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INTRODUCTION

The purpose of this paper is to summarize important historical developments in agriculture in what is now the United States, from the earliest colonial times to the present. In terms of the length of time of human history on this world, this period is so short as to seem almost insignificant. However, in terms of progress, the situation is the opposite–more has been accomplished in agriculture in this fraction of a millenium than in all previous history combined.

Agriculture, under immigrant settlers in what is now the United States, had its beginnings in the seventeenth century. The thirteen original colonies were settled predominantly by the English, but also by the Dutch, Germans, Swedes, Irish and Welsh, and by African slaves. Meanwhile, the Spanish and French, and to a lesser extent the English, also established colonies in the southeastern part of the United States, and the Spanish also in the southwest. All of these settlements had agricultural involvements.

Although not all, most of the major crops and livestock species being produced in the United States today were being produced in colonial times. An exception was soybeans. Alfalfa, though not grown on a farm scale, was being tried. Some crops like indigo, common in colonial times, have since disappeared– in fact after invention of the cotton gin, cotton completely replaced indigo. Most power was provided by man and draft animals. At that time, the simple tillage tools were made of wood, but, increasingly, iron was being utilized. Harvesting was done by hand, with a sickle or scythe. Crops were threshed with the flail, hand winnowing, and sieving.

Farmers provided a much higher proportion of farming requirements than they do today. Except for the sun, there was little source of external energy. Energy consisted principally of human labor and animal power, the latter being sustained with feeds grown on the farm. Primarily by means of farm manures, soil fertility was added. Chemical fertilizers and pesticides were almost unknown. Farmers produced, processed, and stored most of the vegetables, fruits, flour and meal, meat, and dairy products that they needed for domestic consumption. They fished and hunted game, depended heavily on furs, hides, wool, and cotton for domestic needs, spun yarn to make clothing, constructed buildings and fences from local stone or wood, and used wood for heating and cooking.

Agricultural exports were vital to the well-being of the colonial farmer. Increasing distances from seaports and cities, combined with poor transportation facilities, often resulted in low profits and limited the choices of what the farmer could produce. Land speculation was common, and farmers struggled hard to gain title to the land they farmed. By the close of the Revolutionary War, most slaves in the northern colonies had been freed.

Now that we have very briefly examined agriculture as it existed in colonial times, let us review the accomplishments in the United States that have taken place in the past 200 years. The labor force in farming has gone from 90% of the total in 1776, to 20% in 1935, to 4% at the present time. In 1870, one farm worker produced enough products for five people–today he produces enough for 55. The maximum number of farms in the U.S. was reached in 1935, when there were 6.8 million–today there are 2.8 million farms. Yet, total farm output has nearly tripled since the beginning of the twentieth century, doubled since the thirties, increased by 50% since 1950, and by 25% since 1960.

On a per-acre basis, wheat yields have tripled during these 200 years, with one-half of the increase having occurred since 1950. Cotton yields have quadrupled, with one-half of the total increase coming since 1950. Corn yields have also quadrupled, with almost 80% of the increase having occurred since 1950.

How has all of this progress been possible? The answer is complex–it has resulted from a combination and interaction of a fairly large number of factors. We shall attempt to identify the most important of these and elaborate briefly on each of them. They will be considered from the following standpoints: mechanical, technological, and socio/economic.

IMPORTANT MECHANICAL IMPROVEMENTS

Well into the eighteenth century, agriculture remained rather primitive–it was not too different from that practiced in biblical times. To the end of the colonial period, farmers possessed only simple tools and implements, made principally of wood, supplemented with a minimum of iron. Important

agricultural tools were the hoe, sickle, and flail. Animal power was used in plowing, transporting, and, to a lesser extent, in threshing.

1. Plowing

(a) The cast iron plow was patented in 1793. By 1840 it was replacing the wooden plow.

(b) John Deere developed the moldboard plow in 1837. It was about this time that improved technology in the production of steel made it economically available for equipment manufacture.

(c) Maintaining a maximum of crop residues on the surface to conserve soil moisture and to reduce soil and water erosion has been on the increase, starting with the 1930's. Special types of equipment—for example, sweeps—have been developed for subsurface tillage. There have even been modifications made in the moldboard plow to leave more trash on the surface.

