# The Energy Crisis and The Future of Our Nation's Animal Industry

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The challenges facing our nation have never been greater. Likewise the challenges facing our nation's animal industry have never been greater. One of the most formidable challenges to all of agriculture as well as to the total economy of our nation is that posed by the energy crisis.

Next to inflation, the energy crisis looms as our nation's most serious problem. It almost goes without saying that the greatest challenge to our future well-being involves the question of whether we are willing to "bite the bullet" in terms of our committment to the solution to our nation's energy problem. That we must effect a strong committment is no longer a matter of choice.

Even though our nation's population is slowing down, annual demand for energy in the United States is expected to double from 1970 to 1985, and to triple by the year 2000. It is, therefore, vitally important to ask what the present energy crisis means to you and to me and to all of our 210 million fellow citizens throughout the United States.

**I am of the opinion that the gravity of our present situation can be summed up in just a few short sentences:**

1. **Our standard of living is in serious peril.**
2. **The strength of our economy is critically endangered.**
3. **Our national defense posture faces unprecendented risk.**
4. **Because of shortages of natural gas as a feedstock for ammonia in the manufacture of nitrogen fertilizers, even our food supply is threatened as never before in modern times.**

It is not surprising that every thoughtful U.S. citizen is now asking whether it will be possible for us to obtain, from reasonably secure sources, the energy which we will need in the future. One thing is certain! Our nation, along with many others, must proceed to investigate a wide array of options! Fortunately, there is just enough evidence that we can meet our future energy needs in this country to give us genuine optimism over the longer term.

Our known domestic reserves of economically recoverable oil, which were estimated at 12 years' supply in 1962, had by 1971, fallen to the equivalent of only nine years' supply. Since that time the Arab oil embargo and subsequent doubling of the price of oil from 1972 to 1973, brought about unprecedented stimulation for petroleum exploration. The results of that exploration have led to recent estimates of both proven and potential reserves of oil which would suggest that we now have enough domestic oil, at present rates of consumption, and at present import levels, to last us anywhere from 40 to 135 years. If, however, we were to double consumption and totally eliminate imports, our oil would last only 10 to 35 years. Despite the wide range in these estimates, it is significant for us to note that in any event our country has enough oil to last for at least the next decade and probably much longer. Maximizing that supply will depend upon our being able to maintain an economic and political climate which encourages maximum exploration and maximum development of our oil resources. Further, our domestic supply of oil can be stretched considerably if we find it possible to obtain at least a portion of our oil from foreign sources and if we can adjust our lives and our economy to the point where we can put up with reasonable conservation measures.

No matter what else we may do, however, it seems imperative that we move rapidly to obtain oil from the oil-bearing shale which abounds in Colorado, Utah and Wyoming. Those deposits are believed to contain enough oil to supply our national needs for the next several centuries even if we were to consume petroleum at steadily increasing rates. Fortunately, the technology for recovering oil from shale is already at hand. Pilot plants have been built and production plans are already underway. The costs from recovering oil from shale appear to be reasonably favorable in comparison with the recently announced cost of imported petroleum products.

As we develop both new and conventional oil resources, we can expect to increase our nation's supply of natural gas. Recent estimates of total natural gas reserves in the United States range from

20 to 90 years' supply. As with petroleum much will depend on our maintaining an economic and political climate which will encourage maximum exploration for and development of our natural gas reserves.

**In terms of coal, the United States is currently consuming 700 million tons of coal each year. By 1985, we shall need to be mining an estimated two billion tons of coal each year. Fortunately, even at that high rate of consumption, our coal reserves are estimated to be sufficient to last at least 400 years.**

The utilization of our coal reserves involves a number of problems. One of the major problems with utilizing coal stems from the fact that three-fourths of our reserves lie in the western states–principally Wyoming, Montana and North Dakota–while three-fourths of our population and more than three-fourths of our coal consumption is in the eastern half of our country. Furthermore, most of our nation's low-sulfur coal is found in the West. Part of our immediate challenge is, of course, finding ways of using our high sulfur Eastern coal and still meet air quality standards.

The combustion cleaning of coal has been a difficult problem to solve but the ultimate solution to both air quality and transportation problems associated with our use of coal may well lie in the conversion of coal to gas or liquid form. As of this date, several new gasification processes have already reached the pilot plant stage. It seems likely that considerable resources will be devoted to the construction of coal gasification plants during the next several years.

Despite the encouraging outlook for energy from domestic fossil fuels, our nation must face the fact that its reserves of fossil fuels eventually will be depleted. This means that the United States must develop alternative energy sources just as rapidly as possible. At this moment in history, nuclear energy is the only large-scale, relatively non-polluting, non-fossil energy source which is operationally feasible. Nuclear energy holds the key to our future supply of electricity and our overall future supply of inanimate energy. It is regrettable, however, that our nuclear energy program has moved so slowly. The 53 nuclear plants now in operation are generating less energy than is presently being derived from hydroelectric sources and reportedly only about the same amount as is being obtained from the burning of wood in a host of heating and power generating applications involving both homes and factories.

