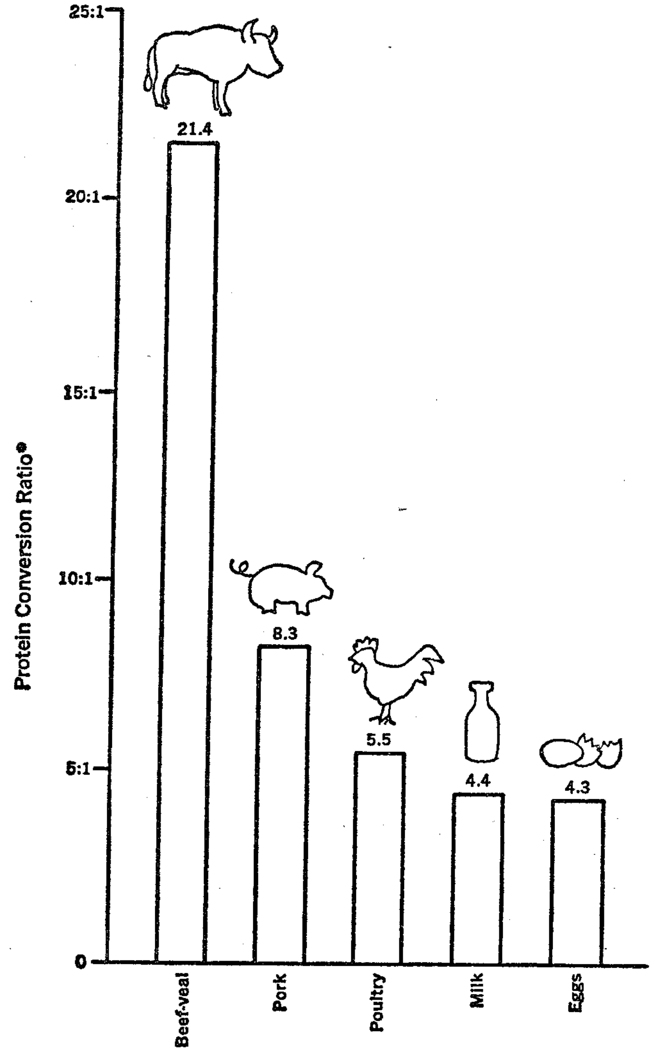
Another way of assessing the relative inefficiency of livestock is by comparison with plants in the amount of protein produced per acre. An acre of cereals can produce *five times* more protein than an acre devoted to

† One by-product fed to animals which is not so "low grade" is the high-quality protein products (e.g., wheat germ) left over after making white flour.

‡ Grain sorghum is not eaten here but is a staple in many parts of Africa and elsewhere.

CHART I

LIVESTOCK PROTEIN CONVERSION EFFICIENCY



*No. of lbs. protein fed livestock to produce 1 lb. protein for human consumption.

meat production; legumes (peas, beans, lentils) can produce *ten times* more; and leafy vegetables *fifteen times* more. These figures are averages—some plants in each category actually produce even more. Spinach, for example, can produce up to twenty-six times more protein per acre than can beef.[10]

Barley, Rye, Millet, Oats, Wheat

Now let us put these two factors together: the large quantities of humanly edible protein being fed to animals, and their inefficient conversion into protein for human consumption. Some very startling statistics result. If we exclude dairy cows, the average ratio for protein conversion by livestock in North America is 10 to 1. Applying this ratio to the 20 million tons of protein fed to livestock in 1968 in the U.S., we realize that only 10 percent (or 2 million tons) was retrieved as protein for human consumption. Thus, in a single year through this consumption pattern, 18 million tons of protein becomes inaccessible to man.* This amount is equivalent to

* The mention of yet another "cost" of meat production should not be neglected in a world where all our natural resources are becoming scarce. C. C. Bradley estimates in an article in *Science* that to produce a beef and grain based diet requires about eight times as much *water* as a diet based solely on grains.[11]

90 percent of the yearly world protein deficit[12]—enough protein to provide 12 grams a day for every person in the world!

