THE MEAT STORY*

ROBERT W. BRAY
University of Wisconsin

Introduction

Meat, the flesh from animals, has contributed to the welfare of man for centuries. The muscle and included fatty tissues have and continue to supply him with a major portion of his protein and energy needs.

Today, meat on the table is an accepted fact in the affluent lives of most Americans; yet younger generations know very little of the extraordinary achievements that have brought them both a quantity and quality of meat available no place else in the world. The amount and quality of meat consumed is tied closely to strong agricultural economics and to the amount of disposable incomes. Thus, it is not too surprising that the U.S. consumes a major portion of the total world meat supply; for example, one-fourth of all beef produced.

Research by meat animal scientists in our land grant colleges since the 1940's has not only made it possible to produce larger quantities of meat, but to provide a basis for producing meats of a higher and more uniform quality--meats tailored to have the desired muscle to fat ratios that produce the highly desirable traits of tenderness, juiciness and flavor.

Today's meat supply is in sharp contrast to that of the days when man derived his meat supply from the fruits of his hunts of wild animals. Animals native to the area provided the meat supply.

Earliest History of Meat

In America the large buffalo, elk and deer herds provided the American Indian and early settlers with their meat supply and hides for clothing and shelter. With the demise of these herds, the development of domesticated herds and flocks of cattle, swine and sheep was a logical course.

Spanish Longhorn cattle were brought to the West Indies by Columbus on his second trip to the New World, and introductions were made into Florida and the southwestern part of the U.S. through Mexico in the early part of the 16th century. The old Longhorn Spanish stock was described as "a wild fierce breed with huge horns, long legs and worth

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little or nothing to their owners"; but with their terrific endurance this led the advance into the western latitudes and its arid grazing lands. These cattle seemed to have a fifth sense in finding water and grass and, thus constituted the best possible material for use in developing our early cattle ranches in the 19th century.

Spanish missions brought large numbers of cattle to Texas and various blood lines ran wild and reproduced rapidly. Early Americans settling in Texas during the 1820's favored ranching and the era of the Longhorn was the beginning of the U.S. beef industry--a time when cattle no longer were raised just for their work, milk production and hides.

Pigs first saw the American mainland in 1539, when DeSoto landed in Florida. In his journeys, the herd grew and many escaped and are believed to have become the foundation stock for some of America's famous razorbacks. Colonists along the Atlantic sea board brought hogs from Europe and historical documents in 1663 refer to dense populations roaming the woods of New England. Hogs became a significant part of the U.S. meat industry and a valuable export item as settlers moved into the present corn belt. The availability of native Indian corn as a swine feed, the ease of curing pork without refrigeration and the need for protein and energy made the hog an economic powerhouse--often referred to as the mortgage lifter.

Families in these days spent most of their time producing food, shelter and clothing for their own use. Ninety percent of the U.S. population was on farms in 1800 compared to 4.5 percent in 1970. Farmers raised work oxen for power and grew crops to keep them going. Farming was truly a way of life and required long hours of hard work. Large families were the rule since youngsters became economic assets as they grew and shared the work load.

Before the modern day freezer, housewives spent hours curing and canning meat in order to preserve it and have it available throughout the year. Often the hams were so salty they needed to be par-boiled before eating and too often mold growth turned them green during storage. The preservation and preparation of food for the families in American homes required approximately one-half of a housewife's time in these early days. This is in sharp contrast to half that total time today.

Domestication of fowl in India dates back to at least 1000 B.C. and records indicate that chickens were raised by the Chinese back as far as 1400 B.C. The origin of the U.S. breeds is obscure, but were probably imported from the British Isles. The Leghorn was imported somewhat later in 1835 from Italy and since then many outstanding egg-laying strains have been developed. The primary emphasis in developing breeds of chickens was for both meat and eggs--a dual-purpose chicken. They commonly roamed the farmstead for their food, which included that found in the barnyards, hay seeds, and wasted grain around corn cribs and grain bins. Breeding poultry for meat production came in the 20th century.

Dawning of an Industry, 1850-1900

As America moved into the middle of the 19th century, the leaders of government recognized the need to develop its agriculture; for only an efficient agriculture could free labor to develop a great nation. Thus, the significance of U.S. agriculture today and meat animal production as a part of it, can be attributed to such enabling acts as the Homestead Act of 1862 which encouraged land settlement and enhanced the development of family farms, the Morrill Act of 1862 which established the Land Grant Colleges, the Hatch Act of 1887 which established State Agricultural Experiment Stations and the Smith-Lever Act of 1914 which established the Cooperative Agricultural Extension Service.

Beyond these governmental acts was the dedication of Americans to make America great. As a fledgling country, it was only natural that agricultural products, including meat, were items it could trade with other nations. Likewise, an expanding population could no longer depend upon wild animals for its food supply. Several significant technological developments such as the mechanical corn planter, the McCormick reaper, the threshing machine, and a steam engine for agricultural use greatly enhanced the production of small grains and corn in the midsection of the United States. As feedstuffs became more available, farmers and ranchers strove to improve the meat producing qualities of their livestock.

