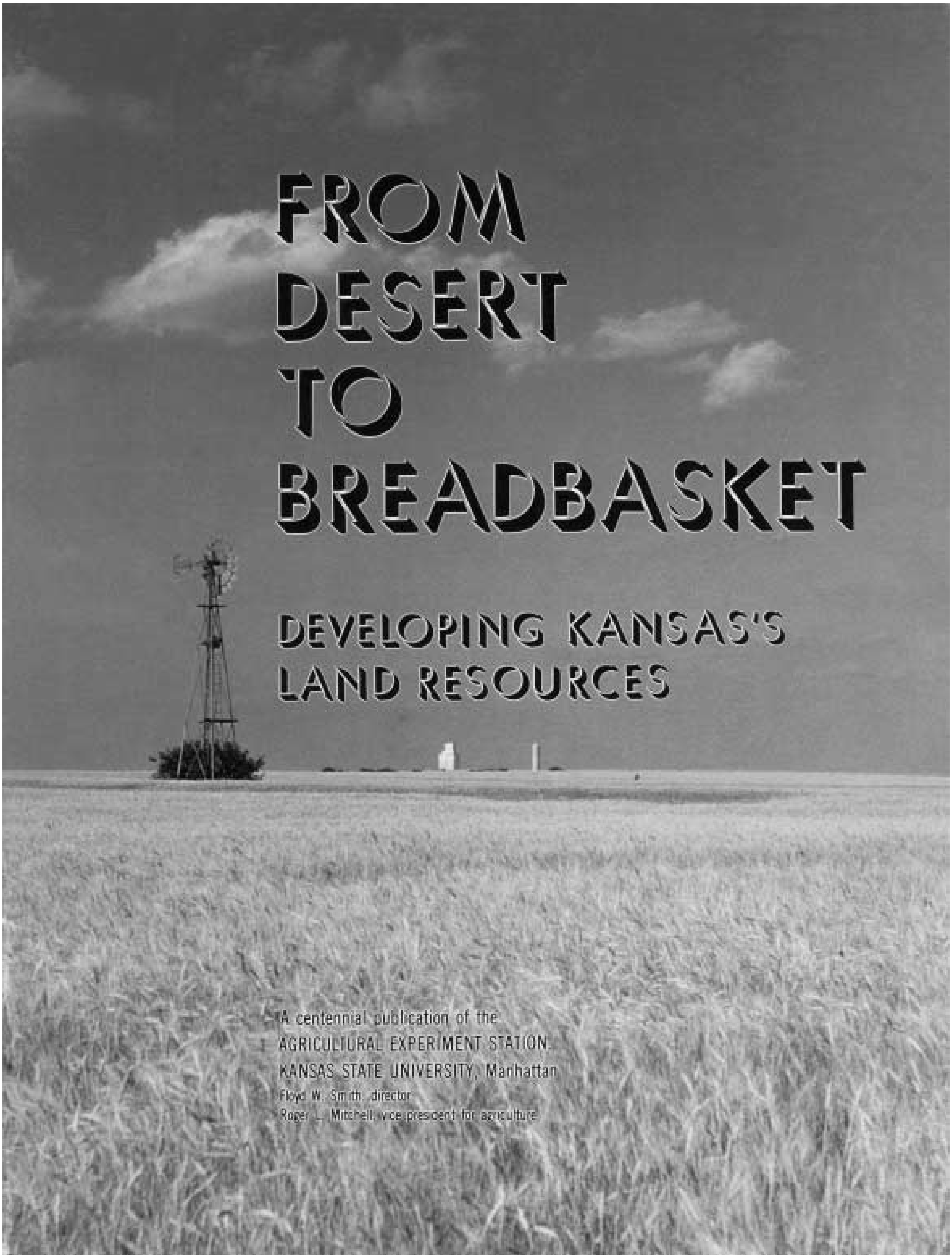

FROM DESERT TO BREADBASKET

DEVELOPING KANSAS'S LAND RESOURCES

A centennial publication of the
AGRICULTURAL EXPERIMENT STATION
KANSAS STATE UNIVERSITY, Manhattan
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A hundred years ago, about a hundred years after the American Revolution, a revolution of a different type was taking place on the Kansas plains. The American bison has all but disappeared, Turkey red wheat was making its debut on Kansas soil, and settlers were determined to disprove the concept of the plains as a desertlike grassland "unfit for human habitation." Gradually they did, coping with an unfamiliar environment by developing a new type of agriculture and eventually transforming the Kansas prairies into "the breadbasket of the world."

Land, fertile land, undeniably was the key resource in that transformation, but developing an agriculture suitable to a subhumid environment, where rainfall is erratic, the wind seems to blow incessantly, and trees were a luxury, has been no mean feat, even within a century. Trial and error, of course, had roles in the agricultural revolution, but had there been no systematic agricultural research and experimentation, the plains of Kansas today quite likely would be a poverty-stricken area -- reminiscent of the dust-bowl conditions that threatened our economy in the 1930s -- instead of a pleasing layout of well-kept farms and pastures and prosperous town, which together now serve not only Kansas but also many other parts of the world.

The value of agricultural research to Kansas's well-being was formally acknowledged by the Kansas legislature March 4, 1887, when it accepted the terms of the Hatch Act two days after it was signed into law by President Cleveland. Kansas thus became the first state to make that move, and the next year the Kansas Agricultural Experiment Station was organized at Kansas State Agricultural College, Manhattan. The creation of the experiment station made it possible for agricultural studies, already a major commitment of Kansas State Agricultural College (now Kansas State University), established in 1863, to be expanded and intensified. Though many Kansans today may tend to take the activities and services of the Experiment Station for granted, most if asked undoubtedly will rank it as the major contributor toward keeping Kansas agriculture a viable part of the Kansas economy.