2. Harrowing

Prior to 1820, harrows were of two basic types: (1) brush drag—made from the crotches of untrimmed trees; and (2) straight tooth—the wooden teeth were replaced with steel teeth in the 1830's. The springtooth harrow was patented in 1869, and the disc harrow came into use in the 1870's.

3. Planting

In colonial times, planting of small grains, rice, and forage crops was done by scattering seeds by hand and covering with hand rakes. Later, broadcast seeders were used—first operated by hand and later supplanted by endgate and horse-drawn broadcast seeders. These persisted well into the present century. In fact, seeding by plane, being used increasingly today, is a form of broadcast seeding.

Grain drills were first used in England in the eighteenth century. In the U.S., the manufacture of drills began in 1841. By the 1890's many farmers with good land (but not all) were using drills. More recently, there have been developed specialized drills for planting small-seeded grasses and legumes. Drills are now also equipped with fertilizer attachments.

Large-seeded crops like corn and cotton were also hand planted earlier, but in a somewhat different manner. Openings were made in the soil, one or a few seeds were dropped in each hole, and then they were covered with soil. To a very limited extent, the method has persisted and is still used today by home gardeners and in some experimental plantings. In the 1850's, hollow canes were used to place the corn seed in the ground. A horse-drawn corn planter was patented by George W. Brown in 1853. In about 1865, a tripping mechanism appeared that ran on wires with knots placed across the field so that corn could be "check" planted. Thus, the corn could be cultivated, first, in one direction and, then, crosswise. Check planting of corn was practiced well into the present century. Cotton planters were developed about the same time as corn planters.

The hard-ground lister, especially useful in drier areas, made its appearance about 1880.

Today's corn planter is a highly engineered, precision machine, planting up to twelve rows at one time. There are attachments for applying fertilizers, herbicides, and insecticides.

4. Cultivating

Historically, weed control in crops has been effected by hand pulling, by hoeing, and by cutting. Specialized cultivators were first used about 1820, supplanting plows which had previously been used to some extent to cultivate crops. The expanding cultivator appeared in 1830. The sulky (riding) cultivator came into use in the 1840's, but the writer, from first-hand experience, can attest to the fact that the single-row, walking cultivator was still used in the 1920's. It persisted because it enabled the operator to do a better job and because it was less burdensome for the horses.

The tendency in recent years has been to cultivate with sweeps—to avoid root damage to crops, to preserve soil moisture, and to retain crop residues on the surface in order to reduce erosion. With the availability of ever-more efficient herbicides, the need for cultivation lessens. Minimum tillage is generally accepted, and no tillage is becoming a reality.

5. Harvesting small grain

Harvesting of small grain has an interesting history. We have already made reference to the system followed in colonial times. The major improvements since that time have been as follows:

(a) The cradle and the fanning mill made their appearance between 1776 and 1797.

(b) McCormick invented the grain reaper in 1809 but did not patent it until 1834—he did not apply for a patent until he had a serviceable machine.

(c) In 1836 the Pitts brothers patented a machine that combined threshing and winnowing. It was powered by horses and required three men for operation.

(d) The development of the horse-drawn, self-raking, binding reaper and horse-powered threshing machines took place largely during the 1840's and 1850's. J.I. Case developed the thresher in 1844.

(e) 1880 witnessed the first combines, which were horse-drawn. However, the binder and stationary thresher constituted the principal small grain harvesting machines until about 1945. More recently, we have seen the development of the self-propelled combine, used for harvesting soybeans and corn as well as for small grains.

6. Harvesting of corn

Corn was harvested by hand until well into the present century. Hand shelling gave way to very simple mechanical shellers which made their appearance in the eighteenth century. In time, the shellers were enlarged, powered by horses, and, finally, by engines. Custom shelling became common by the 1860's.

Placing entire corn plants in shocks in the field was practiced in this country for three centuries.