**Foremost among the factors which have delayed development of our nuclear power program is fear about safety. This fear has been expressed by a small but vociferous group of citizens who are concerned about the escape of radioactive elements in the environment. The great majority of scientists and engineers who are closely involved with and intimately knowledgeable of nuclear generation of electricity, believe that the possibility of serious accident is exceedingly remote.**

More than 70 nuclear generating plants are now under construction and it has been reported that 113 more of them are on order. However, this total of 236 nuclear generating plants already operating or under construction as well as those on order falls far short of the 1,000 nuclear power plants which it has been estimated the United States will need by the year 2000.

One of the means of expediting construction of nuclear generating plants as well as overcoming some of the safety and environmental objections might well be the building of floating nuclear plants, which could be located two or three miles off-shore. Floating nuclear plants could be standardized and built on an assembly line basis and could therefore be built more rapidly and efficiently than those which have been built thus far. Like the nuclear plants presently in operation, the proposed floating nuclear plants would be expected to employ fission-type reactors. One of the serious problems with the fission reactors is, of course, that they utilize uranium, and our nation's supply of uranium is not only limited but is rapidly becoming very expensive.

The fast-breeder reactor, which creates more nuclear fuel than it burns because it literally "makes" plutonium, will extend the life of known uranium reserves to hundreds of years. However, the fast-breeder reactor, like other fission-type reactors, generates waste products which are highly radioactive, and which have to be contained and stored with great care and at considerable expense for centuries. On the other hand, nuclear fusion–the process which fires the sun and the stars–may well be the ultimate answer for mankind's energy problems. Fusion releases only small amounts of radioactivity, and it can be fueled with deuterium, which is available in almost unlimited quantities in sea water.

A major concern at this point in time stems from the fact that scientists have not yet demonstrated that controlled fusion is feasible. They have reportedly made tremendous progress in just the past several years. If nuclear fusion can be achieved there is no question but what it will be one of mankind's greatest scientific achievements, providing an abundant source of energy for billions of years into the future.

Solar energy is yet another major source of energy for the future. The United States receives enough energy from the sun in a year's time to meet our total energy requirements at least 500 times over. But sunlight is of low intensity, and its availability is subject to vagaries of the weather as well as variations due to both latitude and the day-night cycle. Furthermore, electricity derived from solar energy is estimated to be more costly to produce than that from nuclear energy. It would appear, however, that solar energy embodies minimal safety and environmental risks. The technology for large-scale production of the electricity from solar energy is still speculative and largely undemonstrated.

Green plants are at present the major converters of

solar energy into useable and storable energy. A bushel of corn and a bushel of wheat can each be processed to produce nearly three gallons of alcohol which can, in turn, be used as fuel. It has, of course, long been known that farm crops offer a viable means of tapping the inexhaustible, virtually non-polluting solar source of energy. However, the use of farm crops as a major energy source awaits technological developments which will make it possible to produce vastly increased per-acre yields of our food and feed crops. Our first concern in agriculture in the future, as in the past, must be to meet domestic as well as overseas demands for food.

**Energy can be obtained from the 940 million tons of solid waste produced in the United States each year. It is estimated that these solid wastes could be converted through pyrolysis to a quantity of oil representing 7.5% of our present oil use, or to enough methane to equal six percent of our total natural gas demand. The technical feasibility of converting organic wastes to oil or gas has been demonstrated, but the economic feasibility is much less certain. Fortunately, further information will soon be available because several "garbage to fuel" plants are now operating or are in process of being built.**

A sizable portion of our nation's waste products are derived from agriculture and forestry. Livestock and poultry manure produced in the United States embodies a potential volume of methane gas equal to about 5% of the total natural gas produced in this country. One of our future challenges for agricultural research is to develop and implement effective, economical methods for obtaining energy from the large array of by-products available from agriculture and forestry.

Several other sources of energy are being developed or considered in the United States. One of the most promising is geothermal energy, which is obtained by capturing the heat of the earth's core. Geothermal energy is limited in its geographical distribution and it may be subject to depletion in those areas where it is readily available. It would appear, however, that geothermal energy has a remarkably small environmental impact and is available at relatively low cost.

Overall, the outlook for production of energy from domestic sources to meet rising demands is highly encouraging. A critical question, however, involves the speed with which we can bring domestic supply into balance with domestic demand. In this connection it is helpful to consider what appears to be reasonable estimates for a timetable related to the availability of domestic energy supplies. Our estimate of a reasonable timetable suggests that between now and the end of the 1970's, we can expect the following developments:

1. By 1976, sizeable tonnages of coal from the Western states will be available. By about that same time, use of Eastern high-sulfur coal will be environmentally respectable either through relaxation of EPA regulations or satisfactory methods of stack-gas cleaning of that coal.
2. By the early 1980's, oil will be available from the Alaska pipeline and gas and oil will both begin to become available in significant quantities from wells located off shore as a result of the off-shore leasing which has been stepped up recently and is expected to be tripled by 1979 compared with 1974.
3. By the mid-1980's, significant quantities of commercially useful synthetic natural gas derived from coal should become available. Synthetic crude oil from coal is a little further away on the horizon but this energy source should also be available in limited quantities by the mid-1980's as will oil from shale. Furthermore, the first floating nuclear generating plant can be expected to be operational sometime during the decade of the 1980's.
4. By the late 1980's, the first commercial fast-breeder reactor will likely be in operation.
5. During the decade of the 1990's, large numbers of breeder reactors can be expected to supply significant portions of our energy needs. Also, solar satellites might be operating by the 1990's and solar energy, generally, could be an important energy source by the late 1990's.
6. By the year 2000, nuclear fusion should be coming on-stream as a source of energy, assuming that its scientific feasibility is determined by 1980-82 as is presently projected. Expectations are that nuclear energy will supply 25% of our total energy requirements by the year 2000 and solar energy about 10% of our nation's energy requirements by that time.