But how many Kansas are really aware of the extent of the influence of Kansas agriculture, and indirectly if not directly of agricultural research, on the lives of people, nationwide and worldwide? It is significant, for example, that today Kansas ranks third among the states in foodstuffs (including animal feeds) exported. Currently, when world food supply is in jeopardy, Kansas farms are exporting a large percentage of the grains they produce, and their future is inextricably linked with the export market. Research is now being focused not only on quantity but also on quality of grains produced. Undoubtedly the plains of Kansas will become ever more important as a source of food with increased nutritive value for a hungry world.

But to understand and appreciate the experimentation process, to know how research and use of land complement each other, to become conscious of the influence of agricultural pursuits on all our lives -- whether we live on a Kansas farm or work in the tallest office building in New York City -- we should first have some understanding of the land itself, of its origins and of prehistoric as well as historic events that have dictated its use and development.

So let us first look at the Kansas scene from the beginning.

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To waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity, which we ought by right to hand down to them amplified and developed.

--Theodore Roosevelt, *Message to Congress*, Dec. 3, 1907

For as long as man has been privileged to observe it and live on it, the surface of Kansas has been basically an inclined plane. It rises from east to west at 10 to 15 feet to the mile, with elevations below 800 feet above sea level in places in eastern Kansas and exceeding 4,000 feet at the Kansas-Colorado border. Except for the extreme southeastern corner, it lies wholly within the Interior Plains of North America. Within its 82,276 square miles, however, this block of plains called Kansas displays some striking contrasts in topographic features, climate, native vegetation, and natural resources. Annual rainfall ranges from about 40 inches in the extreme eastern part, where landscape contrasts are perhaps most noticeable and where native timber is not everywhere confined to narrow belts along stream courses, to about 15 inches in the far west, where under semi-arid conditions only short grasses seemed to thrive until agricultural research found ways to turn much of it into productive farmland.

The Four Seasons

Overall, Kansas climate is considered to be subhumid. Yet amounts of precipitation received in all parts of the state vary greatly annually and seasonally. As if conceding to agricultural pursuits, however, probably 70 to 80 percent of the annual rainfall comes during the growing season, from April to September, with January generally the driest month and June the wettest. Snowfall probably averages about 18 inches annually and generally covers the ground for no more than a few days at a time. Most comes during December through March, but there are notable exceptions.

Mean annual temperature ranges from about 58 degrees fahrenheit in the southeastern part to about 52 degrees in the northwestern part, but seasonal variation is great, mainly because of the state's mid-continent and mid-latitude location. Temperature extremes of 40 degrees below zero in winter in one locality and of more than 120 degrees in summer in parts of the state have been reported. Eastern Kansas has more freeze free days than does western Kansas. (Growing averages more than 200 days in southeastern Kansas and 150 days in northwestern Kansas.)

Kansas has many sunny days, especially in the western half. Weather changes, however, can be sudden in all parts of the state; several warm, cloudy days, with southerly winds, can be followed by several cool, clear days, with strong westerly or northwesterly winds. Winds are especially persistent in the western part of the state, and evaporation is rapid during warm weather. Destructive storms include winter (and occasionally late-spring) blizzards, tornadoes, and hailstorms. All can do considerable damage to crops and property, even though occurring only locally and lasting but a short time.

At the least, Kansas climate in the age of man is invigorating, which surely contributes to the vitality of the state's plant and animal life.