The Dean of Agriculture of Ohio State University has estimated that 40 percent of world livestock production is derived from vegetable sources suitable for human food. If made available to man directly, he concludes, the world food supply could be increased by 35 percent.[13] And, according to Don Paarlberg, a former U.S. Assistant Secretary of Agriculture, just reducing our livestock population by one-half would release about 100 million tons of grains for human consumption.[14] (This amount would meet the caloric deficit of the "non-socialist" developing countries almost *four times over*.[15])

But perhaps the most revealing statement about the way the rich West uses its productive capacity is that of Lyle P. Schertz, an administrator in the U.S. Department of Agriculture, in the June, 1971 issue of *War on Hunger*: ". . . the billion people in the developed countries use practically as much cereals as *feed* to produce animal protein as the two billion people of the developing countries use directly as *food*." (emphasis added)

That our current level of protein waste can be compared to the world protein deficit is staggering. But the waste of our food resources appears even more grievous in light of the existence of malnutrition in this country. The tragic irony is well stated by Senator Ernest Hollings in his recent book, *The Case Against Hunger*[16]: "With our U.S. Department of Agriculture setting the rules, we no longer allow farmers to give their livestock and poultry anything but the best formulated feeds. . . . Yet millions of American human beings are hungry, and the early scientific indications are that general nutrition in this country is worse than it was at the close of World War II."

In his book Senator Hollings reports results from the National Nutrition Survey whose director, Dr. Arnold Schaefer, has stated that the nutrition problems among the poor in the United States "seem to be similar to those we have encountered in the developing countries." The two most serious nutritional diseases, are kwashiorkor, caused by severe, long-term protein deficiency, and marasmus which results primarily from prolonged lack of food calories. (You may recall seeing pictures of starving Biafran children whose bodies were misshapen from starvation. They were suffering from these diseases.) "Both," Senator Hollings points out, "are rare exceptions except in famine conditions. But both were found by doctors of the nutrition survey, here in our great and bounteous land."

Early samplings of the National Nutrition Survey (undertaken by the Department of Health, Education and Welfare) in which half the families earned less than $3000 a year showed that more than 16 percent had serious protein deficiencies—some well below the levels normally associated with malnutrition in underdeveloped countries. Bone underdevelopment and swollen bellies due to protein or calorie malnutrition were observed in 4 to 5 percent. This data was gathered in Texas and Louisiana. Cases of marasmus were found in Nashville, Tennessee, and both kwashiorkor and marasmus were identified in the U.S. Public Health Hospital on an Indian reservation in Arizona. As Dr. Schaefer quietly put it, "We did not expect to find such cases in the United States."

The reason I am able to give you only preliminary data is that the National Nutrition Survey, originally intended to be nationwide, was curtailed in 1970 before an analysis of even the first ten-state study could be completed. Senator Hollings reasons that the early results of the survey were "politically embarrassing" to the Nixon administration. So this is where we stand: unwilling even to register the extent of this country's failure to use its unparalleled agricultural capacity to provide healthy diets for its people.

B. The Fatted Calf

It is astonishing that, although protein is a precious commodity in most parts of the world, Americans actually place a higher value on fat. The purpose of the high-protein feeds is *not* primarily to produce a high-protein carcass, as one would assume. On the contrary, when cattle are fed in the 120 to 150 days before slaughter, the purpose is to fatten up or "finish" (as cattle men say) the animal. The higher the fat content of the meat, the higher the animal is graded—prime grade being the fattiest, and choice grade next. Choice grade beef, for example, trimmed to retail level, has about 63 percent more fat than standard grade.

One reason we use high-protein feeds to produce fat is that the meat taste to which we are accustomed results in part from the fat content. But we don't know the minimum level of protein concentrate feeding consistent with our definition of "good taste." In fact, we continue to *increase* the level of high-protein feeding. (Though I've heard no one complaining that steaks don't taste good enough!) The pressure to use high-protein feeds is mounting. According to James Clawson, an animal scientist at the University of California, Davis, a cow may now be fed these concentrates for up to two-thirds of its life. Why? Well, Mr. Clawson states, the pressure is economic. It's more profitable to feed a high-protein diet than a largely roughage diet for two reasons. First, when the greatest profit is derived from the highest turnover of livestock, the producer will prefer the shortest possible feeding method, i.e., a high-protein diet. Second, a roughage diet requires grazing land and, he asserts, land prices are prohibitively high. Thus, as the land prices go up, so does the pressure to turn to high-protein concentrates.[17]