Although Shorthorn cattle were imported from England prior to 1850, large numbers were imported about that time as dual-purpose--milk and meat cattle. Shorthorn bulls were used on the western ranges but gave way to Hereford cattle in the latter part of the century. Angus cattle were imported at about the same time as Herefords, but attained their popularity in the corn belt as cattle that became "finished" for the market earlier and produced well-marbled meat. Other breeds were introduced, but none became as popular as the Shorthorns, Herefords, and Angus.

Shortly after the beginning of the 19th century, swine breeding stocks began to be imported from the British Isles. Unlike the beef cattle producer who at times imported whole herds of purebred stock from Britain, the hog producer used imported boars to breed to so-called mongrel American sows. Some of the breeds used were Chinese, Berkshire, Tamsworth, Russian Suffolk Black, Byfield, Irish Grazier, Yorkshire and Hampshire. Out of the various crosses and combinations which varied from place to place were created the several genuinely American breeds we know today such as the Poland China, Duroc, Chester White and Spots.

In the 1880's there was a trend toward what was called the "cob roller" type--a quick fattening hog and one that would produce abundant quantities of lard. Lard was then in great demand as a shortening for home cooking and baking and to cover fried down meats to prevent spoilage during storage.

Swine breeds were generally classified as "lard" or "bacon" breeds. The bacon breeds have only in recent years become more popular in the U.S., with the substitution of vegetable oils as shortenings for lard.

Increased farm production per farm worker during this period provided labor for the beginning of this country's great industrial revolution. As people left the farms, it became the farmer's role to produce not only food for his family, but for those that toiled in factories developing in the east. Factory workers in turn began to produce machines and supplies necessary to expand farm production.

As cattle took over the range from the buffalo, it became necessary to move them in large droves eastward for slaughter and consumption by those living in America's fast-growing cities. Hogs were also driven to market. The need to move meat in the form of livestock led to the development of many miles of railroad into the Midwest. The building of the Kansas Pacific railroad across Kansas and the Union Pacific across Nebraska and Wyoming provided major outlets for cattle to slaughtering plants in the East. Railroads and the stock cars provided came at a most opportune time during the seventies and eighties when the cattle industry was growing very rapidly.

The development of stock yards for the sale of livestock to slaughter came during this period. The Chicago Stockyard was established in 1865 and soon became the nation's leading livestock market.

The shipment of meat during the warm months of the year was not feasible because of spoilage; thus, a most significant development, the refrigerated railroad car which provided a sufficiently air-tight car and a means for icing, was a major factor in developing huge meat packing industries in Chicago and Kansas City.

It was also during this period that livestock shows, patterned after those in Europe, became popular. A few livestock shows were held in the early 1800's but major shows such as the Centennial Exposition in Philadelphia and the Fat Stock Shows in Chicago and Kansas City were established in the latter part of the century. These fat stock shows were the forerunners of the International Livestock Exposition in Chicago and the American Royal in Kansas City about 1900. These shows still remain as major influences in setting breed and market types.

Energy and Epidemics, 1900-1950

At the turn of the century, cattle were fed grass and hay and marketed from two to four years of age. Grassers, as they were commonly known, were the primary source of beef until the 1940's. Hogs consumed grass, corn, and at times byproducts of the dairy industry. Differences in performance of cattle and swine led scientists to look into nutritional requirements. It was during this period that animal nutrition came into its own with the discovery of the vitamins, essentiality of

various minerals and the proper ratio of protein and carbohydrates in the rations of livestock.

It was discovered that meat animals were in a real sense what they ate. No one feed material provided the necessary nutrients in the amounts required for growth and reproduction. The now famous single grain experiments by Wisconsin researchers in 1907 gave the first evidence that grains varied in their nutritional value. Thousands of nutrition experiments conducted by animal scientists since that time have contributed to tremendous advances in animal nutrition.

The proper amount and quality of protein in meat animal rations along with the contribution of energy from carbohydrates and starches in grains led to significant increase in the supply of beef, pork and poultry during this period.

It was recognized that high energy rations provided great potential for more rapid weight gains. Corn, a native to this continent, was studied by plant scientists who saw the potential for increased livestock production if this valuable grain was made available in greater quantity. This led to the most significant agronomic development during this period--the development of hybrid corn. The benefits of hybridization were a boost in corn yields of 20 to 30 percent, stronger and more vigorous plants that resist adversity such as drought and to mechanical harvesting and systematic processing. The corn crop has become the backbone of meat production in this country.

The importance of protein in nutrition was recognized prior to 1900, but the benefits through feeding protein supplements were discovered during this period. It was also observed that all proteins were not equal in feeding value. Amino acids, the building blocks of protein, were carefully studied by many nutritionists, but perhaps the most significant discovery was that some amino acids were essential while others were not for good animal growth. Likewise single-stomached animals required essential amino acids in their diets in the amounts required by their bodies; while ruminants could synthesize some of these amino acids. The lack of sufficient protein or quality of protein resulted in poor growth and muscle content in the carcass especially swine and poultry.