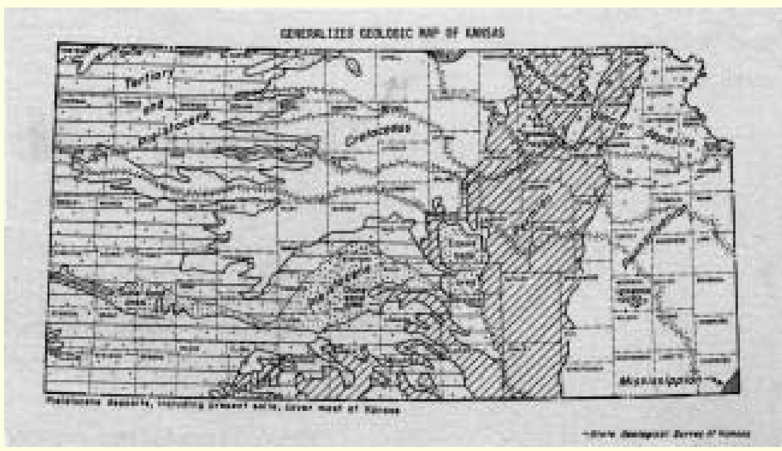
A Bit of Prehistory

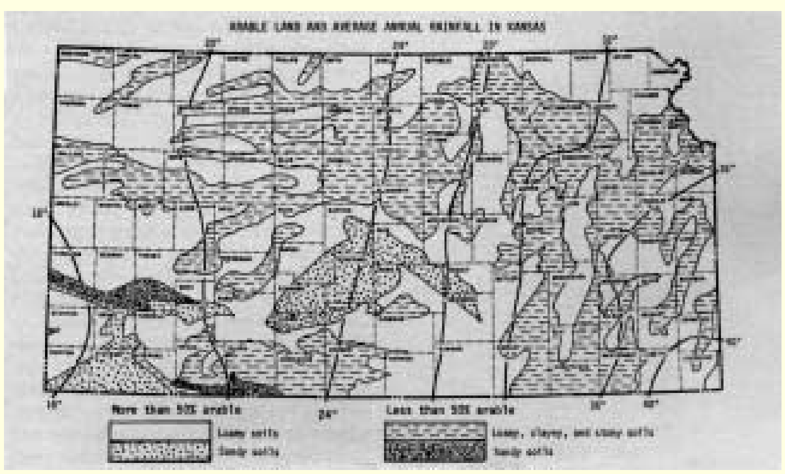
But conditions as we know them did not always prevail, and sometime in the distant future they undoubtedly will be drastically different from now, for the forces of Nature are ever at work attempting to achieve balance in an ever-changing environment. Though we are primarily concerned with the Kansas of "now," we should consider the state's prehistory, the events responsible for its present form and makeup, the better to know how human activities can complement those of Nature in developing the land and its resources for the greatest good of all, with land and man interacting harmoniously.

Geologists who have studied the rocks that are the framework of Kansas tell us that the structure has been taking shape during an almost inconceivably long time -- the earth's age is estimated to be at least 41/2 billion years -- and that 20th century Kansas is the product of both constructive and destructive forces, operating alternately and sometimes concomitantly. There have been many uplifts, depressions, and rearrangements. Many times Kansas or a part of Kansas has been a sea, and during such times sediments have been eroded by water, wind, and other natural agents from nearby land masses and carried by streams into the sea, there to accumulate along with shell remains of marine creatures and various precipitated mineral matter, and eventually to be elevated to dry land for another cycle of erosion. Thus, to simplify greatly the events of the state's geologic past, during various eras of geologic time, sediments were laid down layer upon layer, periodically were worn down or altered, and finally were compacted into the mineral-laden rock strata that have become a storehouse of many resources coveted by modern man.

Under today's Kansas surface are several thousand feet (in places 7,000 feet or more) of sedimentary rocks : predominantly shales and clays, limestones, sandstones and siltstones, and sands and gravels of various thicknesses. Strategically placed in the rocks at various depths are mineral resources -- such as fuels (oil, gas, coal), construction materials (ceramic clays, gypsum, building stone, aggregates) salt, and water -- vital to the state's current economy. The rock strata are so arranged that they tilt slightly downward toward the west, as opposed to the upward slope of the surface to the west. Thus, the eroded edges of the oldest rocks (those deposited first) appear near or at the surface in eastern Kansas, at the low end of the incline; the youngest (those deposited last) in the west, at the high end of the incline. Going a step further in our deductions, these assumptions seem reasonable: In different parts of the state different types of rocks appear near the surface or crop out in the hillslopes and stream banks, and because the rocks are the parent materials of our soils, the state's soil covering reflects the character of the underlying rocks.

Soils, of course, are the foundation of our agriculture, but water also is essential. It is appropriate, therefore, to note that in much of Kansas the water that accumulates in underground reservoirs has been a more dependable source of water supply for human needs than has that in surface reservoirs. That is especially so in western Kansas, where fortunately thick deposits of permeable sands and gravels and silts underlie much of the High Plains (built up by sediments eroded from a former surface of the Rocky Mountains and transported to Kansas by





eastward-flowing streams). The sands and gravels are an ideal reservoir for water. Further, surface conditions and materials in much of western Kansas are conducive to the downward percolation of water that falls as precipitation (rain and snow), thereby providing an avenue for ground-water recharge. As a consequence, despite the area's unpredictable and generally inadequate rainfall, water for domestic, municipal, and agricultural use generally (to date) can be obtained from wells that tap those water-bearing materials. That condition will hold, however, only so long as withdrawal rates do not over the long term exceed recharge rates.

The Landscape Today

Today's Kansas landscape was carved and the "finishing touches" added during Pleistocene time, the last one or two million years. Most of Kansas was truly a plain at the beginning of the period, commonly identified as the Great Ice Age, because within that time four, or five or more, major ice sheets extended south into the United States. Even though only two of the glaciers are known to have reached Kansas, and those two extended only into the northeastern corner, the events of that time profoundly affected the climate and surface of all the state; were responsible for placing most of the deposits that contain large supplies of ground water; and produced almost all of the surface soils -- the state's most valuable single resource. Though many of our soils are residual, having been formed directly from underlying rocks, a number consist of transported materials, and conditions in Pleistocene time were uniquely right for such activity. Streams from the melting (retreating) glaciers spread silts over the land beyond the edges of the glaciers' advance, and "productive" dust storms carried sifted, sorted, porous silts to resting places far beyond the ice sheets. The wind-blown deposits, or loesses, are some of the most fertile and thickest soils in the world. They mantle the High Plains of Kansas, in places reaching a depth of more than 100 feet; cover much of northeastern Kansas, forming bluffs 60 to 100 feet thick along the Missouri River; and occur to some extent in other parts of the state.

During the Ice Age all Kansas streams began flowing eastward or southeastward, making their way to the Mississippi River by way of two major drainage systems: the Arkansas; and the Kansas, a part of tile Missouri River system.