Some mechanical corn pickers were being marketed by 1909. The picker-sheller made its appearance in the 1930's. Artificial drying was essential for general adoption of the picker-sheller. The portable corn drier was starting to be used about 1949. Today, most corn harvested for grain is picker-shelled. Husking by hand has become virtually a lost art. The hand cornhusking contest and the husking bee, so popular in yesteryear, are gone forever.

7. Forage harvesting

The horse-drawn rake began to be used in New York in 1812. Cyrus Wheeler patented the mower in 1856. Hay loaders appeared in 1866. Today, there is equipment available which obviates the use of any hand labor in stacking and feeding loose hay. The "perpetual press" hay baler made its appearance in 1872. The field pickup baler was in use by 1932. More recent improvements have been a machine making a small bale and throwing it into a wagon pulled behind the baler, and still more recently, machines making jumbo bales (up to 1500 lbs. in size) which are handled entirely by machines.

The first cutter-loaders used for making silage appeared in 1876. The first field forage chopper appeared in 1915 but did not become widely used until after 1928. By 1960, 90% of the silage was harvested with field choppers.

8. Harvesting cotton

A very significant step in the history of American agriculture was the discovery of the cotton gin by Eli Whitney in 1793. This machine made economically possible the separation of seed from lint of upland cotton, a task that had previously been done very tediously by hand.

The second revolutionary step in cotton production was the beginning of manufacture of the spindle cotton picker in 1942 on a commercial scale by the International Harvester Co. By 1970, cotton harvesting was almost completely mechanized.

9. The evolution of power

Human beings supplied most of the farm power in early colonial times. From human power, we shifted, in part, to oxen, to horses, to the steam engine, and, finally, to the internal combustion engine and electricity, the latter being generated in a variety of ways.

The change from oxen to horses represented progress. An ox moves very slowly; probably the only draft animal which is still slower is the water buffalo.

The next step in progress was the coming of the steam engine. Steam engines were used to process sugarcane in Louisiana as early as 1833. The first steam engines used to power threshing machines were produced in the United States as early as 1849. Five thousand steam tractors were being manufacturered annually in this country by 1900. They were somewhat too heavy for plowing. They were used to a limited extent for pulling combines prior to 1912, but their use for this purpose was limited because of the danger of starting fires from sparks.

Probably no other single development has had as much effect on American agriculture as the discovery in 1876 of the internal-combustion engine by the German, Nicholas Otto. In this our bicentennial year, we should pay tribute to him on the 100th year of that discovery. Much of the advancement in farm machinery has been made possible by the coming of the internal combustion engine.

By the 1890's stationary, internal-combustion engines were being manufactured in the U.S. These found important uses on farms, as they still do today. Then in 1892, John Froelich of Iowa, mounted a sta-

tionary, gasoline engine on a wooden and steel frame–i.e., he built the first internal-combustion tractor. This opened up tractor manufacturing on an industrial scale. Improvements after World War I, such as adding power take-off and putting the tractors on rubber–which contributes dramatically to the power, efficiency, and ease and flexibility of operation–have added immesurably to the value of the tractor in providing power for the farm.

In summary, we can say that the internal-combustion tractor has all but replaced the steam engine, horses, and mules for farm power purposes. It, along with electricity, has also replaced most human energy in farming. Professor William Splinter of the University of Nebraska has stated that in a ten-hour day one man working by hand contributes 2.8 cents worth of energy as measured by the amount of equivalent energy provided by diesel fuel used in a tractor.

10. Livestock and poultry

Livestock production has also been mechanized to a considerable extent. Whereas in colonial times most of the processing of livestock and livestock products was done on the farm, most of it is now done commercially. Refrigeration, improved processing methods such as freezing, improved transportation, and other progress in technology have made this possible.

Dairying has successively seen the coming of the butter churn, the cream separator, and the milking machine (1905). Significant, too, was Babcock's announcement in 1890 of his test for butterfat in milk and cream. We have witnessed the shift from farmers selling fluid milk, cream, cheese, and butter ready for consumption, to bulk handling of milk–the milk going by pipeline from the milking machine to a storage tank, to the tank truck, and, finally, to the central processing plant. In order to have it pasteurized, the dairy farmer of today typically buys milk for home consumption. The cream separator, the home butter churn, and even the milk can have largely gone the way of the horse and buggy.