The accuracy of the foregoing timetable estimates depends not only on technological progress, but also on the establishment of deliberate objectives and priorities by our government and by the energy industry. The foregoing analysis reveals quite clearly that few significant new sources of energy will be available for our use until the early 1980's. The sad fact of the matter is that for the next several years we're either going to have to continue to rely heavily on imports or take dramatic, perhaps drastic steps to conserve energy. Very likely, we are going to have to do both of those things because conservation alone will not close the supply-demand gap during the next several years. In other words, it is unrealistic to think that we can eliminate the importation of fuel in the near future.

Since we will have to continue importing fuel, it is desirable for us to find ways of placing less reliance on the Middle East and expanding imports from nations such as Venezuela, Nigeria, Indonesia and various areas where petroleum has recently been discovered, such as in several countries of Latin America which might well offer hope for providing reasonably reliable sources of imported energy. A sizeable

amount of oil should be available from Canada which has vast oil deposits located in its tar sands, but recent action by the Canadian government would seem to discourage heavy reliance on that source. In any event it seems probable that we will find it necessary to accelerate our conservation efforts. In this connection, it appears we shall need to save 17% of the energy that we would have otherwise consumed if we are to effect economic survival through the next decade. Our challenge is to effect this level of conservation of energy without curtailing economic growth or materially reducing our standard of living. Theoretically, at least, this should be possible because it has been estimated that 25 to 40% of the total energy we have been consuming in the United States has been wasted.

Increasing the efficiency of energy production will help greatly in conserving energy. With present technology, more than 70% of the energy which goes into the generation of electricity is lost in the production and transmission processes.

**Another priority candidate for energy conservation involves architecture and construction practices in our country. It is believed that energy use could be cut in half by improved design of our buildings and by proper insulation of both commercial and residential structures. Then too, we can save additional energy through more judicious use of heating and cooling equipment including the development of more efficient furnaces and air-conditioners and by more efficient use of appliances, lighting equipment and water heaters.**

Shifting from highway to rail transportation offers an opportunity to make significant contributions to energy conservation. Mass transit systems in those communities where such systems can serve the public need offer considerable opportunity for energy conservation. But as we consider possibilities for reducing energy demand through conservation, it is important to keep two points in mind. In the first place, many of the measures now being proposed will not result in immediate savings. Improved designs for buildings to be built in the future won't save anything right now. Secondly, we must not, under the guise of energy conservation, unnecessarily restrict the freedom which our democratic society offers. Energy savings which create unemployment will be a menace to our society. It is really disturbing to hear increasing numbers of people advocating that we discontinue use of such things as air-conditioning or prohibit use of second or third automobiles per family or eliminate some of the appliances that we have in our homes. We simply must find other and better ways to survive the energy crisis.

Before we indulge in too much self-criticism or listen with too much attention to those who would give all of us a guilt complex, we need to remind ourselves that a very high proportion of all the energy consumed in the United States presently is utilized for constructive purposes such as reducing or eliminating back-breaking labor, and replacing the inefficient forms of transportation which have characterized the human condition until very recent times. It is significant that as little as a half century ago, our nation's energy resources were utilized primarily for the production of heat in our homes and our places of employment. Today, the industrial sector is the major user of energy in our society, accounting for more than 40% of our energy consumption.

Transportation is the second heaviest user of energy, followed by residential, and finally by commercial applications other than industrial needs *per se*. Included in the preceding list of uses are substantial quantities of energy which are required for the production, processing and transportation of food and other products of our farms and forests.

Energy has been one of the key ingredients in the tremendous increases which have occurred in agriculture's productive efficiency. Despite this fact, the use of tractor fuel, heating and drying fuels, electricity and other energy uses on the farm accounts for only about 1.6% of the total energy used in the United States today. An additional 1.9% is required to produce the machinery, fertilizer, pesticides and other supplies utilized on our farms and ranches. The major energy requirement for agriculture and forestry comes after the farm-produced raw materials leave the farm. The energy requirements for food processing and for packaging are rather substantial.

Energy requirements for the processing of cotton, wool and other natural fibers are relatively small, whereas the energy utilized in sawmills, pulp and paper mills and related processing of forest products is quite substantial. Even so, agriculture and forestry, when broadly defined in terms of all the supplies needed for production, production agriculture itself, plus the processing and transportation of farm-produced raw materials requires less than 10% of all the energy consumed in the United States.