By and large the native vegetation of Kansas is of the prairie type. Tall grasses, predominantly bluestem, along with many forbs, dominate the landscape in the eastern third: especially in the terraced Flint Hills, just east of the 6th principal meridian; and also in parts of the rolling Glaciated Region (northeastern Kansas), the Osage Plains (cuesta topography east of the Flint Hills and south of Kansas River), eastern Great Bend Prairie (central Kansas), and eastern Red Hills-Wellington Area (south-central Kansas). In the Great Plains of central Kansas -- in the Smoky Hills Region (hummocky hills in the eastern part and dissected plateaus toward the west) and the western parts of the Great Bend Prairie and the Red Hills-Wellington Area (the part displaying distinctly mesa-type topography) -- the vegetation is mixed: tall, medium, and short grasses, including especially bluestem and grama. In the far west, on the High Plains, short grasses predominate: buffalograss and grama. In the sand-dune areas south of the Arkansas and Cimarron rivers in central and western Kansas and in a part of northwestern Kansas, sagebrush is found.

Native forest-type vegetation in Kansas essentially is confined to the northeastern corner and along the eastern border (oak and hickory types mostly); the Chautauqua Hills in the southeast (a cross-timber area), and the floodplains adjoining streams (which support scattered trees and shrubs of various types).

The natural vegetation is an expression of ecological conditions on the landscape, and in that sense is a clue to proper land use by human beings. Natural vegetation would slowly return on soils untended by man. Fire periodically would be necessary to keep forest from occupying the area that was once prairie. Observing that the physiographic regions, major divisions of outcropping rocks, areas of soil types, and areas of native vegetation tend to have similar borders further points up the wisdom of taking into account all aspects of environmental "interplay" when developing land resources, whether for agricultural or other uses.

Wildlife that evolved or became adapted to the Kansas environment was uniquely suited to the plains habitat. Animals included the buffalo, or bison, which now exists only in captivity but once proliferated and nearly dominated the life of the plains Indians; the American antelope, or pronghorn, the swiftest runner among wild animals on the American continent; the jackrabbit, the hare of the plains; the prairie dog, really a ground squirrel; and the coyote, called by some the plains outlaw. The animals – most of them misnamed by well-meaning explorers familiar only with the habits of forest-living creatures -- had several characteristics in common: All except the coyote were grass eaters; two, the antelope and jackrabbit, are noted for their speed, which they depend on for safety; all can get along on little water; and all are shy and have great vitality. In addition, a multitude of small animals, game birds, insects, and other creatures set up housekeeping on the plains before man moved in.

We might say that the pristine landscape of Kansas, however forlorn it might have appeared in broad perspective, was an active place by the time the American Indian came to give chase to the buffalo and the Spanish to seek gold. Yet it baffled the early explorers and was misunderstood for several centuries before being transformed into one of the most important agricultural kingdoms in the world.

A pristine landscape in western Kansas.

From Buffalo Range to Farmland

. . . it is almost wholly unfit for cultivation, and of course uninhabitable by a people depending upon agriculture for their subsistence. Although tracts of fertile land considerably extensive are occasionally to be met with, yet the scarcity of wood and water, almost uniformly prevalent, will prove an insuperable obstacle in the way of settling the country. . . . The whole of this region seems peculiarly adapted as a range for buffaloes, wild goats, and other wild game, incalculable multitudes of which find ample pasturage and subsistence upon it.

--Major Stephen H. Long, of the U.S. Topographical Engineers, 1819

When Major Stephen H. Long in 1819 declared the central American plains, which included most of Kansas, to be "uninhabitable," he was not the first to mention the desertlike appearances of the region. Zebulon Pike in 1806 thought that the plains might in time become "as celebrated as the sandy deserts of Africa." William Clark and Captain Meriwether Lewis in 1804 described that part of the Louisiana Purchase as "desert and barren." And in 1541, after he had been to the heart of what 320 years later would become the state of Kansas, the Spanish conquistador Francisco Vasquez Coronado wrote to the King of Spain, "It was the Lord's pleasure that, after having journeyed across these deserts seventy-seven days, I arrived at the province they call Quivira."

Major Long, however, may have been the first to use the term, "Great American Desert," which he wrote across a map prepared as a part of his expedition report. The label caught on and between 1820 and the first decade of Kansas statehood, those words could be found inscribed on maps in the country's school geographies. (The main body of Major Long's party in 1819 skirted Kansas to the north. But Professor Thomas Say, zoologist and naturalist, detoured with a detachment into northeastern Kansas as far west as the mouth of the Big Blue River, near the approximate site of Manhattan, where Kansas State Agricultural College a little more than four decades later would be established as one of the country's first land-grant schools. There Say observed "the orbicular lizard, cacti and plants delighting in a thirsty, muriatiferous soil," which convinced him that he need explore no farther into the plains' desert interior.)

Had Coronado and his men, thought to be the first Europeans to step on Kansas soil, chosen to do so, they might have established an agricultural colony in the area in the mid 16th century. They were f amiliar with similar terrain and climate in parts of Spain, recognized the soil's fertility and owned hardy steeds and other stock that could subsist on the native prairie vegetation. But they had no interest in developing the land. Finding no metals or other plunderable goods, they dismissed the region as desolate and of novalue. So for at least the next two and a half centuries, other explorers tended to shun the central plains, which remained for three centuries more the domain of American Indians.

The American Indian in Kansas: Hunter--Agriculturalist

Of the historic Indian tribes of Kansas, at least four practiced some agriculture: The Wichita, Kansa, Osage, and Pawnee. Their permanent homes were earth or straw lodges near valley bottoms where they raised crops; they also hunted.