Chicken production, both broilers and eggs, has become almost completely confined, mechanized, and automated. It is a factory operation. Increasingly, hog production is moving in the same direction. Except to some extent in ranching, horses and mules have almost ceased to be a factor in production. Beef cow and calf operations still require a good deal of labor. Fattening of cattle has been mechanized to a considerable extent, with respect both to feeding and waste removal. In the larger operations, there is also a good deal of automation. The situation with respect to sheep is similar to that for beef cattle, but we are less aware of this because of the continuously sharp decrease in the number of sheep in the United States.

Today, except for vertically integrated operations, the farmer markets live animals, directly or indirectly, to the processing plant. Virtually no home slaughtering and processing remain. The smoke house has disappeared from the farm.

TECHNOLOGICAL PROGRESS

For the purpose of this paper, a distinction has been made between mechanization (and all of the improvements in machines and equipment that are implied) and technological progress. The latter has to do principally with management and with the biology of the crop or livestock species and/or with biological enemies, such as weeds, diseases, insect pests and parasites.

In this country we are fortunate to have started with comparatively good crop varieties (obtained chiefly from Europe and the American Indians) and with good breeds of livestock. Witness such crop varieties as Turkey wheat and Lincoln bromegrass, and livestock breeds such as Holstein-Friesan cattle. The gene base was a good one on which to build. The virgin soils were largely non-eroded and generally high in inherent fertility. Pest problems were far less serious than they became later, following years of farming and increased intensification. My father grew 40 bu. per acre of wheat 65 years ago, a yield which we find it difficult to average on the same farm today. Also in earlier times, farmers produced fruit of reasonably good quality in their farm orchards, with no attention given to the crop except for harvesting. Trying to grow full-season apples in a backyard in Lincoln today without a minimum of about nine sprays is likely to be an exercise in futility. In general, we do have much higher crop and livestock yields today, but we would have had to apply a considerable quantity of improved technology over the years just to stay even.

Technological improvements have been made principally through genetics (breeding), fertilizers, pest control, better livestock nutrition, irrigation and drainage, and improved farm practice and management.

1. Genetics

Improvement in plant varieties and animal breeds received a great impetus with the discovery of the laws of heredity by Gregor Mendel in 1865. It was not until we understood the principles of genetics that we could do really effective plant and animal breeding. The discovery of the phenomenon of hybrid vigor in corn by Shull and East early in this century, followed by the discovery of the double cross hybrid by East and Jones, and other scientific knowledge, have led to the development of commercially superior, hybrid corn. Hybrid

seed corn began to be used in earnest by farmers in the 1930's. Today, open-pollinated corn is almost unknown in the United States.

The hybrid principle of corn production has spread to a number of other crops. Concomitantly, plant breeders have continued to use other improvement methods and with very marked success. The result is that for most crops today, we are using planting stocks of hybrids or improved varieties. Not only is yield enhanced significantly thereby, but there are improvements in quality, and resistance to pests and to stress. More uniform maturity and other desirable growth characteristics have contributed materially to mechanical harvesting. All of this is much to the benefit of the consumer ("Hard Tomatoes and Hard Times" notwithstanding).

Livestockmen were slower in adopting a scientific basis for animal breeding than were crop specialists. But today, they are making every possible application of genetic knowledge. This is very much in evidence, for example, at the USDA Meat Animal Research Center at Clay Center, the world's largest livestock research facility in terms of total animal units. The utilization of hybrid vigor through cross breeding explains the variegated cattle that are seen there and elsewhere over the state—a phenomenon which not too many years ago would have been considered the mark of a farmer too backward to utilize modern breeds. Numerous so-called exotic cattle breeds have been introduced into the crossing programs, especially in the past decade, in order to broaden the gene base. The hybrid principle is also being extensively utilized in poultry and swine improvement.

2. Fertilizers

The value of fertilizers was recognized in colonial times. In those early days fertilizers, like most other inputs, were largely farm produced. Animal wastes were the principal means of improving soil fertility. Legumes were used to add nitrogen to the soil. Lime and guano were among the early commercial additives and fertilizers used. Some buffalo bones were collected, ground, and shipped east for use as fertilizer following the slaughter in the west in the 1870's.