Even if fat were as valuable nutritionally as protein, our present practices would be wasteful. You see, there's no way to insure that the extra fat put on the animal will be internal fat, marbled in the meat; it can also be external fat that is trimmed away. We feed and grade for the highest fat content despite the fact that today's beef carcass is one-fifth fat, swine is one-fourth fat, and lamb is one-third fat.[18] Much of this, of course, is thrown away. The rest becomes part of an interesting trade pattern in which the U.S. comes out decidedly on top. For example, in 1968 Peru and Chile shipped to the U.S. about 700,000 tons of high-protein fish products which we fed to animals.[19] And what was a major U.S. agricultural export to Peru? Twenty-six thousand pounds of inedible tallow and grease![20]

Barley

C. The Hidden Talent of Livestock

Nothing inherent in livestock production requires this enormous waste of protein. Potentially, livestock *can* function as "protein factories"; they just aren't given a chance to do so! Already, livestock convert land of marginal fertility unsuited for crops into meat for man. In fact, between one-third and one-half of the continental land surface is used for grazing.[21] This is one of those staggering figures that leaves one incredulous. I did not believe it until I verified the estimate in the original Department of Agriculture source. It then became one of the first facts which motivated me to pursue the research for this book.

But the biology of ruminants is more remarkable than this figure would indicate. Animals like cattle, sheep, and goats don't need to *eat* protein to *produce* protein. Microorganisms in the stomachs of ruminants can convert nitrogen, in the form of urea, into protein. Dairy cows, for example, have produced up to 4235 kilograms of milk a year containing 164 kilograms of protein, on a diet of urea, ammonium salts, potato starch, cellulose, and sucrose, without any other source of protein. *Many cows on the standard U.S. high-protein diet do no better!* And the vitamin and mineral content of the "deprived cows'" milk was normal.[22] In another study a beef calf weighing 290 pounds was given urea as its only source of protein. The calf more than tripled its weight and when grown gave birth to a healthy offspring.[23]

As the President's Science Advisory Committee points out, the only reason more urea (humanly inedible) is not used as animal feed is that grains (humanly edible) are available at low prices. The reason, of course, for the low price of grain is the limited "demand." Of course, real demand exists in terms of human need but hungry people are by definition unable to express this demand. Traditional dollar values obviously have little to do with human needs.

D. The U.S. Protein Sink

Not only do our agricultural practices waste domestic protein resources, but America also puts into her "protein sink" meat and feed of underdeveloped countries. In 1968, we imported 332 million pounds of meat from Latin America—much of it coming from the poorest areas of Central America.[24] At least 20 percent of this meat is protein, enough to provide 60 grams of protein per day for an entire year to 1.4 million people, or most of the population of a country like Costa Rica.

Ironically, the U.S. Agency for International Development is willing to provide up to $40,000 for an American company to go into Central America to see whether or not they can make a profit by selling novel high-protein food supplements to the hungry peasants.[25] At the same time this area exports about 100 million tons of meat to us and we play an important role in determining that much of their land is used to make money for a few, not food for the people.

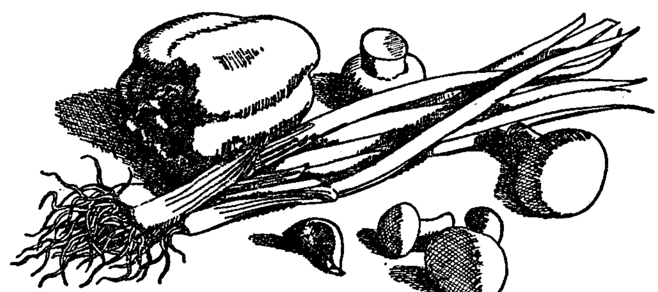
In 1968, we imported primarily from Chile and Peru 700,000 tons of fishmeal for use as feed.[26] There is enough protein in this quantity of fishmeal to supply 15 million people—more than the whole population of Peru—with protein for a year. In fact, according to an official of the Food and Agriculture Organization of the U.N., half of the world fish catch in 1968 was fed to livestock![27] Some try to rationalize such practice on the grounds that native populations find the fishmeal unpalatable. But, considering the many possibilities for treating fishmeal and adding it as a tasteless protein concentrate to popular local foods, this is hardly an excuse.

In any case, the *last* place that the fishmeal should end up is the stomachs of American livestock!