In the mid l6th century, the Wichitas living in the approximately 25 Quiviran villages visited by Coronado tended small patches of Indian corn (maize), beans, squash, and a few other garden products in the Arkansas River valley. For most of their food, clothing, and shelter, however, they depended on the plains bison, or buffalo, which they hunted on foot with bow and arrow and spear. We do not know how long before Coronado's visit the Wichitas had lived in Kansas, but they probably were residents longer than any other historic tribe. Hence, we may call them the region's pioneer agriculturalists. Before their contact with European traders, their cultivating implements were shaped of sticks and stones and buffalo bones.

During the latter half of the 18th century most of the Wichitas moved to the Red River valley in Texas and Oklahoma. Returning to Kansas in 1863 (the year that Kansas State Agricultural College was established in Manhattan), they erected on the site of what is now the state's largest city a village of grass houses known as "the Wichita town." Here they planted corn, pumpkins, melons, and Mexican beans, protecting their gardens by fences of upright poles. They also continued to hunt buffalo on the plains to the west. In 1867 their numbers were greatly reduced by cholera, and on orders from Washington the survivors were removed to Washita (Anadarko), Oklahoma.

The Kansa Indians may have lived in Kansas about as long as the Wichitas, but the earliest documented Kansa village was reported by French explorers in the early 1700s: 150 lodges close to the Missouri River near present Doniphan, northeastern Kansas. Explorers' reports indicate that the Kansa Indians began shifting to sites near the Kansas River during the latter half of the 18th century. By 1822, according to a report of the U.S. Department of War. they numbered 1,750. The principal Kansa settlement from about 1800 to 1830 was near the mouth of the Big Blue two miles east of Manhattan. When Professor Say of Long's party visited that village in 1819, he described it as consisting of 120 earth lodges. Between 1830 and 1873, the Kansa Indians had small villages elsewhere along the Kansas and Neosho rivers.

Until about 1815, most of the villages of the Osage Indians were along the Osage River in Missouri, but close enough to the Kansas border so that they hunted in Kansas. During the reservation period (after 1825), they were considered a Kansas tribe.

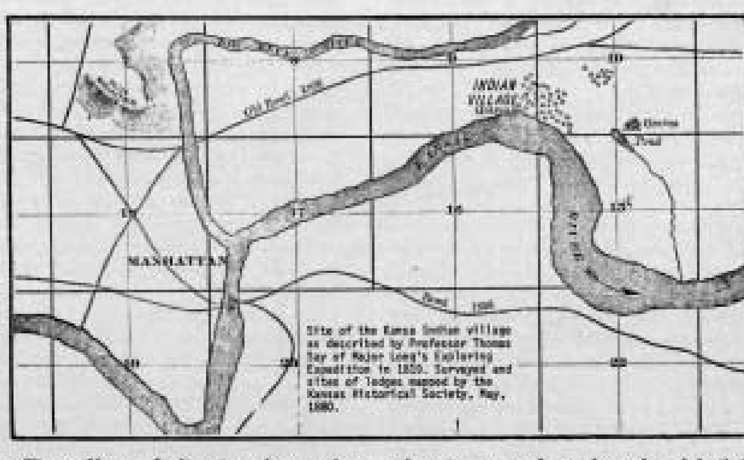
The Pawnees lived primarily along the Platte and Loup rivers in Nebraska, but also along the Republican River near the Kansas-Nebraska border, and their hunting ground included much of northern Kansas west of the Republican. The Pawnee Indian Village Museum at Republic (maintained by the Kansas State Historical Society) preserves the excavated interior of one of the 30 to 40 dome-shaped earth lodges of a village occupied by an estimated 1,000 Pawnees in the 1820s and 1830s. On a hillside, the restored lodge overlooks the Republican Valley, where the Pawnee women grew corn, beans, and squash. Garden products, dried meats, and other foods were stored in a pit still visible in the lodge floor, and on the floor are remains of tools and implements, some of which are metal trade goods.

The principal nomadic, nonagricultural Indian tribes known to frequent central and western Kansas on bison hunts at various times from the mid 16th century to the last quarter of the 19th included the Plains Apache, Comanche, Kiowa, Kiowa-Apache, Arapahoe, and Cheyenne. Of those, the Plains Apache and Comanche came closest to making the Kansas part of the plains their habitat. They made use of dog traction and the travois, lived in skin tipis, ate pemmican hunted with bow and arrow, and fashioned implements from stone, buffalo hair, and sinew.

There is some evidence that the Plains Apaches occasionally tilled the soil, however half-heartedly, in some of the stream valleys of western Kansas. Quite likely in such endeavor they were influenced or assisted by groups of Pueblo Indians who at various times escaped Spanish rule in New Mexico and lived with the Apaches. One such community, El Cuartelejo, existed in the late 17th or early 18th century on Ladder Creek in the plains-break area now a part of the park at Scott County State Lake. El Cuartelejo is important as the site of one of the first agricultural enterprises in western Kansas, *perhaps the first where there was irrigation farming*. Still evident are irrigation ditches dug by the Indians to divert water from springs in the valley walls to their gardens of corn, squash, and gourds.

When the highly mobile, horse-riding Comanches extended their hunting range from Wyoming onto the Kansas plains in the 1700s. they became full-fledged bison hunters. They seemingly never had been even semi-horticuituralists. The Arapaho and Cheyenne Indians, however, had been horticultural peoples in western Minnesota, but after they migrated to the Kansas plains (sometime between Pike's journey in 1800 and Long's in 1810), they hunted exclusively.