In the past few years, agriculture in our country has been increasingly criticized for allegedly contributing needlessly to the energy crisis. The argument goes something like this: Primitive agricultural systems produce as many as 50 units of food energy for each unit of mechanical energy used in production, and the energy that is used is primarily human and animal energy. On the other hand, it is claimed that modern mechanized agriculture requires as many as three to five units of fossil fuel-derived energy for each unit of food energy produced. In other words, some of agriculture's detractors are saying that from an energy standpoint, agriculture in the least developed nations is as much as 150 to 250 times more efficient than our U.S. agriculture. Based on that type of analysis, there are those who advocate widespread adoption of both organic farming and subsistence farming for our agricultural industry in the United States.

The foregoing allegations and proposals are not only totally unrealistic, but they are likewise fraught

with many fallacies, not the least of which is the fact that much of the food produced in the primitive nations is consumed by work animals and is therefore not available for human consumption. Furthermore, the world is not in any mood to accept starvation for many millions of people in order to effect energy conservation in agriculture. The example of malnutrition and starvation which stalks the countryside in many of the nations which employ primitive agricultural practices illustrate all too clearly the futility of any attempt to "turn back the clock" relative to the mechanization of agriculture. Agricultural producers simply cannot shift back to lower energy-consuming technology without suffering serious losses in productivity and without bringing catastrophe to huge segments of the present world population. Any such backward step would require massive inputs of human labor and those who advocate organic subsistence farming have not bothered to tell us where such labor would come from. Further, they have never bothered to tell us where we would find 81 million acres to produce the feed for the work animals which would be required here in the United States.

**Instead of looking backward, our primary goal must be to look forward to new sources of energy which will make possible the maximization of consumer nutritional health, and help the people of the world to achieve greater convenience and greater satisfaction in their daily lives.**

Mechanization and the use of energy-consuming input, such as fertilizers in modern agriculture are among the principle reasons why our United States agriculture is so very highly competitive in foreign markets. That same mechanization is the major reason why our United States standard of living is so very high.

Agriculture does, of course, have a responsibility for improving its energy efficiency where it is feasible to do so, just as do all other segments of society. Our challenge is to identify and adopt production methods which will reduce energy consumption but not reduce productivity and profitibility. In this connection we already know that fuel consumption for production of several of our crops can be reduced by 50% or more through use of the no-tillage method which has been developed in recent years. No-tilled crops are planted directly through the residues of previous crops, instead of utilizing conventional plowing and tillage operations.

*One of the most important points for all of us to remember is that research which leads to higher crop yields, or which leads to reduction of losses from insects, diseases and weeds offers the very best means for reducing energy input per unit of output.* The plant material available to us at this point in time is not very efficient in their utilization of solar energy. Our farm crops utilize less than 1% of the solar energy that falls on the land where those crops are growing. In considering ways for reducing the amount of energy used in agriculture and forestry, it has been estimated that perhaps as much as 1/5 of the 10% of the nation's total energy supply which is now used in agriculture and forestry could be saved by increased efficiency in energy application by our nation's agriculture and forestry industries. Beyond that, agriculture and forestry can in other ways contribute significantly to our nation's energy conservation effort. For one thing, we can make greater use of natural fibers in place of the energy-demanding synthetic fibers. The fossil-fuel energy input for sheep production is very minimal and production of a pound of cotton requires only about 40% as much fossil-fuel energy as the production of a pound of synthetic fiber. Then too, we could use more lumber in place of many of the presently used building materials such as steel, aluminum and plastics which require much larger quantities of energy for the production.

The necessity of our conserving energy presents a special challenge to us in terms of the past enviable growth which we have had in per capita consumption of animal products. Over the past two years we have seen and heard a good deal of rhetoric on the alleged ineffiency of livestock relative to our overall uses of resources in this country. This suggests that livestock products are going to encounter increasing competition from traditional as well as non-traditional plant and marine food sources, as well as from other even less conventional sources of food energy and nutrients. Competitive products will increasingly be synthetics of one form or another. Many of them will be fabricated to appear analogous to animal products.

It is difficult for me to understand why, but there are those who predict, and some will even advocate, lower consumption of animal products in the future. Their rationale can be summarized as follows:

1. Since a high proportion of animal fats are the so-called saturated fats, and since they contain varying amounts of cholesterol, most animal products are *suspect* as being contributors to heart and circulatory diseases.
2. The cost of protein from animal sources is considerably higher than the cost of protein from crop plants or marine sources.
3. Because most animals are relatively inefficient converters of crop products to food, the United States will not in the long-term future be able to devote the requisite large quantities of land resources to animal production.
4. The United States livestock industry is a major source of environmental pollution.

Those are the usual allegations. Fortunately, none of them hold up well under close scrutiny. Let's look for a moment at the so-called cholesterol problem. In no important dietary matter, except perhaps in his gullibility with respect to fad diets for weight reduction, and in his susceptibility to absurd claims about the so-called "health" foods, has the United States consumer been so thoroughly confused and so often

misled as has been true with respect to cholesterol. Today, two decades after nationwide publicity caused cholesterol to become the word most closely associated with circulatory disorders, and after years of research, there is very little evidence of a "cause and effect" relationship between heart disease and consumption of animal products. In fact, the Framingham Study, which appears to be one of the most credible among several studies designed to determine the risk factors associated with coronary heart disease, has revealed that:

1. **With but one exception there was no discernible association between reported diet intake and serum cholesterol levels. The one exception was a weak negative association between caloric intake and serum cholesterol levels in men; and**
2. **No relationship was found between diet and coronary heart disease incidence.**

Growing numbers of medical and nutritional scientists are now concluding that at least 25% of all heart attacks are of genetic origin. They are also concluding that the remaining 75% involve a complex of factors, many of which may be as yet unidentified. Thus, there is good reason to conclude that the indictment of saturated animal fats has not only been premature, but also quite probably incorrect. One medical scientist recently called the alleged relationship between saturated fats and heart disease (and I quote) "the biggest delusion in medical research in the past 10 years."