E. Wasting the Waste

Some people believe that although we do feed enormous quantities of high-grade protein nutrients to livestock with relatively little return as food for humans, there is really no loss. After all, we live in a closed system. Animal waste returns to the soil, providing nutrients for the crops that the animals themselves will eventually eat—thus completing a natural ecological cycle. If this were only true!

Animal waste in the U.S. amounts to 2.0 billion tons annually, equivalent to the waste of 2.0 billion people, or more than half of the world's population.[28] What a Herculean task it would be to collect and distribute this quantity of animal waste in order to complete our idealized ecological cycle! In contrast to the agricultural practices of other countries, conditions of livestock production in the U.S. completely mitigate against any such possibility. Concentration of from 10,000 to 50,000 animals (and up to 250,000 poultry) in a single feedlot



Green pepper, Scallions, Mushrooms, Garlic results in a surfeit of potential fertilizer far exceeding the capacity of the surrounding farmland. And, since it is not economical to transport the waste to where it might be used, most of the waste finds its way into our water systems. This leads to depletion of oxygen, encourages eutrophication, and contaminates the water with pathogens. Thus, as you can see, the ecological cycle is not able to complete itself and even the waste is wasted!

F. Land That Grows Money Can't Grow Food

So far I have concentrated on the loss of nutrients through livestock production. But I'd also like to mention another misuse of the earth's productive potential for which the West must bear responsibility.

Beginning over 300 years ago the wealthy Western powers established the plantation system in their subject lands. The plantation's sole purpose was to produce wealth for the colonizers, not food for men. Thus, most of the crops selected by the colonizers—tobacco, rubber, tea, coffee, cocoa, cotton, and other fibers—have negligible nutritional value. The name subsequently given to them, "cash crops," is quite an appropriate label.

Cash crops became established in world trade as the only proper exports from the Third World; so that even after emancipation from formal colonial control, Third World countries were economically "hooked" on cash crops as their only means of survival. Coffee alone is the economic lifeblood of *forty* developing countries—as in the African country of Rwanda, where coffee represents 87.5 percent of earnings from foreign exchange.

Obviously cash crops usurp land, often the best

agricultural land, that could be growing food for an undernourished local population. Over 250,000 square miles are presently planted with nonnutritious cash crops[29]*—more than one and one-half times the entire area of California and equal to two-thirds of all the arable land in Latin America. And, more land is put under the system every day. The Food and Agriculture Organization of the U.N. reports that *nonedible* agricultural production is growing at a faster rate than edible food production in the developing countries.[30]

The rich West points to the demands of international trade as the reason for the bind in which the Third World finds itself. True enough. But the real question remains unanswered: who is responsible for creating this pattern of land use and the subsequent rules of international trade?

G. Mining the Soil

But let us for a moment accept the rules of the economic game. Then, since the U.S. can "afford" this waste of protein, why not indulge ourselves? Why not continue our inefficient livestock production and heavy importation of protein until such time as the pressure of our own population or political changes abroad force us to use our resources more wisely?

This reasoning assumes that the only cost of our present indulgence is wasted protein which at any moment could be retrieved. But in reality our productive capacity hinges on the quality of our soil which, if lost, cannot so readily be regained. Our heavy use of agricultural land depletes the soil and results in lower-quality agricultural

* Includes only rubber, coffee, tobacco, cocoa, tea, cotton, and other fibers. Other cash crops from which the local population receives little nutritional benefit include bananas and sugar.

output. For example in 1940 it was quite common for Kansas wheat to be as much as 17 percent protein. By 1951, only *eleven* years later, no Kansas wheat had over 14 percent protein, most being between 11 and 12 percent.[31]

Georg Borgstrom, nutritionist, geographer, and the author of two outstanding books* on the world's food supply, decries the fact that in many parts of the world "overgrazing and excessive ploughing have . . . paved the way for the destructive forces of soil erosion. It is well documented," he states, "that the United States has lost one-fourth of its topsoil since the prairies were first broken by the plough."[32] But what necessitates this intense use of the soil that precludes its natural self-renewal? The source of the "pressure" becomes apparent if we recall that half of the harvest in the U.S. each year goes to livestock.

One factor that has allowed us to push the limits of the soil's productive capacity is pesticides. Let's see how they get into our diet and pertain to the main theme of the book.