Soybeans are an excellent source of protein and the livestock industry has great dependence upon this crop which is estimated to be planted upon 51 million acres in the U.S. in 1976. The soybean plant was introduced into American agriculture in the 1880's and became an important forage crop in the early 1900's. The production of soybeans for seed exploded in the 1940's and 1950's and is now America's number one cash crop. Soybeans as a source of protein for livestock feeding was a major stimulus for increased production; however, of equal importance was the utilization of the oil extracted from the beans. Whereas the protein assisted the livestock industry, the oil provided the impetus for the development of the vegetable oil industry and severe

competition for animal fats--especially lard. Hogs were produced by early settlers in America for both their fat and lean, but the competition from vegetable shortenings brought on a real concern on the part of the swine industry in the late 1940's to produce meat-type hogs with minimum amounts of fat. A more recent concern for livestock producers is the use of the soybean protein in producing simulated meat products, and, thus, a partial substitute for meat from cattle, swine and poultry.

About 1900 it was discovered that microorganisms could use materials other than protein such as urea and other ammonium salts to form protein in their bodies. Since cattle are ruminants and have large microorganism populations in their rumen (the largest of four stomachs) they derive protein from the proteins produced in microorganisms; thus, the need for protein supplements is less than that for swine and poultry. There was, however, a need to provide a nitrogen compound for the microorganism to convert to amino acids and subsequently protein. Scientists found urea to be a relatively cheap compound that could be used to supplement cattle rations. Today more than half of all cattle in U.S. feedlots have urea in their rations. This discovery greatly reduced the costs of producing fed beef.

Most of the vitamins were discovered during this period and since experiments were conducted with animals the livestock industry was an early benefactor. For example, the discovery of vitamin D and its sources had a major impact upon the poultry industry. In 1930 cod-liver oil was added for the first time to poultry rations. This supplementation made it possible to grow ricket-free chickens indoors over long periods of time--thus, a major roadblock had been removed for our present-day broiler industry. Also, the discovery of the B vitamins in the late 1920's proved to be of great importance in growth for swine and poultry.

The role of many minerals in livestock production was determined prior to 1950, but more importantly it became known that there were many areas producing livestock that were deficient in one or more of the minerals required for good growth, reproduction and elimination of certain nutritional diseases. Iodine deficiencies resulting in goiter formerly caused heavy losses in new-born pigs, lambs and calves. Anemia in young animals caused major livestock losses until it was discovered that small amounts of iron and copper would prevent this condition. This new knowledge virtually eliminated these maladies from our livestock populations. The proper ratio of calcium to phosphorus and vitamin D led meat animal producers to rations which essentially eliminated poor bone structure in breeding animals.

The livestock population in the U.S. expanded rapidly, but so did the U.S. human population. As cities and towns grew across this nation less land was available for agriculture. Within agriculture many changes were also taking place. The cash crop farmer--those specializing in wheat, cotton and now corn and soybeans--no longer used the land to produce livestock. This simply meant that the livestock was becoming

concentrated on less land. This also required greater purchases of grains and feed supplements on the part of the livestock farmer. It was the dawning of a new structure for meat animal production--confinement rearing. This change in agriculture meant that it would no longer be possible with new encumbrances in buildings and equipment for livestock producers to get in and out of a certain type of meat animal production or increase and decrease the size of his operation without serious financial consideration.

Careful selection for desired meat animal traits and good nutritional practices has been accompanied by major efforts in maintaining a healthy animal population in the United States. Veterinary medicine has become a very sophisticated profession and has recorded many major achievements since the earliest record of veterinary services in America in 1625 (a "cow doctor" in Virginia); however, most of the progress has been made during the last seventy-five years.

The outbreak of foot and mouth disease that struck the United States in 1914 was largely responsible for the increased concern by the public to improve its standards in veterinary education and research. Six months after the first case was identified some 68,000+ cattle, 68,000+ hogs and 9,000+ sheep and goats were slaughtered or died of the disease. This exotic disease has gained entrance in the U.S. eight times since 1870, but this most dreaded plague of livestock has been kept out since 1929 through a full-scale effort by state and federal veterinarians.

The outbreak of foot and mouth disease in England in 1967, although brought under rapid control, resulted in a 70 million dollar loss; obviously the considerable effort to protect the U.S. supply of meat is a good investment in protecting our food supply. Europe experienced another epidemic in 1973.

Eradication of diseases has also proven to be an effective method for other livestock diseases. Contagious bovine pleuropneumonia was introduced into the U.S. in 1843 and foreign embargoes threatened the life of this growing U.S. livestock industry. This disease was completely wiped out in 1892 and has not been allowed to reappear.

Hog cholera, a disease which was recognized as a disease killing 50 percent or more of the pigs in Kentucky and Tennessee in the 1840's and causing losses of over 400 million dollars between 1914 and 1924, has been essentially brought under control through the use of vaccines.

The protection of livestock from diseases has helped make meat the mainstay in the American diet. However, of equal importance has been the protection of the American public from diseases communicable from livestock to man. The present state of medicine's campaign against human tuberculosis is largely attributable to the efforts of veterinarians. In 1900 tuberculosis resulted in a death rate of 194.4 per 100,000 population; the chief single cause of death in the U.S. The near

elimination of pulmonary tuberculosis of bovine origin has resulted in a reduction in death rates to less than five percent per 100,000 population.

In 1947, the estimated annual economic loss from bovine brucellosis in the U.S. was 100 million dollars and 6,321 cases of human brucellosis had been reported. In 1966 a decrease of 95 percent in the incidence of the disease was made through a 19-year eradication program.