I suspect that if we gave serious attention to all of the unsubstantiated claims that have been made in an effort to denigrate the healthfulness and safety of our food supply we would have no choice but to go through life malnourished if, in fact, we didn't die of starvation. Alternatively, of course, we might spend a much larger proportion of our income for food, because we would be spending our food dollars in complete disregard of what we have learned through a half century of scientific research in food science and nutrition.

It seems to me that a much more serious diet-health problem than cholesterol–or DES, antibiotics, nitrites, or any of the other substances contained in or added to animal products–is the tendency by a growing number of United States citizens to consume an excess of calories, whether derived from animal or vegetable fats or carbohydrates. It is clear to me that animal products *per se* are not to blame for the tendency of too many Americans to eat too much and exercise too little.

During the 20-year period from 1947-49 to 1967-69, fat and energy in the United States diet provided by animal products declined, but the percentage of protein supplied by animal products increased substantially. The progress we've made in reducing external fat on both pork and beef carcasses, to cite only two examples, has also brought about significant reduction in the fat which is distributed within and between the muscles. I am convinced that we can, through application of animal breeding principles, reduce the caloric content of pork carcasses by an additional 35-40%, and beef carcasses by another 15-20% from what they are presently. These possibilities represent a major challenge for United States animal agriculture in the future.

But enough on that subject, let's now consider a second area of often expressed concern–the comparative cost of protein from various food sources. Studies are frequently cited to show that a given quantity of protein from plant sources costs considerably less, at either the *production* or *wholesale* levels, than an equal quantity of protein from animal sources. In this connection, we readily concede that there is an *apparent* cost advantage for vegetable proteins, even after cost figures for the vegetable protein have been adjusted upward to reflect the fact that vegetable proteins are always incomplete in terms of their content of essential amino acids, and they are typically less digestible. It is unfortunate, however, that many popular writings which tend to glamorize plant proteins fail to give sufficient attention to several significant factors.

First, many persons who champion the meat substitutes which are fabricated from vegetable proteins fail to consider the ultimate retail costs. The texturizing and shaping of soy flour, which begins by extruding soybean slurry and then adding flavoring to produce a product that United States consumers will eat, is expensive, and that expense must be reflected in the final cost to the consumers. There is, of course, much more besides cost to be considered in comparing vegetable protein with animal protein.

Second, as we make comparisons between animal and vegetable sources of protein we must keep in mind the fact that vegetable proteins are nutritionally incomplete. Vegetable proteins have to be enriched in order to be comparable to an equal quantity of animal protein, and this process of enrichment adds to the expense of getting plant protein analogs on the market.

Third, and this may be the most important factor to be considered, animal proteins are much more nutritionally complex than plant proteins and post-nutrition experiments have given indications that animal products contain what are as yet unidentified, nutritional properties.

Finally, food consumption projections based solely on comparative costs tend to ignore the fact that few people who have sufficient income to eat as they choose, select their diets on the basis of the lowest cost per unit of either essential nutrients or food energy. Instead, human beings tend to choose foods that satisfy their taste buds as well as their psychological and social whims. In other words, *people do not eat protein, or energy, or vitamins, or minerals, per se, they eat food!* We have little reason to anticipate any significant change in man's desire to select his food on the basis of his enjoyment of the flavor, texture and appetite-satisfying characteristics

of animal products.

The foregoing is not to say that efforts by United States animal agriculture to improve quality and to reduce production costs can be minimized or ignored. The competition from vegetable proteins cannot be minimized! We need only listen to the hue and cry about food prices these days to realize that we have our work cut out for us. The rising levels of prices paid by farmers, processors, wholesalers and retailers–for feed, labor, energy, capital and other production inputs–dictates that only through increased efficiency can we continue to provide reasonably priced food to the consumer.

Let us now consider some of the opportunities available to us for increasing efficiency in beef and dairy cattle production, thereby lowering production costs. Let's look first at the beef industry. Ranchers now have to maintain 111 beef cows throughout the year to produce 100 calves for our feedlots. This is expensive. We must step up our efforts to produce two calves from each beef cow every year. This has already been accomplished on an experimental basis through use of hormones. There is now a great deal of effort underway to use embryo transplants so that the best cows can be made to produce several times as many calves during their lifetimes as they do now. Improved techniques for inducing multiple births should soon enable us to achieve a 125-150% calf crop on the average. By the year 2000, we will see *average* weaning weights of beef calves going up to 600 pounds versus 400-450 pounds at present. Daily gain in the feedlot will reach an average of 3.5-4.0 pounds versus 2.2 pounds now, and feed conversion will drop to a ratio of six to one from current levels of eight or nine to one.