Rice and Legumes

* *The Hungry Planet* and *Too Many.*

H. Eating Low on the Food Chain

By now most of us are familiar with the facts of environmental damage wrought by chlorinated pesticides like DDT: in predatory birds like pelicans and falcons, DDT and related pesticides like Dieldrin can disrupt reproductive processes, and in ocean-going fish like salmon, DDT can cause damage to the nervous system. What may be less familiar to you, and of greater importance to us here, is just *why* these particular species are being affected. A major reason is that these animals are at the top of long food chains in which pesticides accumulate as one organism is eaten by another. This process of accumulation results from the fact that organochlorine pesticides like DDT and Dieldrin are retained in animal and fish fat and are difficult to break down. Thus, as big fish eat smaller fish, or as cows eat grass (or feed), whatever pesticides they eat are largely retained and passed on. So if man is eating at the "top" of such food chains, he becomes the final consumer and thus the recipient of the highest concentration of pesticide residues.

But unlike most other predators (or "carnivores," if you like), man has a choice of what and how much he eats. We have already explored one of the reasons for choosing to be an "herbivore" that eats low on the food chain—it is simply less wasteful. Another consideration, the one we are going to evaluate here, is that herbivores are less likely to accumulate potentially harmful environmental contaminants than are carnivores.

Now, the Food and Drug Administration of this country knows its ecology as well or better than we do, and they have taken pains to keep pesticides out of the diets of the animals and animal products that we consume. Indeed, there are exceedingly few feed products for which the FDA has authorized pesticide spraying. In particular, they have scrupulously prevented the spraying of alfalfa with chlorinated pesticides like DDT. Does this mean that our concern about food chain concentration of contaminants is unfounded?

Marc Lappé, my husband, who is an experimental pathologist interested in the problem of environmental contamination, has pulled together the information necessary to answer our query. He turned to an important new scientific journal devoted exclusively to monitoring the levels of pesticides in the American environment, *The Pesticides Monitoring Journal.* In 1969, this journal included an extensive study of the pesticide residues in the American diet. Between 1964 and 1968 the principal types of pesticide residues found (about 85%) were chlorinated pesticides like DDT.* In a summary report given in 1969, two principal investigators of pesticide contamination in the U.S. diet reached the following conclusion: "Foods of animal origin continue to be the major source of chlorinated organic pesticidal residues in the diet."[88]

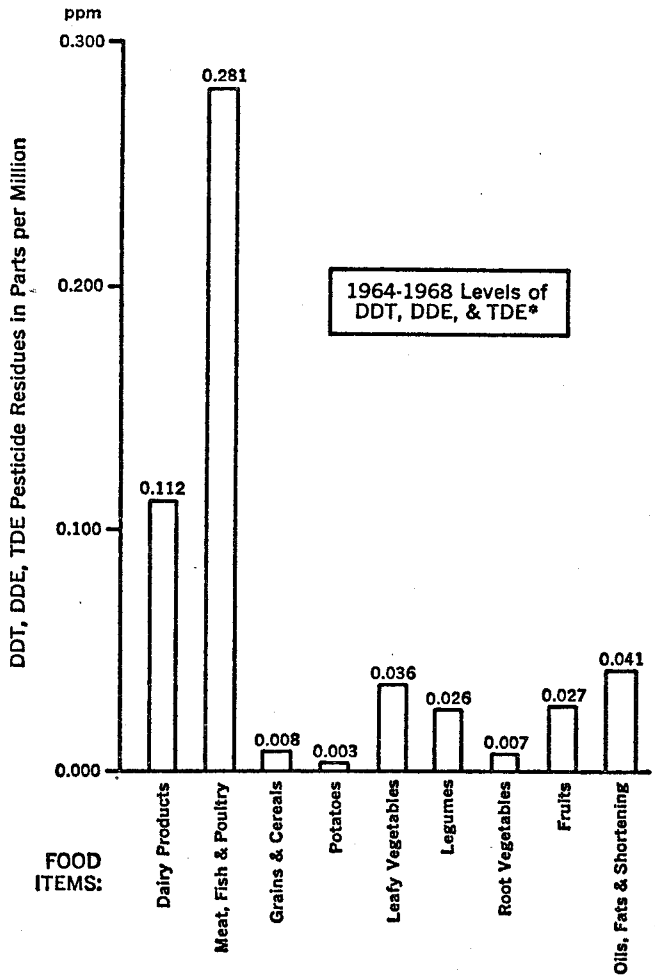
They note that this is true *in spite* of the fact that food categories like dairy products, meat, fish, and poultry received little if any direct application of pesticides during the period when monitoring was done. Thus, the "precautions" taken to avoid beef contamination with pesticide residues have actually proven to be ecologically meaningless. Apparently, most of the residues were coming from indirect sources in the environment.