With increasing animal populations in the U.S., parasitic worms began to take their toll in the form of poor weight gains and death losses in livestock. Various treatments were recommended and discarded, until in 1935 Phenothiazine was found to prevent the development of the horn fly larvae in cattle feces. This first true wormer soon found application for poultry, swine and other species of livestock.

Age of Animal Health and Urbanization of Livestock, 1950 to Present

A vast accumulated knowledge in meat animal production by researchers in animal breeding, nutrition, meat science and veterinary science and the supporting roles of the plant, soil scientists and agricultural engineers have provided the base for a vigorous on-going livestock industry in the United States. Innovative meat animal producers have utilized this basic knowledge and developed a meat-producing industry second to none in this world. Figures are not available to show how many persons are supplied meat by one farm worker; however, one farm worker now produces enough farm products to meet the needs of 41.2 persons as compared to 13.8 people in 1950. As an example of increased efficiency, 135 hours of labor were required to produce 100 bushels of corn in 1912 as compared to only eight hours in 1972.

Research and applied technology have provided record-breaking productions of corn, grain sorghum, soybeans and forage production. Thus, immense supplies of animal feed have made it possible to urbanize cattle, swine and poultry in confinement feeding facilities. These facilities and their nearly automatic feeding and waste disposal features have produced increased efficiency.

A record beef production of twenty-three billion, 664 million pounds was established in 1975 and thus provided a record beef consumption per capita of 120.0 pounds (carcass weight equivalent). In order to attain this record, beef production has become highly specialized--some produce only feeder animals, while others only feed cattle for the market.

In the cattle feedlot world, confinement feeding began prior to 1950 in the west and southwest, but the major transition to feedlot feeding has taken place in the last 20 years. Fifty to 100,000 head feedlots have existed for some time in Colorado, California, Arizona and Texas. However, there are still thousands of small feeders in the corn belt feeding 500 to 1,000 a year, with sound operations showing a

profit. On the other hand during 1971, there were slightly over 2,200 cattle feedlots operating in the United States with a one-time capacity of 1,000 head or more. These relatively few feedlots, however, accounted for 59 percent of the nation's supply of 25 million head of fed cattle. About three-fourths of all cattle marketed for the fresh meat trade are fed in feedlots. This technological change in producing beef has reduced the age at time of slaughter from two to three years of age to 12 to 18 months and provided for less variation in the grade of meat. Thus, the American consumer now has a more uniform and higher quality of beef available than ever before or in any other country of the world.

Investments in beef operations continue to increase. Feedlots holding 2,000 head require presently $65 to $150 per head. Costs vary with the amount of confinement and waste disposal system costs, but the total cost for buildings and equipment for a confined feeding facility is approximately one-fourth million dollars. Two thousand head of cattle require two full-time men plus some part-time help.

Pork production in 1974 was 13.8 billion pounds and provided 66.6 pounds of pork per capita; however, in 1975 pork production declined sharply due in part to higher grain prices. Although the pounds of pork consumed per capita have remained fairly stable, one must remember that a substantial increase in production has been necessary to accommodate an ever-increasing U.S. population.

Swine production like beef and poultry has become more specialized. Some produce only feeder pigs while others specialize in feeding pigs for the market. There are a few 10,000 head feeding units in the U.S., but in the corn belt 500 to 2,000 head units are more common. The two major deterrents to increased size are waste disposal and sources of feeder pigs. The source of feeder pigs may well lead to a greater number of large-size feeder pig production units in the corn belt.

In combined operations where the pigs are produced and fed out for market, about $300 per sow is required for farrowing, feeding and waste disposal facilities. Thus, a unit that would produce and feed out 2,000 head would represent an investment of about 40 to 50 thousand dollars and would require the full-time effort of two men.

The management expertise of units of this size becomes critical in view of the stringent requirement for disease control and the need for efficiency in the operation.

Poultry meat is no longer an item for special occasions such as Sunday dinners and holidays. The specialization in the production of broilers and turkeys during this period has led to a supply which for many years exceeded the demand enough to depress prices to the point of forcing marginal operators out of business. More than 95 percent of all commercial broilers produced in the U.S. are grown under contract or by integrated firms.

Contracts have provided a mechanism for developing a share-the-risk-share-the-profit plan among the producer, feed supplier and the poultry processor. Also, a number of firms are now virtually integrated to the point where they now produce, feed, process and merchandise poultry. Since 1950 the production per hour of labor has increased sixfold. On the other hand, capital investments have increased greatly. In 1909 only 17.2 pounds of poultry were available per capita, but this has now tripled in spite of a 125 million increase in the U.S. population.

Thus new technology has contributed to greater production at less cost and lower cost to consumers. Of particular interest is that farm chickens sold for 19 cents per pound in 1922 while broilers sold at 14 cents per pound in 1972.

The size of poultry units varies from those that hold 30,000 broilers up to about 90,000. Several units may be under one operation, but heavy density populations are discouraged because of possible disease outbreaks. The cost of the facilities and equipment is about $1.00 per space or an investment from $30 to $90,000 dollars. One unit can be handled by a family; the larger-sized units essentially require two full-time men.

Nutrition and breeding technology have made it possible to have five turnovers in each unit per year which is in contrast to only three and one-half turnovers 20 years ago.

Major developments in animal health have also aided greatly in making it possible to rear and feed animals under various degrees of confinement.