Today, the lion's share of fertility is added to the land through commercial fertilizers. In North America, the consumption of commercial fertilizers in millions of metric tons of plant nutrients went from 11.8 in 1966, to 25 in 1975, and will reach an estimated 35 to 40 by 1980. Of the nitrogen available to crops in the United States, one part comes from animal wastes, two parts from legumes, and nine parts from chemical fertilizers. Truly, the U.S. farmer has a high stake in what happens to the oil reserves in the Middle East.

In the U.S. in 1974, the following percentages of crops grown were fertilized: corn 94%; cotton 79%; soybeans 30%; and wheat 66%.

3. Pest Control

In all likelihood, pests, including weeds, diseases, insects, and parasites, have been a problem throughout history. They have sometimes reached destructive proportions and resulted in famines. This was the case, for example, when the potato crop was virtually destroyed by late potato blight in Ireland in the 1840's.

(a) *Plant and animal diseases.*—Louis Pasteur, the founder of the science of bacteriology, played a role in disease control equivalent to that of Mendel in genetics. From him we learned that we had to control microorganisms which were causal agents in diseases. One of the first recognized plant diseases of serious proportions was black-stem rust. It was first noted in 1660. It became so serious that commercial wheat production was virtually dropped in New England until after the Revolutionary War. Partial control of this disease has since been effected through the destruction of the alternate host, the common barberry, and through development of resistant varieties.

The use of chemicals for plant disease control has been taking place over a considerable period of time. The well-known Bordeaux mixture was developed in 1890. Many other chemicals have been utilized over the years, including the introduction in recent years of systemics. Controlling vectors, destroying alternate hosts and hosts for vectors, management practices, and breeding for resistant or tolerant varieties—all have played an important role in plant disease control.

There have also been many important developments in animal disease control, starting with the latter part of the nineteenth century, and based principally on immunization. For example, Marion Dorset developed the hog cholera vaccine in 1903. A test for bovine tuberculosis, which can spread to human beings through milk, was developed by Koch in 1890. Through a federal program, the United States was virtually free of bovine tuberculosis by 1942. Pasteurization of milk has contributed to human health, especially in preventing undulant fever.

A modern breakthrough in animal disease control came with the use of sulfa drugs beginning in 1935. These were followed rapidly by anti-

biotics, the first of which was penicillin. It had been discovered by Fleming in 1928, re-studied by Florey and Chain ten years later, and the supply was made available on a large scale by the end of World War II.

The antibiotics were found to stimulate animal gains as well as to help control disease and, as a result, have come to be very widely used as feed additives.

Most advances in the use of systemic poisons to control internal parasites have occurred in the period starting with the 1940's. Much progress has been made in the use of metallic arsenates and a host of other poisons.

Control of animal diseases and parasites has closely paralleled human medical developments. Preventative disease control, based on good management, is becoming increasingly important.

(b) *Insects.*—Insects have been a problem for man, animals, and plants since long before the first colonies were established in the U.S. In Exodus (10:15) we read "And they [locusts] covered the whole face of the earth. . . . And there remained not anything that was green . . . in all Egypt."

Insecticides have been used over a long period of time, but the problem has been one of selectivity—that which was toxic to insects was often also toxic to plants and/or animals. The real breakthrough came with DDT, the first synthetic compound used as an insecticide. Patented in Switzerland in 1939, it became available in the U.S. in 1943. A series of other chlorinated hydrocarbons followed. Then came other synthetic compounds, viz., the organic phosphates like malathion, and carbamates like sevin.

Problems arose with respect to the development of insect resistance and with residues in plants and animals which were toxic to man. Some of the compounds were found to have carcinogenic properties. Over recent years, the Pure Food and Drug Administration has been ordering removal of some of the insecticides previously offered for sale in this country.

The use of biological controls is very appealing from an economic, health-related, and environmental standpoint. Some advances have been made, especially with use of resistant varieties. Autocidal control has been successful with the screwworm, through the use of releasing large numbers of males sterilized by treatment with radioactive materials. Diseases, parasites, and predators of insects have been used with some success. Effective sex attractants have been synthesized.