The accompanying bar graph, Chart II, shows you in summary form the kind of data on which these researchers relied. The bars indicate parts of chlorinated pesticides per million parts of food (parts per million, or ppm). Note that meat, fish, and poultry contain two-and-a-half times more chlorinated pesticides than the second-place dairy products, but about thirteen times more than

* DDT and its breakdown products DDE and TDE accounted for over two-thirds of the total organochlorine residues.

CHART II

SOURCES OF PESTICIDE RESIDUES IN THE U.S. DIET



Source: Calculated from data presented in P. E. Corneliussen, "Pesticide Residues in Total Diet Sample (IV)", *Pesticides Monitoring Journal* (2:140-152, 1969).

*Averages of combined data from five American cities: Boston, Kansas City, Los Angeles, Baltimore and Minneapolis.

the average level of the remaining seven groups. This means that if you eliminated meat, fish, and poultry entirely from your diet and replaced them with plant sources of protein, you could *triple* your intake of vegetable sources of protein and still have a fourfold margin of safety in pesticide intake compared to meat sources!

But parts per million take on practical significance only when we also consider the *amount* of food we eat in each food group. The same study reported that in the diet of a typical sixteen- to nineteen-year-old, meat, fish, and poultry contributed only 10 percent of the diet on a weight basis. (Note that this is an unusually low figure, much below the estimate given by the U.S. Department of Agriculture for the consumption pattern of the average adult.) But even at this *low* level of consumption, meat, fish, and poultry contributed *36 percent* of the total ingested chlorinated pesticides—or more than three times their proportion by weight in the diet.

In this study, the composition of the diet was such that the weight of dairy products, grains, cereals, potatoes, leafy vegetables, legumes, and root vegetables was about six times that of meat, fish, and poultry. Nevertheless, the total amount of pesticides contributed by dairy products *plus* these plant sources was less than that contributed by meat, fish, and poultry! I have included the complete statistics from this study in Appendix E for your convenience.

You may wish to note also that the types of dairy products considered in this study, which as a group showed the second highest level of pesticide contamination, were those with an average fat content of 8 to 13 percent. Since virtually all of the pesticide residues considered here (chlorinated hydrocarbons) are found in the fat, you could reduce your intake of pesticide residues by a judicious choice of low-fat dairy products like cottage cheese, low-fat milk, and yogurt.

In general, we have seen that plant foods contain less pesticide residues than foods of animal origin. It is probably fair to conclude that the principal explanation for this phenomenon is an ecological one: animals consuming large quantities of plant food accumulate biologically stable molecues like pesticides. But a key question still remains unanswered: aren't these patterns of pesticide contamination likely to change now that pesticides like DDT are being phased out? The answer is probably not to any great extent in the near future. Remember that the pesticide residues now in livestock are largely the result of *indirect* pesticide contamination coming from the general environment. As long as pesticides are in use on other agricultural products or in general use elsewhere, they seem to find their way into the body fat of higher organisms. Estimates of the life span of organochlorine pesticides already introduced into the environment range from seven to over forty years. In the case of extremely long food chains, recent calculations indicate that the maximum concentrations of pesticide residues derived from the *original* use of DDT in the 1940s may still not have been reached in the "highest" carnivores (e.g., eagles). Indeed, the pesticides currently in our ecosystem are not likely to reach equilibrium for another 100 to 200 years, *even if pesticide usage were to stop immediately*![34]

You may also like to know whether or not the other potentially hazardous environmental contaminants you have been hearing about might actually be an unforeseen danger in eating vegetable foods. According to Dr. Lappé, the few reported studies on such things as mercury and arsenic show that these substances are present to about the same extent in foods of animal and vegetable origin. Grains and cereals come under close inspection because their seeds may be dressed with mercury to retard fungal growth and decay. However, in a study conducted in December 1967, meat, fish, and poultry were found to contain about the same amounts of mercury (0.036 ppm) as did grains and cereals (0.034 ppm).[35] It is perhaps noteworthy that dairy products and legumes had about a fifth of this amount.