Eradication of diseases has proven to be a sound policy for both the protection of our human and livestock populations; yet, we should also appreciate the great effort on the part of researchers in our universities, private industry, and federal research laboratories for the many biologicals they have developed for the protection of our meat animal populations against numerous diseases. Thirty-five years ago, the livestock industry could turn to only a half dozen vaccines that would help fight animal diseases. Today, the industry can call on an arsenal of veterinary biologics which include approximately 250 kinds of vaccines, antiserums, antitoxins and similar products. Although these advances have not been without cost both for their development and to the livestock producer, they have very significantly added to the quantity and quality of our meat supplies.

Today's modern animal agriculture, with its confined feedlots containing several thousand animals at one time, present the veterinarian with new challenges. Recruit diseases, those brought into feedlots by animals derived from many sources, are more prevalent; many of which were not serious in a dispersed livestock population. Swine dysentery, I.B.R. (red nose) in cattle and Marek's disease in poultry are examples of diseases with increased incidence in large scale feeding operations. However, a vaccine for Marek's disease is beginning to bring this disease under control.

Dysentery or scours in young calves is causing large economic losses to beef cattle producers, but again researchers are very close to making available a reo virus vaccine. Other similarly promising biologics are being researched to aid in the control of diseases now becoming prevalent in confined feeding operations.

Substantial economic losses are currently resulting from bovine respiratory diseases, transmissible gastroenteritis in swine and Newcastle disease in poultry. The recent outbreak of Newcastle disease in flocks in California resulted in federal indemnity payments of 40 million dollars which was only a part of the total loss to the industry.

A constant effort to produce meat more efficiently and subsequently at a lower cost to consumers spearheaded a continuing search for more suitable combinations of known nutrients and for new chemical substances. These efforts have led to the use of antibiotics, hormones and other chemicals in animal feed.

The first antibiotic, penicillin, was discovered in 1929; and the first antibiotic, aureomycin, to become widely used in animal feeds was discovered in 1948. Of the more than 1,000 antibiotics known today, 30 are used extensively in human medicine and 16 in animals. Since 1950, livestock production probably owes more to the incorporation of antibiotics in feeds than any other improvement. Today it is estimated that 80 percent of all animal products are derived from livestock and poultry which have been fed medicated feeds for the purpose of prevention of disease for increasing the rate of gain and increased feed efficiency in cattle, swine and poultry. In 1951 farmers used $17.5 million worth of antibiotics in feeds, but by 1961 they had increased their purchases to $43 million.

Apparently, the antibiotics used act selectively against certain transmissible microorganisms, either pathogens or nonpathogens which produce somewhat adverse growth rates. Antibiotic benefits to the swine industry have been calculated at 202.5 million dollars. This means more meat can be produced in a shorter period of time at a lower cost to the consumer.

During this period, researchers found that certain hormones act as growth promotants and had pronounced effects upon rates of gain in market animals. Studies conducted in the 1950's showed that feeding as little as 10 to 15 milligrams of diethylstilbesterol (DES) to cattle would improve daily gain by about 10 to 15 percent and that it increased red meat production. A majority of cattle feeders used DES prior to the banning of its use in rations January 1, 1973. This action on the part of the government has been estimated to have increased the cost of producing beef in the feedlot by 10 percent.

Melingestrolacetate (MGA) is a growth stimulant and has been shown to increase rate of gain by about 10 percent in heifers; however, heifers make up only about 10 to 15 percent of our total fresh meat supply.

Other estrogens are permitted in livestock feeds, but these are also coming under very close scrutiny. A new feed additive, Rumensin (trade name), which alters the kind of fatty acids produced in the rumen, appears to offer increased efficiency in feed utilization and, thus, greater efficiency.

Although artificial insemination was used in dairy cattle for improving milk yields in the 1930's and 40's, it was not until the 1960's that the beef cattle industry saw the need to use it. Purebred breeders of cattle carefully guarding their market for bulls, and the technological difficulties encountered in breeding cattle on pasture or on the range, slowed its adoption as a means for more rapid upgrading of the beef cattle population. Today's desire to use exotic beef breed sires has greatly enhanced the use of A.I.

Poultry breeders including chickens and turkeys have used artificial insemination very effectively in improving both egg and meat production. The modern-day turkey with its broad breast is virtually unable to reproduce naturally, thus A.I. has made it possible to continue to select for meatier turkeys.

An integral part of livestock improvement through artificial insemination was the development of a program recording performance of breeding stock.

Records of performance of meat-producing animals were practically non-existent until the middle of the 20th century. Performance and progeny testing has become a movement in livestock production. It has grown because of the demand from commercial breeders and feeders of beef cattle, swine and poultry for animals that will gain rapidly and efficiently and at the same time produce carcasses required by processors and ultimately the consumer. Swine testing stations were established in many swine producing areas in the 1950's for the purpose of identifying outstanding performing sires. In the 1960's bull testing stations sprung up across the country.

Where We Are Today

Over time the demand for better performance has driven American breeders to examine the economic characteristics of exotic breeds. At one time, the British beef breeds could have been considered exotic breeds as they were imported to improve the meat-producing qualities of the Longhorn. Likewise, Zebu cattle from India--commonly referred to as Brahmas--were found to be superior in heat tolerance; thus, Brahmas were crossed with the British breeds and Longhorns were found to be more adaptable to the climate of our southern states.