We cannot say exactly when Indians began coming to Kansas to hunt or live – maybe 8,000, maybe 10,000 years ago -- or even



"They (Kansa Indians) make much use of maize roasted on the cob, of boiled pumpkins, of muskmelons and watermelons." (From Say's report, 1819.)

exactly how all of them lived before being influenced by white man. But the distribution of the historic tribes, with their various subsistence economies, conformed rather well with the several natural regions of the state, as pointed out by Waldo Wedel in ***An Introduction to Kansas Archeology***: 1) The Kansa (and the Osage), who found valley-bottom horticulture a reliable food source in the eastern third of the state, where annual rainfall generally exceeds 32 inches; 2) the semi-horticultural Wichitas and Pawnees in the central third, where rainfall averages 25 to 30 inches annually and 3) the nonagricultural or hunting groups (Apaches, Comanches, Arapahos, Kiowas, Kiowa-Apaches, and Cheyennes) on the plains of the western third, where rainfall averages about 20 inches annually.

Up to 1854, the year Kansas Territory was created, the Kansas population (except for traders and missionaries) remained predominantly Indian. From the mid 1820s up to then, Kansas was a pathway for frontiersmen en route to the far west, and approximately the eastern third was a reservation for emigrant Indian tribes from eastern states. A number of the emigrant Indians became excellent farmers, using white man's methods and implements. Most, however, continued to make hunting expeditions to the central and western plains until they were removed to Indian Territory (Oklahoma) or the buffaloes were gone (which they were by the mid 1870s).

No exact figures are available on Kansas population during the time Indians were the principal inhabitants, but probably the count was never large. A census in 1844, a year after the last emigrant tribe had been located in Kansas, revealed a total of 34,000: 1,700 Kansa; 4,000 Osage; 11,300 emigrant tribes; and an estimated 17,000 tipi dwellers (bison hunters of the plains).

So long as buffalo abounded, the Indians of the Kansas plains were seldom hungry. On the other hand, they exported no products. The more than two million people living in Kansas today produce more of the basic foodstuffs than they consume (for example, only about 5.7 million of the 319 million bushels of wheat produced in 1974 were consumed as food by Kansans). Thus, we see that "American breadbasket" is more appropriate for describing Kansas now than "American desert" was then.

But let us ponder the Indian's concept of and relation to the land, for whatever lessons we may learn. The Indian characteristically saw the land and its resources as a gift to all mankind, something that belonged to all, like air and water and sunshine, and hence no part of it could belong to an individual. In that perspective, the Indian lived with the land. He adapted to his environment. He tended not to abuse the land and the resources on it nor to waste its resources and wildlife.

Homesteads on the Kansas Prairie

Within the first year of Kansas Territory, a number of westward-bound pioneers stopped in eastern Kansas. A few farmsteads that year appeared as far west as the site of the main village of the Kansa Indians "at the confluence of the Big Blue and Kansas rivers," once considered to be at the eastern edge of a great inland desert. When Manhattan was laid out near the site in 1855, herds of buffalo still frequented the area to feed on buffalo grass, which had not yet been displaced by taller grasses on the surrounding high prairies. (Professor B. F. Mudge, geologist-naturalist who joined the faculty of the agricultural college at Manhattan a decade later, observed that for some as yet "unexplained reason" the buffalo grass was naturally displaced by taller nutritious grasses soon after the buffalo disappeared and settlements became established.)

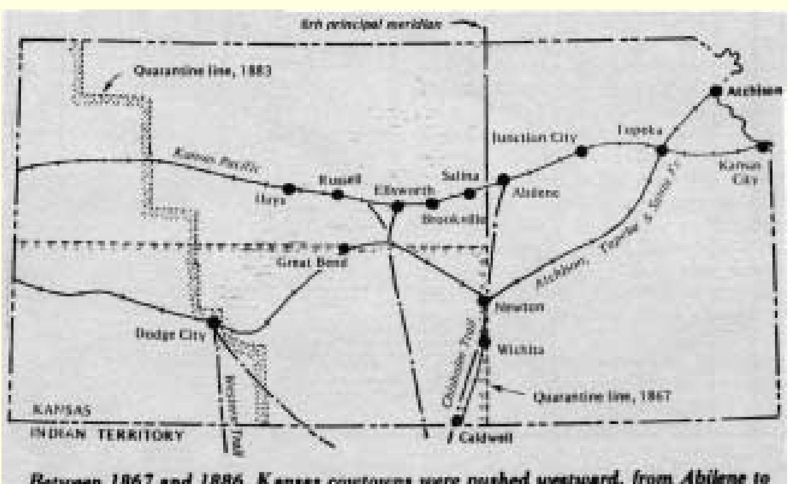
In retrospect, it may seem providential that Bluemont Central College, forerunner of the state's agricultural school, should open its doors in this frontier town on the edge of the untested prairie even before Kansas statehood. Clearly the framers of Bluemont's charter in 1858 were cognizant of what one of the school's missions should be, for that document authorized the governing association of Bluemont College:

> ... to establish, in addition to the literary department of arts and sciences, an agricultural department with separate professors, to test soils, experiment in the raising of crops, the cultivation of trees, etc., upon a farm set apart for the purpose, so as to bring out to the utmost practical results the agricultural advantages of Kansas, especially the capabilities of the high prairie land.