Lest you be deceived by the seemingly modest levels of mercury contamination cited for fish above, note that this does not apply to *all* species. Some species are so heavily contaminated with heavy metals like mercury as to pose a real threat to human life. Almost all of the heavily contaminated fish discovered to date have been large oceanic species which are at the ends of long food chains. Even the game fish are contaminated with mercury in states like California where both agricultural and industrial effluents carry mercury into watersheds. Game fish like some species of trout in California and large oceanic fish like blue-fin tuna and swordfish may be contaminated with more than 0.5 milligram of mercury for every kilogram (2.2 pounds) of body weight. This concentration equivalent to 0.5 ppm is currently set as the "safety limit" for fish in this country. (Remember that this high limit assumes Americans eat very little fish.) Since only 70 milligrams of mercury are enough to kill you and mercury is one of those elements which can accumulate in the body, this is a real menace indeed —if you ate these species of fish in the same quantity that the average American eats meat, you could easily accumulate 10 to 20 milligrams of mercury in one year!

A fact not mentioned in the cited article is that tolerance limits in the U.S. for mercury through December 30, 1970, were set at *zero* because of its known toxic effects. Keeping mercury pollution down makes good health sense, but in a country that uses over 400 *tons* of costly mercury a year in its agriculture and industry, the Departments of Health, Education and Welfare and Agriculture *jointly* agreed that after December 31 zero

tolerance would have to be dropped—such a level was considered "administratively impractical."[36]

But let's return to the more widespread problem of chlorinated pesticides where the potential health hazard is less clear. All of this discussion presupposes, of course, that you wish to reduce pesticide intake or that such reduction is desirable. Here is where there are likely to be differences of opinion. While everyone agrees that pesticide residues are an unfortunate concomitant to virtually all foods, experts seem to differ radically as to what constitutes a "health hazard." Thus, the authors of the article previously cited in the *Pesticide Monitoring Journal* felt obliged to point out that none of the levels of pesticide residues that they measured were likely to represent a health hazard. Indeed, less than 1 percent of the samples of foods in the meat, dairy, or fish category actually exceeded the then current toxicity standards established by the government.

A word to the wise: these toxicity standards are established on the basis of short-term toxicity tests on small animals. They say nothing about the possible *long-term* damage that pesticides may produce in humans such as chronic liver damage and possible cancer. There is evidence, for example, that DDT (as well as a number of currently less prevalent pestcides) produces cancer in mice when they are fed large amounts over protracted periods of time. Furthermore, the governmental agencies responsible for setting so-called "safety limits" or "tolerances" have proven themselves notoriously unreliable. Tolerance levels such as those set for the organophosphorous pesticides malathion and parathion were adjusted upward as the residue levels began to increase in milk samples in one state (Montana). Thus, "safety" will always be a matter of degree when it comes to biologically toxic pesticides and safety limits will continue to be adjusted to meet public outcry or agricultural exigency.

My purpose is to show you a way to minimize the amount of ecologically concentrated pesticide and heavy metal you ingest: by eating low on the food chain, you are simply reducing the quantity of most if not all pesticide residues in your diet. If we are wrong and there are no real health hazards that accrue from this period of environmental saturation with pesticides, then no harm has been done. If time shows that accumulated pesticide residues do produce damage to humans (and we may not know this for another ten or twenty years) then you may be grateful you heeded this cautionary note.

But even to have introduced the pesticide issue may seem to some of you a bit unfair. It may be an effective tactic in trying to convince the reader to eat less meat but does it relate directly to the theme of the book? A discussion of pesticides *is* particularly apposite here because our theme concerns the rational use of agricultural land.

In the last twenty years crop yields in the U.S. have increased sharply. The average annual yield of field corn, for example, jumped from 32.8 bushels per acre in the years 1941–45 to 50.1 bushels per acre in the years 1957–61 (an increase of 55 percent).[87] A major result of these greater yields, if not part of the impetus for them, has been to increase the amount of our agricultural yield available to livestock as feed. Currently, one-half of the yield of our harvested acreage is fed to animals, in part making possible our increase in meat consumption. (Beef and veal consumption has doubled in the U.S. in the last thirty-five years.)