Today, chief control is through use of insecticides. All the unfavorable publicity notwithstanding, the world food supply today would be critically short without the synthetic compounds. We are using an integrated system of control, but leaning heavily toward the use of insecticides.

(c) *Weed Control.*—Up until World War II, about the only herbicides available were inorganics such as sodium chlorate. They were used only to a limited extent because of cost and residual effect. Then came significant breakthroughs with the synthesis of 2,4-D by Pokorny in 1941, the suggestion by Kraus in the same year that hormones might be good weed killers, and in June, 1944 the recommendation by Mitchell and Hamner of 2,4-D as a herbicide. The use of 2,4-D became widespread. Even today it is still the number one herbicide in terms of volume used.

The middle-to-later 1940's was characterized by the development of growth-regulating hormones for herbicide use; the mid-50's, by compounds which blocked photosynthesis, such as the triazines and the substituted ureas, like di-uron and the uraciles; the early 60's, by compounds which blocked cell division, such as lasso and treflan; and the early 70's, by the use of a simple amino acid like roundup that blocks amino acid production.

The use of herbicides is very widespread. For example, in the United States in 1964, we grew 30 million acres of soybeans, of which 10% were treated with herbicides; in 1974, we grew 58 million acres, of which 90% were treated with herbicides.

Presently, farmers commonly use a combination of herbicides and cultivation for weed control. However, the use of herbicides is increasing, and the amount of cultivation is decreasing. Fairly extensive acreages of row crops now receive no cultivation whatsoever.

4. Better livestock nutrition

The value of legumes to provide proteins in animal rations has been recognized for a long time, along with the need for carbohydrate concentrates. The discovery of vitamins by Funk in 1911 and vitamins A and B by McCollum in 1915 opened the field of using vitamins in

in livestock feeds.

Antibiotics stimulate animal growth and are used as feed additives. Early in the 1950's manufacturers began the addition of synthetic amino acids to feeds; also about this time was seen the addition of antioxidants to preserve fat-soluble vitamins and fats. Urea began to be substituted for a part of the protein in feed rations. The synthetic hormone, diethylstilbestrol, was found by Wise Burroughs about 1951 to increase gains in livestock. It became very popular among livestock producers, but its use has been curtailed more recently by rulings of the Pure Food and Drug Administration. The February 6, 1976, issue of *Science* (p. 453) discusses three possible substitutes.

In general, there has been much advancement in livestock nutrition, including the use of improved forages. In no other type of livestock has the efficiency of feed equalled that of poultry.

5. Irrigation and drainage

Irrigation and drainage have been practiced for numerous centuries. Drainage is done to improve or reclaim wet lands for farming and must also accompany irrigation for good water management.

There was a large increase in the use of irrigation following World War II. The development of bulldozers and earth-moving equipment greatly simplified and lowered the cost of clearing and leveling land. The substitution of gated, aluminum pipes for canals and ditches to convey water constituted a big improvement. Although dams on streams are still an important source of irrigation water, the use of wells to tap underground water has been growing rapidly in both actual and relative importance. Sprinklers, chiefly center pivot systems, are becoming rather commonplace. They obviate the necessity of most land leveling, can be used on rolling land, sandy land, and they save labor. In Nebraska, especially, land being placed under irrigation is increasing very rapidly.

6. Improved farm practice and management

Farm practice has improved markedly since colonial times. Mechanization, improved technology, and increasing the size of operations have necessitated ever-higher levels of management. Farmers, with the help of research findings and education, have learned how to better handle livestock, manage crop production, conserve soil and water, irrigate, fertilize, apply pesticides, summer fallow, harvest and store crops, and market farm products. Good farming is both a science and an art and requires business acumen. Farming is extremely complex, and success does not come easily—a fact sometimes not fully appreciated by non-agriculturists. Few other professions require the breadth of mechanical capability, technical knowledge, and business-management judgment that are necessary in farming.