It should be noted, however, that crossing breeds for beef production has been less common than for swine. Crossbreeding in swine is very commonplace with perhaps 95 percent of the market hogs representing crosses of two or more breeds.

Producers of beef cattle have seen their production costs steadily increase; thus, they are looking for more rapid growth and efficiencies of gain in their cattle to meet higher costs. To achieve these goals, producers seem to be quite willing to consider crossbreeding in order to take advantage of desirable traits from two and sometimes three breeds.

With any first cross they have learned that they can expect 10 to 15 percent faster gains in the crossbred offspring. The desire to produce carcasses with more red meat, desirable quality, and faster and more efficient growth has led to the influx of many new breeds. The Charolais, a French breed, entered the U.S. in the 1930's but did not become popular in crossbreeding until the late 1950's. Since that time, many other breeds have been introduced into crossbreeding programs. The list is long and continues to grow, but among those under scrutiny of the beef producers are the Limousin, Simmental, Maine-Anjou, and Chianinia.

Swine breeders have not seen the same potential in exotic breeds for their crossing programs. Natural mating rather than A.I. is used by the majority of swine breeders. Boar semen cannot be preserved satisfactorily in the frozen state; thus, A.I. is limited to the use of fresh collections. Researchers in several of the Land Grant Universities are trying to unlock the secret to maintaining viable semen when frozen.

The increase in managing meat animals in confinement brings with it a very major problem--waste disposal. The need to cope with this problem and the environmental protection movement has challenged agricultural engineers and has brought forth many new concepts in waste handling. Slatted floors, oxidation ditches, lagoons, manure stacking, "honey" wagons are now common terms in the language of livestock producers. Any system that is installed for handling animal wastes adds to the overhead cost of producing meat, but these investments must be made if we are to have a good supply of meat and a desirable environment in which to live.

A further challenge to the meat producer is a possible restriction on the use of antibiotics in animal feeds. As mentioned previously, the use of antibiotics has to be one of the major advances leading to increased meat production since 1950. The Food and Drug Administration's major concern is that of transferable antibiotic resistance--first that antibiotics will create a population of resistant bacteria in the animal which will make it impossible to treat the sick animals with the same or another antibiotic; secondly, that a population of resistant bacteria might be transmitted from animal to man and that this might lead to a disease that cannot be treated. Controversy reigns on this subject, but in the end the cost-benefit ratio must be the deciding factor. The cost-benefit ratio has not been the criteria used in banning the use of chemicals used as herbicides and pesticides--nor was it used in banning the use of DES in feed formulations for cattle. The Delaney Amendment was the culprit.

The Delaney Amendment simply means as it pertains to livestock feeding that there will be no residues (commonly called zero tolerance) in meat of carcinogenic materials fed to livestock. Thus, if any amount--no matter how infinitesimal--is found, the product is banned for use. DES was found in very minute amounts in the liver of animals fed DES--none was found in the muscle. Greater research effort must be directed toward determining minimum levels of tolerance for safe consumption--zero tolerance may be unnecessary.

Another important aspect of the meat story is the role of the meat processor and distributor. As producers of beef, pork and poultry have responded by increasing the supply of meat, the meat processor has likewise responded to the new life style of Americans. With about 40 percent of the married women in the labor force and a desire for more free time for recreation, etc., the food industry has taken much of food preparation out of the home.

Meat, poultry, seafoods and vegetables--cooked and uncooked--in almost infinite variety emerge from the frozen state with the taste, texture and appearance of the original fresh or prepared product. Precooked meat items, sausages, frozen dinners and many ready-to-serve items are rapidly becoming popular. Microwave ovens reduce the time in meal preparation even more.

Today, when convenience and variety are the hallmarks of American eating habits, the U.S. Department of Agriculture estimates that it takes the average homemaker about one and one-third hours for all of her day's meal preparation, exactly one-third of the time required just to make dinner in the 1920's. Add to this the fact that many of the meals are taken outside the home by efficient commissaries and restaurants. Again, the food processing industry has responded with standardized, and in many instances, processed items for these institutions.

The demands of the consumer will be met by the processor and the producer of meat animals. The producing phase of the industry is meeting the challenge of producing a more uniform, highly standardized product for processing.

The U.S. is the only major nation with the "know how" for developing an intensified agriculture that meets its own basic needs, but also furnishes many of the food needs of others in this world. Often, we are reminded of the starvation that exists throughout the world--but more importantly we are told of the severe protein shortages that exist and the subsequent nutritional diseases that persist for many. Increasingly, the world's underdeveloped nations are turning away from a starch-oriented diet to one based on animal protein. Likewise, as the economics of developed countries such as Japan and those in Europe improve, so does the demand for animal proteins. The demand for meat is soaring in these countries. In the past ten years world beef trade has doubled, rising from 980,000 in 1960 to 1,980,000 metric tons in 1970. World production has risen 50 percent since 1960, but due to the sharp rise in population, the increase per person is only 10 percent. A reversal of this trend does not seem likely in the decade ahead.