Feed efficiency in beef cattle and in other meat producing animals is extremely important to us as we face continued competition from vegetable and marine sources of protein. It has been calculated, for example, that a pound of salmon or of catfish can be produced on only one to 1.5 pounds of dry feed. Let's compare those gains with what may be on the horizon with beef cattle. As you folks know, our animal nutritionists have recently learned that the so-called "waxy corn" can boost daily gains and feed efficiency by 8-10%, over presently used dent corn hybrids. New high-energy corn varieties with oil contents 50% higher than regular corn are already available. And hybrids incorporating both higher oil content and waxy starch are now being developed. Based on those developments, we have reason to believe that daily gains in the feedlot can be much better than those which I mentioned a moment ago. We know, also, that some breeds and crossbreds will gain up to four or five pounds a day, with today's genetic and nutritional knowledge.

Use of computers to formulate feed rations for lowest cost and greatest efficiency is now commonplace and will expand greatly in the near future. Through improved nutrition and breeding, the percentage of carcass fat now common in beef cattle will be cut in half by the end of this century. With only modest advances in reporductive efficiency along with heavier weaning weights, faster gains and higher feed conversion efficiencies in the feedlot, it should be possible for us to reduce the cost of producing live beef by 20%.

Continued genetic improvement of our dairy cattle will result in milk production per cow nearly doubling in the next 26 years. This will result in 50% more milk per pound of feed. And that will mean a significant reduction in the relative cost of producing milk.

I am sure that all of you have from time to time been confronted with statements to the effect that animal agriculture has reached plateaus in production efficiency. However, the genetic variation which exists in today's livestock and poultry indicates to me that the biological *potential* for efficiency improvement and cost reduction is even greater than the very sizable gains we have observed in the past. Furthermore, the prospects for greatly increased feeding of agricultural waste materials to livestock may well lead to further cost reduction. In other words, the major plateaus facing us are likely to be in our *thinking and in our ingenuity*, as well as in our support for science and technology, rather than in the biological materials with which we will be dealing. Our really challenging opportunity is to continue to accelerate efficiency in agriculture, as in all other areas of our economy, for only in this way can we accomplish the multi-faceted goal of increasing net farm income; of assuring a fair profit for off-farm agribusinessmen; and of continuing the long-term trend of reducing the cost of food and fiber to the consumer! It seems to me that our responsibility in rural-urban society must always involve the Utopian concept of seeking the greatest benefit for the greatest number! To achieve this goal will require gains not only in efficiency of production on the farm, but also in marketing and distribution of agricultural products. Furthermore, in the future, more than ever before, we must educate the consumer as to how best he can satisfy his nutritional wants and needs.

**I, for one, am convinced that increased effort must go into the maintaining of improved herd and flock health as well as into the tailer-making of the genetic makeup of our livestock to provide the quality of meat and other animal products for which consumers will be willing to pay a reasonable price. Biopsies on the living animal for the purpose of determining potential tenderness as well as protein and fat content offer possibilities for livestock producers to improve animals on an objective basis. Quality control in processing and packaging plants will be increasingly affected by on-stream analyses for flavor, moisture, protein, fat and bone content utilizing nuclear magnetic resonance, gamma radiation and other instrumentation techniques yet to be developed. The future for animal products in the United States will de-**

**pend, to a large extent, upon how efficiently and how well meat animals are converted into food products which meet human needs and desires.**

Convenience for the housewife will continue to be vitally important. A quarter of a century ago, 55% of the food purchased in the United States was processed food. Now, that proportion is approaching 75%. We expect this upward trend to continue. Major advances will continue to be made in the area of fabricated meats. We'll go far beyond the sausages and hot dogs of today, to fabricated steaks and roasts. Fabrication will permit the rigid control of texture and flavor characteristics, and the tailor-making of products which are nutritionally balanced for different age groups in our society. It will also permit more advantageous use of meat scraps and other byproducts which are presently considered inedible.

As one might anticipate, some among our current forecasters of gloom and doom have raised a question as to whether we will have the resources of land and water to support a greatly expanded livestock industry. One of the most pessimistic forecasts I've seen recently comes from Arthur C. Clarke, author of the highly publicized book and movie titled *2001: A Space Odyssey,* Mr. Clarke wrote, and I quote: "Natural meat production is so inefficient that it will probably be totally uneconomic, if not prohibited by law, in the next century. It takes ten pounds of fodder to make one pound of meat. This means that for every man who eats meat, ten men have to starve, as indeed is happening on much of this planet." In response to such pessimistic speculation I would point out that a comprehensive study completed in 1968 by the USDA, covering agricultural production and land use requirements to the year 2020 concluded, and I quote: "It appears that the national agricultural resource base is adequate to support the projected levels of output . . . (to the year 2020)." Several more recent studies including our own studies at The Ohio State University support and reinforce the USDA conclusion. What the die-hard detractors of our animal industry fail to comprehend is that animals will continue to consume roughages that human beings, even very hungry human beings, cannot or will not consume, let alone digest or utilize even if consumed. Furthermore, a great deal of animal feed will, in the future, come from non-crop waste materials. *In short, there appears to be little question but what sufficient land, water and other resources will be available to produce the feed grains, hay and pasture that will be required by a dramatically larger United States animal agriculture in the year 2000 and beyond.*

There are, of course, those among us who question whether we can handle the waste and odor arising from expanded animal production, in our increasingly urban and ecologically-minded society. As we see it, this will present no insurmountable problems. In fact, we believe that livestock will help to alleviate pollution problems arising elsewhere in our society. Within just the past few years, our livestock industry, in cooperation with agribusiness, agricultural experiment stations, and various governmental agencies has taken steps to correct a number of the pollution problems which previously existed. This effort has involved the processing and recycling of waste materials, thereby causing the wastes to become resources rather than pollutants.