SOCIO-ECONOMIC DEVELOPMENTS

The socio/economic changes that take place off the farm have a great influence on the welfare of the farmer. To a considerable degree, the well-being of the farmer moves upwards as socio/economic advances are made in the nation as a whole. True, there may be a lag of farm income as contrasted to non-farm income, but, in general, the correlation between the two is fairly high. Without attempting to answer the conundrum of whether in the U.S. industry has made such fantastic advances because of a highly successful agriculture or vice versa, we can safely say that both are the envy of much of the rest of the world.

Agriculture in a developing country can reach a level such as that in the U.S. only when adequate economic, industrial, and educational developments also takes place. We often see in developing countries inadequacies in the following: advancement with respect to port facilities, storage, transportation, marketing, quality control and grading standards, purchased production inputs (e.g., parts for repairing tractors), farm credit, skilled workers to provide the farmer with necessary inputs and to handle the products he sells to the point that they reach the consumer in good condition, educational and research facilities, and others. Too often the worker on the farm and in agri-business is illiterate. Even if one placed our best Nebraska farmers into an underdeveloped country on good land with adequate equipment and with plenty of irrigation water, most, if not all, would fail without the above developments also taking place.

Now, let us examine some of the socio/economic developments in the U.S. which have helped make our agriculture superb.

1. Education

Perhaps in No. 1 place is education. In the U.S., we have always placed much emphasis on children going to school. Not only have we virtually eliminated illiteracy, but there has been a continuous increase in the average level of education, both on and off the farm.

2. Land—free or, at least, very cheap land

In spite of the fact that most of the early settlers in the Jamestown Colony were indentured servants, it soon became apparent there and elsewhere that individual land ownership constituted the basis for maximum farm production. So, the policy of making land available to settlers without cost or at a low cost evolved, European law and economic theory notwithstanding.

Following colonial times, there have been numerous laws passed by Congress to dispose of federal lands, not only to individuals, but also to the states, to railroads, and to land-grant colleges. It was easy to give land away because of the westward-moving frontier over so much of our history—especially since we largely disregarded the interests of the previous owners and long-time occupants. Here in Nebraska we are especially familiar with the Homestead Act of 1862 as a means of securing free land.

Over much of our history, free or cheap land—combined with the fact that one would start farming with simple, inexpensive equipment—enabled the young man with little or no capital to enter the profession. Rather suddenly, and largely since World War II, all of this has changed. The cost of land, equipment, and livestock necessary to start a farming unit with a reasonable chance of success is now in excess of two or three hundred thousand dollars. It is no longer easy to enter farming without extensive capital.

3. Processing of food and fiber

Moving the processing of farm products off the farm was necessary in order to develop the technology, mechanization, automation, and general industrialization of the processes which have taken place. We dry, smoke, can, refrigerate, freeze, dry-freeze, season, fortify, pasteurize, irradiate, roast, ferment, culture, bleach, and/or purify raw agricultural products in order to provide the consumer with maximum quality at a reasonable price. Can you imagine where we would be in the food world today if processing had remained on the farm as it was in colonial times?

4. Marketing

To move farm products from the farmer to the consumer in the United States and into export channels has, of necessity, resulted in the establishment of a complex market system. This included the establishment of commodity exchanges such as the New Orleans' cotton exchange established prior to 1837 and the Chicago Board of Trade in 1848, the New York Produce Exchange in 1862, and many more since. Livestock marketing was gradually centralized and, more recently, again decentralized to a considerable extent.

There are numerous regulations to protect the producer and buyers, including consumers. To a reasonable extent, the market system operates on a free-economy basis. It is far from perfect but has served the farmer fairly well. The consumer, too, has a fair deal when he goes to his supermarket to purchase his groceries.

5. Transportation

The improvements in transportation have been great, indeed. In ocean transport, we have gone from wooden sailing vessels to iron and, ultimately, to steel ships powered by engines. There has been continuous improvement in internal transport systems, including river navigation; the building of canals; constantly improved roads; and the coming of the automobile and truck; steamboats (Fulton's invention of 1807); boats powered by internal-combustion engines; railroads, including, more recently, rail shipping combined with truck shipments through the "piggyback" arrangement; and, finally, air transport. Refrigeration has played a major role in transporting perishable foods. Without good transportation, it would be impossible to carry on the heavy exports of agriculture products which are essential to the farmer and, equally important, necessary for the balance of payments of our country.