How We Compare With Other Parts of the World

The United States is by far the leading meat producer in the world and it leads all countries in beef, pork and total beef production. The U.S. accounted for about one-fourth of all the pork and total meat produced and about 30 percent of the world's total beef output. This quantity of beef produced is a real compliment to the U.S. modern beef production technology, since less than 10 percent of the world's population of cattle is located in the U.S. The USSR ranks second in beef and veal production, but produces only one-half as much as the U.S. Argentina ranks third and Australia seventh in beef production, producing about one-fourth and one-fifth, respectively, as much beef as the U.S.

Australia was the world's largest consumer of total red meat in 1973 closely followed by New Zealand and Argentina. The U.S. ranks fourth. Beef and veal consumption per capita in the U.S. has risen rapidly and steadily during the past decade as domestic production has expanded. The U.S. is second in consumption on a per capita basis to Argentina, and consumed about 25 percent of the world's beef supply.

World pork production continues to increase with major increases in the U.S., the United Kingdom, France, Russia, West Germany and Denmark. The United States ranks first in pork production, again producing about twice as much pork as Russia the second largest producer of pork. West Germany, always a heavy consumer of pork produces a little over one-third of that produced in the U.S. Denmark, a leading exporter of pork, produced about 12 percent as much as the U.S.

Poultry production and consumption in the U.S. has increased dramatically and U.S. production easily exceeds that of any country. It is of interest that this country produces 25 percent of the world's egg supply and about 50 pounds of poultry meat per person in the U.S., and this is accomplished with only about one-seventh of the total world's chickens each year. Russia ranks first in the number of chickens produced but the European countries (common market and other Western European countries) produced more in total.

The production data for the U.S. makes it obvious that animal production technology and the will on the part of producers to produce have been strong forces in an abundant, uniform and high quality meat supply for Americans.

Human beings, generally speaking, like the taste of meat and other animal products. This is evident from the review of meat consumption data for the more affluent nations of the world. An improving standard of living for many other nations is leading to an increasing demand for meat in the diets of their people. As incomes continue to rise in the U.S., there will be a corresponding increase in meat consumption. Thus, we are now facing and will continue to face a world meat shortage, especially beef.

The U.S. policy of exporting grains to other countries for animal and human consumption will place further strain upon the meat-producing capacity of U.S. farms.

The use of soybeans as a source of protein for humans or as meat analogs will also reduce the supply of protein supplement for swine and poultry rations.

The increasing demand for protein in the world will require that the livestock industry look for new sources of protein not now available and in volume to substitute for soy protein. Likewise, not everyone in the world will have available or will be able to afford meat protein; thus, many will need to be content with consuming plant sources of protein.

Less developed nations must give priority to animal production, a commitment this country made to animal agriculture from the very beginning. Their main efforts must be devoted to decreasing the age of slaughter, increasing the fertility rates of the breeding herds, increasing the weight of slaughter animals and decreasing losses due to disease.

Coupled with the need to produce more meat on a world-wide basis, the more developed countries are facing the challenge of finding sources of protein for livestock that are not competitive for human use.

Where From Here

Animal wastes offer a challenge in terms of disposal and researchers are devoting much attention to the proper handling of these wastes in order to prevent contamination of our environment. One approach which may have double value is the recycling of animal wastes back through livestock as feed ingredients. Research today with poultry indicates good results with this practice.

Preliminary work at the University of Wisconsin provides considerable optimism about the possibility of dewatering freshly cut alfalfa for the purpose of preserving more of the protein in this important legume crop. The juice pressed from the green plant has a high protein content and the good potential for use for either humans or animals. If the liquid is used as a protein source for humans, preliminary results indicate that the residue still remains as an excellent feed for livestock.

Another significant effort to meet the increasing protein requirements of livestock has resulted in the development of high lysine corn. Lysine is an essential amino acid and because it is relatively low in corn, rations with corn must be supplemented with protein supplements higher in lysine. High lysine corn when produced in volume can reduce the supplementation required in present rations containing corn.

Also, the agronomist's and soil scientist's knowledge of protein and other nutrient requirements of meat animals has led them to breed other plants and feed plants for greater nutrient content and higher digestibility. For example, a long-standing crop such as oats varies widely in its protein content. Agronomists are not only selecting for yield of oats but also for its protein content.

Today's meat animal feeding programs are large in scale and demand efficiency. A rather wide variety of feedstuffs are available; but one must remember that these materials vary widely in energy, protein, vitamin and mineral content. Thus, it is becoming imperative that an analysis of the nutrient content be known in order to blend these materials in the balanced rations.

The analytical chemists and engineers have developed methods and equipment which will simultaneously determine several nutrients. Although the costs for assaying is high, it is becoming apparent that the cost-benefit ratios are becoming such that nutrient assays will be an essential part of ration formulations in the future. A knowledge of nutrient contents of feedstuffs will make it possible with the use of computers to calculate periodically least cost rations. Least cost rations are an absolute must for greater efficiency in the production of meat.

Perhaps the most important need we have in the U.S. if we are to increase our meat supply is to produce more offspring per breeding animal and to save more of the animals born. The production of one calf per cow per year costs very close to $100. A swine producer must have five pigs per litter to break even. Greater fertility in turkey eggs will make for greater efficiencies. These problems challenge the reproduction physiologist. Much progress has been made but major breakthroughs are necessary if significant increases in meat production are to be achieved.