Many experiments currently underway are exploring *how best* livestock wastes can be processed and utilized as soil amendments. In still other research efforts livestock wastes are being recycled. Our scientists at the Ohio Agricultural Research and Development Center have in the past few years conducted several experiments involving the feeding of both dried and fermented cattle manure to sheep and cattle. One feedlot in Ohio is using a digester to compost manure. The stabilized compost has been fed to brood cows with good results, utilizing a ration consisting of 65% stabilized compost, 30% corn silage, and 5% protein supplement. More recently the compost has been fed back to the cattle being fattened as a total replacement for the silage previously used. The stabilized compost has also been sold through garden stores and supermarkets as a soil amendment for potting plants and for improving the tilth of soil in home gardens and landscape plantings. A highly successful technique for handling liquid manure is the tank distributor which injects liquid manure into the soil, leaving nothing on the surface to cause odor or to wash off into streams and ponds.

**The point of my making reference to these examples is that we can, and we must, take a positive and innovative approach toward the disposal of livestock wastes in addition to our findings new ways in which animals can be used for the disposal of other wastes, including those arising from crop production and the processing of all types of food products as well as human wastes. The feeding of citrus pulp, cannery waste, and other by-products of crop processing is now commonplace. Our work in Ohio and at other experiment stations has shown that it is possible to feed processed garbage to cattle and sheep, and to utilize sewage sludge for crop and forage production, which, in turn, can be fed to livestock.**

We are finding that waste products from many segments of industry can be fed to livestock. For example, we now know that it is feasible to feed processed wood pulp and recycled waste paper to cattle and sheep. Thus, we have now added a dramatic new dimension to the age-old role of animals, particularly ruminant animals–that of consuming products formerly thought of as useless waste materials. This new dimension may, in itself, assure us that the livestock industry will continue as a vital part of our United States economy, and an increasingly important part of our world economy.

These, then, are our views as to four major challenges to the animal industry of the future. We are convinced that the future is bright! Our food

production and consumption system–once local, and now regional and national–is rapidly becoming international. As incomes continue to rise here in the United States and worldwide, and as nations lift more and more of their populations above poverty levels, increased numbers of human beings will have ever-greater choice in their diets. Available evidence suggests that when a choice is available more and more people will choose to consume animal products. Today, nations such as Japan, Taiwan, Russia, and many of the developing nations are following the historical patterns established in the United States and in Western European countries by increasing their consumption of animal products, and by enlarging their animal industries.

There is a sound basis for efficient animal production in every nation in the world, even if only on a limited scale. First, every country has some cereal by-products or waste materials which are not suitable for man. These include cereal bran middling or polishings, vegetable wastes, distillers by-products, and packinghouse by-products. Also, many potentially suitable foods for man may not be considered safe for man. Fish meals, cottonseed meal, and even some of the peanut meal now produced would fall into this category. Recycling of processed animal wastes for animal feeds is still another example. Under circumstances currently prevailing in much of the world the use of substantial amounts of cereal grains and high quality protein feedstuffs for poultry and pig feeds can be justified in order to realize the greatest total nutritional benefit for human beings. At present, many farm herds and poultry flocks in developing countries are poorly fed and poorly managed and, consequently, are inefficient producers. With improved breeding stock, nutritionally complete feeds, more adequate management, and greatly improved disease control, the efficiency of even small production units can be markedly improved. I believe that there is a fantastic opportunity for better use of animals in most of the developing countries if for no other reason than to utilize presently wasted feed resources. Their use could materially increase the supply of high-quality, high-protein food for human beings, and at the same time provide income opportunities so desperately needed for economic development in those countries.

The present strong demand for animal food products can be expected to continue even at relatively higher prices, particularly in the industrialized countries. Increasing production efficiency through the application of science and technology will help to extend the benefits of animal agriculture to many future generations. It appears to us that it will be possible for United States agriculture to continue to provide sufficient quantities of meat, milk and eggs to all our citizens and make it possible for them to purchase those products with a decreasing proportion of their incomes.

**By the year 2000, we estimate that each United States citizen will spend only 12.5% of his disposable personal income for food and beverages, compared with about 16% today. Except for isolated instances, synthetics and substitutes will not make devastating inroads into the demand for animal products over the next 30 years. As we indicated earlier, it is just not likely that our United States consumers will markedly shift their eating patterns during the next 30 years to include large quantities of food from nonconventional sources.**

Now then, what does all of this mean in terms of consumption? We have estimated that each United States citizen will consume an average of 667 pounds, retail weight equivalent, of animal products in the year 2000, compared with 634 pounds in the 1969-71 period. Each person will eat 140 pounds of beef and veal, or 21% more; 75 pounds of pork, a 10% increase; and three pounds of lamb meat; which is an approximate 9% decrease on a per capita basis. We predict that total red meat consumption will reach 218 pounds by the year 2000–that is 17% above today's level of consumption. On the basis of retail product weight, the historic decline in dairy product consumption is expected to level off at 360 pounds per person.