6. Federal and state support for agriculture

There have been a series of laws passed and appropriations made by the federal government and by the fifty states to help farmers and, in turn, consumers. These have proven to be most valuable. Important among these have been the following:

(1) The establishment of the U.S. Department of Agriculture in 1861—a federal agency providing agricultural research, educational, regulatory, and service functions of inestimable value to farmers and consumers alike.

(2) The Morrill Act of 1862, providing support for land-grant universities, including a great impetus for the establishment and support of agricultural colleges.

(3) The passage of the Hatch Act in 1887 and legislative action by the fifty states which have resulted in establishment of, and in continuously increased support for, state agricultural experiment stations.

(4) Passage of the Smith-Lever Act in 1914, providing for the establishment and continuing growth of the co-operative extension services in the fifty states and in the federal government.

(5) The Smith-Hughes Act of 1917, providing federal support for teaching agriculture in high schools.

(6) The Agricultural Adjustment Act of 1933 and its successors (today, the Agricultural Stabilization and Conservation Service) which, through the Commodity Credit Corporation, provided support prices through non-recourse loans for farm products; assisted in the adjustment of crop acreages; and provided incentives through the Siol Bank and

other means to conserve the soil. This much-maligned agency has served American agriculture very well. It helped preserve and advance farming, especially during those years when surpluses constituted a major problem. The wisdom of supporting agriculture during those years should be apparent to almost everyone today when we need all of the food farmers can produce. It would have been a sad mistake, indeed to have permitted the agricultural plant to deteriorate during the period of surpluses.

(7) The creation by Congress of the Soil Conservation Service in 1935. This agency has contributed and continues today to contribute greatly to the conservation and wise use of our natural resources.

(8) The establishment early in the New Deal days of what is now the Farmers' Home Administration. It has enabled many individuals with inadequate resources to enter and/or remain in farming.

(9) The various federal acts and subsequent amendments which have resulted in the present Agricultural Marketing Service, Agricultural Research Service, Economic Research Service, Statistical Reporting Service, Foreign Agricultural Service, Forest Service, Farmer Co-operative Service, Bureau of Land Management, Bureau of Reclamation, Farm Credit Administration, Rural Electrification Administration, Tennessee Valley Authority, and others.

(10) The ever-increasing financial support by the states for agricultural research, regulatory services and education, through both state agricultural colleges and state departments of agriculture.

7. Farm organizations

There are today four major, general, farm organizations in the United States. The oldest is the Grange, which was begun in 1867. Then followed the Farmers' Union, the Farm Bureau Federation, and, finally, in 1954 the National Farmers' Organization. All attempt to speak for the farmer, but over the years there has been considerable variation in the policies enunciated by these organizations.

Farmer co-operatives had their beginning over 100 years ago. Many sad experiences have since followed. But today farmers utilize co-operatives extensively and successfully. These involve both buying and selling, and they operate on local, regional, and national levels. Examples of very successful co-operatives are the farm credit banks.

8. Miscellaneous

In a paper of this length, it is impossible to cover all aspects of agricultural history. There have been some recent breakthroughs which have not yet been fully developed; for example, EROS for getting unbelievably detailed information on the earth's resources, and microbial nitrogen fixation on grasses.

A few additional organizations and developments are worthy of mention. The private foundations–such as Rockefeller, Ford, Kellogg–and the Farm Foundation have made significant contributions. The private sector has been the backbone of much of our progress. Private industry has built the machines, provided the farmer with most of the purchased inputs, and done much of the processing, transporting, and marketing of food and fiber. Increasingly, private industry has entered into research, education, and service to the farmer. Today, for example, the private sector devotes far greater resources to developing improved corn hybrids than do the USDA and state experiment stations combined. We have a good, stable government which always has and still does today provide an excellent environment for agricultural progress.

And, finally, we have good people doing the farming. Like our colonial forefathers, they have a high respect for integrity and for hard work. They are educated, intelligent, resourceful, and ambitious. They constitute an example of excellence in our economy. We can take just pride in our American agriculture wherever we travel in the world.

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