The present trends toward larger and more efficient livestock and poultry units will continue and shortages of labor and needs for offsetting capital investments will hasten this trend. There is an urgent need to study the effects of large private or corporate units or businesses operated on an industrial or integrated basis upon the livestock industry. Can efficient, independent commercial farms survive? Credit and continuous financing arrangements will become an even greater part of the meat animal industry of the future.

Thus, it must be concluded that there are many problems facing meat animal producers and their solution can provide a greater meat supply. On the one hand the livestock producers face an increasing demand for their product, but on the other hand they face increasing costs for facilities, labor and feedstuffs. All of this seems to add up to higher prices for meat animals and the cost per pound of meat sold to consumers. Consumers will make the decision as to how much they will pay for meat--my guess is that they will pay more, but perhaps more willingly if they appreciate the meat story.

Larry Borchert: Thank you, Bob, for a very good overview of the History of Meat and Animal Agriculture in the United States.

I'm sure that because of the great expanse of time that has been covered in this morning's presentation, all the way from prehistory up to the present time, many of you have developed and raised questions on some of the spaaker's topics. At this time, I'd like to have the speakers come forward and take a seat. Are there any questions for the speakers this morning?

A. E. Reynolds, Michigan State: Yes, have you ever eaten pemmican made with bone marrow as opposed to the regular meat pemmican?

E. F. Binkerd: I'm really not that old. No, I haven't. I have lots of regrets during my life, things that I wish I could do over again. One of them occurred one of the many times we moved in Chicago: back in the early '50's, I cleaned out a basement locker and threw out all the cans of pemmican that I had carefully squirreled away. They just don't exist anymore. I have not eaten much pemmican. I had eaten some of that at the time, and the only other time is the sample that I have with me. I can guarantee you it does not have bone marrow in it.

Al Pearson, Michigan State: I'd like to ask Don Kinsman: I've heard the story told that if you ask the merchants that "Uncle Sam" comes from one of the early battles in New England. I was wondering if you'd come across that in any of your research.

Don Kinsman: Al, if it comes from New England, it must be authentic. Supposedly, Samuel Wilson of East Green Bush, New York, supplied the U.S. Troops in the War of 1812 with meat packed in barrels. He was properly known as Uncle Sam to his friends and neighbors, so they put on U.S., and that carried. Incidentally, the dollar sign was the "S" overlaid on the "U", and if you believe that, I guess you'll believe most anything. They tell us that Uncle Sam Wilson, anyway, was supposedly from where the term "Uncle Sam" was derived.

Gene Allen, Minnesota: Don, I believe this is for you, and the other people might have a comment on it. My impression from the comments you made, as well as the things that I've read, is that pork was kind of singled out as the product that was more frequently cured than beef and lamb. I am wondering if this was true in the early history of this country.

Don Kinsman: I think that statement is correct, Gene, at least the formulas, recipes and all that I've found was principally pork, although some mutton and some beef was also cured. Whether the stability of the product meant that perhaps beef and mutton were kept a little longer under natural conditions and the pork did not, then undoubtedly pork lent itself to immediate curing. Whereas, perhaps the beef parts and lamb and veal were consumed more readily while fresh. That would be the only background I have to document that.

John Sink, Pennsylvania State: Following along that question, Don, you indicated that a lot of our practices are results of ethnic or cultural heritages from the "Old Country." Can you reflect any special tracing back to the "Old Country?" Was pork the item that was most often cured there?

Don Kinsman: I think that's a good follow-up, John. Undoubtedly, this was more traditional than as a European carryover, especially among those people who were more oriented to pork products. I think that's a tie-in.

Ray Field, Wyoming: This question is for Bink. You've outlined a demise of pemmican very well, I think, over the period of history. Yet, during the same recent years, at least, we've seen an increase in jerky manufacture and jerky consumption, which many people think isn't particularly palatable. Would you compare the two and perhaps comment on the possibility of pemmican rising again?

E. F. Binkerd: Well, I doubt very much if it is popularly sold in the State of Utah, because it normally is eaten with beer or some other alcoholic beverage. There is a chief difference, Ray, that one has a lot of fat in it and that's pemmican, and certainly the jerky doesn't.

Now, will pemmican rise again? I kind of doubt it. When Ole Kolari made this product that I have with me, I went back and said, "Oh, that doesn't taste too bad at all. Maybe it has a new product potential." I said, "What does it cost?" He says, "Oh, between eight and ten dollars a pound." That probably is the best answer I could give you, Ray.

Larry L. Borchert: Any additional questions? I have one, Bink. In my introduction, I mentioned the first written record of meat processing in the United States and they talked about venison blood and marrow. Would that be classified as pemmican in your definition, or would it be a blood sausage?

E. F. Binkerd: I don't know, Larry. I have not seen any indication that they use blood in pemmican.

Larry Borchert: Well, if there are no further questions, I'd again like to take this opportunity to thank the speakers for their excellent presentations. I hope you all appreciate the amount of background work that each of these speakers has put into these papers. As I mentioned before, most of them are not historians and it's all been work, a labor of love, outside of their regular occupations, putting together some excellent presentations for our morning session. Thank you very much.

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Bill Stringer: Our next speaker is David Stroud, who is President of the National Live Stock and Meat Board and has a long history of being very closely associated with our association. We, as American Meat Science Association, really appreciate very much the moral support, and financial support, and all the other things we get from the National Live Stock and Meat Board. Dave.