Here is where pesticides enter in. These increased crop yields are almost entirely due to the introduction of the new kinds of pesticides in the mid-1940s. We might well ask whether it has been worth the cost of the subsequent contamination of our environment. We can observe the damage from pesticide residues to wildlife and speculate on their hazard to man. Like the waste of

protein and like the overtaxing of our agricultural land, the presence of pesticide residues in our diet can be seen as yet another price we are paying for our unquestioning acceptance of increased meat production and consumption as an unassailable good. How often have I heard well-informed friends with concern about protecting the environment lament the fact that pesticides are a necessity. Organic agriculture would be ideal, they will say, but we couldn't feed 200 million people that way! I am not claiming to be able to estimate exactly how many people could be well-fed without the use of pesticides. *But*, the knowledge that we can presently afford to feed half of the yield of our harvested acreage to animals with so little return leads me to believe that we have an enormous "margin of safety" (or, more accurately, "margin of waste") in feeding our population. Curtailment of pesticide use might mean that we could no longer afford this extravagance and that our population would be eating less meat. But, as I hope the information in this book will make clear, eating well does not necessarily mean eating meat. But so far we've just been taking for granted that Americans eat an inordinate amount of meat. You would probably like to know

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whether this is really true. So let's look at our protein consumption pattern.

I. Americans, the Protein "Heads"

Earlier I spoke of seeking a guideline for eating from the earth in a way that both maximizes the earth's potential to meet man's nutritional needs and at the same time minimizes the disruption of the earth necessary to sustain him. But all of the practices I've described are having just the opposite impact. Obviously my intent has been to suggest that we could reverse this pattern by consuming more plants directly, i.e., before they are put into the "protein factory in reverse"—livestock. But any suggestion for altering our protein-eating habits should be considered in the light of our current protein consumption patterns.

I recall reading a newspaper article reporting a survey in which Americans were asked: "What would be the first thing you would buy if you had extra income?" The majority answered, "Steak." Since meat consumption is associated with status in this country and is thought by many to be the key to good health, their answer is not at all surprising. The richer we get as a nation, the more meat, and hence, the more protein, we consume. The fact is that we are already consuming a greatly disproportionate amount of the world's supply of food from animals. Although North Americans comprise only 7 percent of the world population, we consume 30 percent of the world supplies of food of animal origin.[38]

In contrast to Asian Indians, for example, we eat about twice as much protein of all types; but we eat twelve times as much animal protein.[39] Obviously Asians get most of their protein from vegetable sources, while we get ours from meat. Indeed, whereas the Indian eats 2.85 pounds of meat and poultry in a year, an

American eats about 212 pounds, or seventy-five times as much.[40] And, the gap is widening. Since World War II the per capita protein available in the developing countries has *declined* by about 6 percent while that of the developed countries has increased by at least that much.[41]

No one would suggest that we should all be eating at the level of an average Indian. What is important, though, is whether or not Americans are *over*consumers, that is, to what extent we waste protein. How, you might ask, can a person waste the food he eats? If an individual isn't gaining weight or isn't actually overweight, doesn't he need all the food he eats? The answer is that although he may need the calories to maintain his weight, he may not necessarily need all the protein he is eating. The U.S. Department of Agriculture, undoubtedly not prone to overstatement, estimates that the average American eats from 10 to 12 percent *more* protein than his body can use as protein.[42] Since excess protein cannot be stored, it is converted to carbohydrate for use as an energy source. A very costly fuel!

And the trend of increased meat consumption is becoming more pronounced all the time. We are eating less grain and more meat than ever before: today we eat twice as much beef and veal[43] and two and a half times as much poultry[44] as we did about forty years ago.

The protein intake of the average American already exceeds the National Academy of Sciences' generous recommendation by 45 percent.[45, 46] And these statistics, based on the *availability* of protein, assume that each of us Americans is getting his fair share. Actually we know many people in the U.S. are protein-starved; this means that many others must be consuming several times the recommended allowance—an assumption borne out by statistics based on actual dietary interviews.

Now you've heard a lot about resource and protein waste—resulting from both America's livestock production practices and our excessive protein consumption. But what other choices are open to man? I have pointed to possible alternatives on an agricultural level, but what about on the level of our everyday diet? *Can* man rely more on plants and less on animals for protein? Just how suitable are plants for human protein nutrition? Since plant sources contribute 70 percent of the world's protein supplies,[47] it is a vital question indeed.

Part II

Bringing Protein Theory Down to Earth