Though many of us today almost instantaneously associate wheat, sorghum, corn, alfalfa, and other grain and forage crops with the "capabilities of the high prairie lands," when Kansas was an infant those capabilities were still unknown.

Although the Civil War slowed the westward movement, two pieces of legislation enacted while it was being fought greatly influenced the settling of the "high prairies" after the war and made possible the establishment of an institution that simultaneously would give direction to a new type of agriculture for Kansas and the Great Plains states. They were the Homestead Act and the Morrill Act of 1862. One opened up the plains as a part of the public domain where land could be obtained cheaply or free except for nominal filing and patent fees; the other provided for the establishment of land- grant colleges.

Almost as soon as the Morrill Act became law, the trustees of Bluemont Central College of Manhattan offered their building and land and library to the state for use as Kansas's land-grant college. Early in 1863 the state legislature accepted the offer, and under the terms of the Morrill Act provided for the college. The state received the deed to the Bluemont properties July 2, 1863, and that fall Kansas State Agricultural College began its first year in the acquired Bluemont College building. One of the country's first land-grant colleges and the first to be established on the borders of the Great Plains, it would soon also become a center for agricultural experiments, with special attention to the agricultural potential of the prairie frontier.



Between 1867 and 1886, Kansas cowtowns were pushed westward, from Abilene to Dodge City, by homesteaders and quarantine lines.

Covered wagons and tents on the Kansas prairie.

A western Kansas homestead in the 1870s or 1880s.

A Land-grant School on the Frontier

During the 1860s and 1870s Kansas State Agricultural College thus had a unique, though perhaps unenviable position among the emerging land-grant schools: It had the task not only of establishing itself financially (through proceeds from land endowments, augmented by hard-to-get legislative appropriations), but also of finding a level of operation (how much classical and practical education and how much agricultural experimentation) that would best serve an incoming population to the untested land of the western two-thirds of the state.

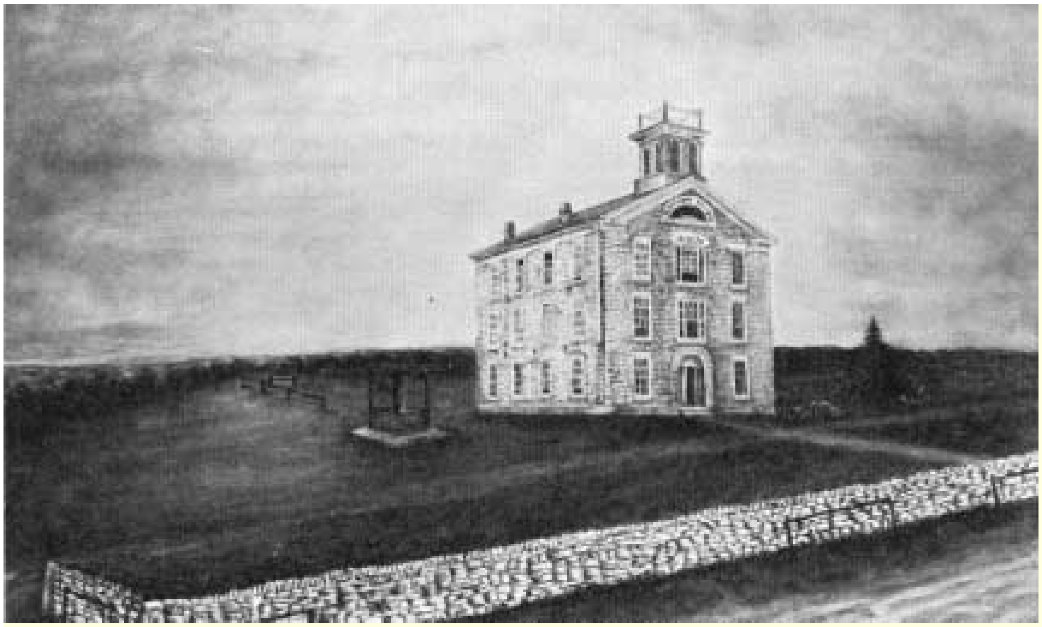
Settlement there under the Homestead Act was hastened by the incoming railroads. Favored by large land grants and having a large stake in peopling the Kansas plains, the railroads may have been overly optimistic in describing the “cheap, available land” and its productive potential, but their promotional literature did much to dampen the long-held desert concept. They in fact helped make central and western Kansas appealing to two agriculturally oriented groups that were at first at odds: cattlemen who saw the area as rangeland and settlers who wanted to try their luck at cultivating the sod land.

Especially after 1870, when plains Indians generally were no longer a threat, settlers (mainly from eastern United States and from Europe) began to surge onto the plains west of the 6th principal meridian, where the climate was subhumid but where by that time most of the “free” or “cheap railroad” land in Kansas lay. Already cattlemen were using the grasslands as open range; some even had preempted land along the water courses, extending their ranches onto the upland interior as soon as they could dig wells and install windmills to assure a water supply for stock some distance from the streams.

After the Civil War to the mid-1880s, Texas cattle drives to shipping points along Kansas railroads (in 1867 Abilene, then near the western edge of settlements, became the first famous Kansas cowtown) aggravated the settler-cattleman controversy. True, some farmers got their livestock start with strays from Texas herds, found the hardy Texas oxen useful as teams to pull plows to turn the tough prairie sod, or made a few dollars wintering some of the Texas stock or selling produce to drovers. Yet they generally feared the Texas longhorns as carriers of Texas fever, and they did not want those range animals destroying their crops or mingling with their stock. So as the settlers pushed westward and their numbers became sufficient to demand and defend quarantine (or dead) lines, east (and north) of which cattle droves were prohibited, cowtowns were forced to move westward, finally to Dodge City.