Our "Life 2000" citizens will eat 50% more chicken, and 50% more turkey, or a per capita total of 72 pounds of chicken and turkey. Per capita egg consumption is expected to decline 10% by the year 2000, but by that time our United States population will have reached 270 to 280 million so that even on a decreased per capita consumption basis, total consumption of both eggs and lamb meat will actually increase.

A United States population of 270 to 280 million means that we will need increased production of all animal products, with increases of about 50% for most of the individual products. We will need 74% more carcass beef, 53% more pork, 9% more lamb, and 20 billion more pounds of milk. We will need twice as much chicken, twice as much turkey, and more than 20 billion additional pounds of the two combined by the year 2000. Egg production will increase from a present total of 9.1 billion pounds to 11 billion pounds long before the end of this century.

**In summary, the opportunity for United States animal agriculture to provide larger supplies of all animal products during the next 26 years offers an exciting challenge. We believe that the challenge can and will be met. Thus, as we look toward horizons of the future, we can be highly optimistic about that great and enduring industry which provides meat, dairy and poultry products for consumers not only here in the United States, but all around the world!**

We can also be optimistic about meeting the challenge presented by the energy crisis. I am convinced that abundant supplies of energy at a reasonable cost will once again become available in the United States of America. I believe that by the

year 2000 we can be assured of having enough energy to provide abundant food for a growing population and for huge exports, and to provide all the other goods and services which contribute to our enjoying a rewarding and satisfying life, while at the same time achieving a high quality environment. But if these things are to come to pass, we are going to have to pitch in and do our part, both in our personal and in our professional lives. It will be incumbent upon all Americans to avoid the temptation to contribute only unproductive criticism, rather than joining in the effort to effect intelligent application of science and technology so that together we *can* meet the challenges which lie ahead.

# The Present and Future Economic Outlook for Beef Production

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During the last 18 months the cattle industry has been buffeted by consumer boycotts, a ban on DES, various phases and stages of price controls, skyrocketing feed grain and protein prices, double digit inflation, and marginal growth in the general economy. Prospects for the next year or two are potentially even more disruptive.

The nation's cattle herd has been building rapidly for several years as stockmen delayed selling cows and held back young heifers to expand their breeding herds in response to rising feeder cattle prices. The total cattle herd had risen to 127.5 million head at the beginning of this year, up 13 million head in just three years. And another six to eight million are being added this year. Also, the calf crop will approach 51 million head this year, up four million head in three years.

**Increases in the cattle herd have not been accompanied by an uptrend in slaughter. Total cattle and calf slaughter has remained at about the same level since the mid-1960's. So there is a very large supply of feeder cattle that will support higher slaughter rates during the next few years. Slaughter will swell further as stockmen become discouraged with lower feeder cattle prices and move more of their cattle to market.**

The record large feeder cattle and cow inventories will dominate the beef supply picture for the remainder of 1974 and on into 1975. Further increases in production are a certainty but the timing and magnitude of the increases are less clear. With less than 10 million cattle in feedlots for slaughter, this leaves well over 90 percent of the cattle inventory drawing upon the nation's forage supplies, particularly grass. General weather and pasture conditions and the severity of the winter will play an important role in slaughter patterns during the coming months.

The disruptive conditions over the last year are contributing to severe financial losses to cattle feeders in 1974. Most cattle feeders are still losing money. Lower fed cattle prices now are adding to the red ink. Cattle feeding is very sharply curtailed. Placements of feeder cattle have been reduced substantially. Almost three million fewer feeder cattle were placed on feed during the first nine months this year–15 percent fewer than the low level of activity a year earlier. The primary outlet for feeder cattle has been partially closed. The result is a very large buildup in feeder cattle supplies. As of July 1 this year, there were almost 16 million steers and heifers weighing over 500 pounds not on feed and not being held for replacement stock–about three million more than mid-1973.

These feeder cattle were on ranges and pastures. Added to this was a new calf crop of nearly 51 million head dropped in the spring and summer, and over two million more cows added since January 1. Now, mix in a very serious drought which began last spring in the Texas Panhandle area, and quickly spread East and North during the summer, engulfing a major portion of the cattle producing areas.

It is not surprising then that we had a very large movement of cattle from the range during the summer and fall. This movement more than offset reductions in fed cattle marketings.

The movement from the range is not limited to older and heavier cattle. Calf slaughter turned higher this spring reversing a long period of decline. Calf slaughter this summer and fall is running 50 percent higher than last year.

**This situation has created some unusual price patterns. Fed cattle prices rose this summer despite larger total supplies of beef than in the spring or last year. The summer price strength was at least partly due to the low level of fed cattle supplies. But other classes of cattle did not fully share in the summer price strength. Feeder cattle prices are remaining well below the fed market, while a year ago they ran $7 to $10 higher than the**