A Kansas blizzard in 1886 killed so many, range livestock that the range cattle industry could not recover before the crop-growing newcomers had become at least semi-established. Nonetheless, this agricultural profile for the plains even then was emerging: Ranching and farming were becoming allies, until eventually ranches having many acres of pasture would alternate with farms having many acres of cropland. Much trial and error accompanied that development, and during many seasons drought, grasshopper invasions, and other natural disasters plagued attempts to find the right crops to grow on the prairies in a subhumid climate. There was also some luck. For instance, in 1874, despite that year’s influx of grasshoppers, Mennonites from the Volga region of Russia (where climate and land are similar to those of parts of central and western Kansas) brought with them to the Kansas plains Turkey red wheat. They planted the seed and had a good harvest, indicating wheat’s suitability to the Kansas area.

Not all, however, was left to luck or trial and error. Scientific experiments in agriculture had begun to evolve at Kansas State Agricultural College, Manhattan, where farmers, as well as their sons and daughters, could get practical instruction and information. In fact by 1875, the year the country’s first agricultural experiment station was established (in Connecticut), Kansas -- still 14 years young -- was well on its way laying a foundation for the Kansas Agricultural Experiment Station at its then 12-year-old land-grant institution.



Bluemont Central College, 1859.

Laying the Groundwork for an Agricultural Experiment Station: 1858-1888

The soil in all our journey is superior. . . . At a point twenty miles above the Forks, I rode on to the high prairie, where the surface soil was not increased by wash, and dug with a spade twenty-eight inches into the fine black loam, without going through it, the grass roots extending to that depth. Near Limestone Creek I dug in a similar position, with a like result. A small box of this soil I have placed in the Agricultural College cabinet. ***Where grass roots run down over twenty-eight inches, why may not corn root do the same, especially when aided by the sub-soil plow?***

-- B.F. Mudge on the Valley of the Solomon, in the ***Kansas Farmer***, November 15 1869.

A geologist and professor of natural sciences at Kansas State Agricultural College from 1866 to 1874, B.F. Mudge had a habit of spending his vacations in the unsettled or sparsely settled regions of central and western Kansas. That was fortunate for the future of the state's agriculture, for on such excursions -- as on the one up the Solomon in 1869 -- he took note of the soils and other natural resources and of the terrain and water courses, collected fossils and soil samples and specimens of plants and insects, and reported on his observations and on the farming prospects of the areas he visited.

Mudge and other members of the College's early faculty were cognizant of the climatic differences between the Kansas prairies and the timbered areas to the east. They knew that making the prairies agriculturally productive depended on selecting crop plants that could grow and mature under subhumid and semiarid conditions. They knew that new methods of tilling and husbanding must be adopted. They also recognized that to do that, scientific agricultural investigations would be needed. And because they accepted agricultural experimentation as a function of their land-grant school, the Kansas Agricultural Experiment Station (organized and located at the College in 1888) received from the College an inheritance that placed the beginnings of agricultural research in Kansas at least two decades before the Station was organized. Included in the inheritance were agricultural data and specimens from various state regions,

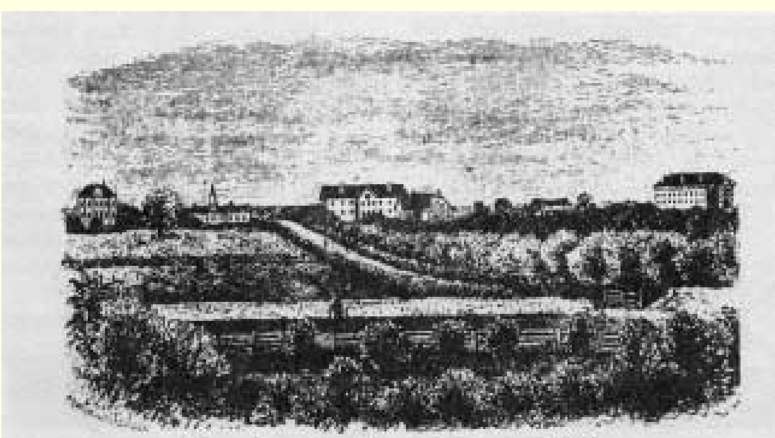
Planting trees.

Stone barn as planned in 1872. Only one wing was built, and it was used first as a barn and then for a time as the College's Chief administration building.

some guidelines on the performances of various crops and on livestock care, and some long-term agricultural and horticultural experiments, as well as the Station's first administrative and research staff. Major contributions can best be assessed by describing some major events at the College during the 25 years it operated before the Experiment Station was created.

A Decade and a Half of Beginnings

When Bluemont Central College at Manhattan, charted in 1858, became Kansas State Agricultural College in 1863, under the Morrill Act of 1862, the bequest included a 100-acre farm intended for agricultural experiments. Though lack of funds delayed the start of experiments, in his report for 1867 Joseph Denison, first College president, stated, "Eighty acres are now thoroughly fenced and forty acres are under the plow." Some trees were set out for windbreak and shade that year, and in 1868 an orchard -- more than 200 apple trees (63 varieties), some cherry and plum -- was established. In his report for 1868, President Denison noted, "During the year 1869, about three-fourths of the land now broken will be cultivated in an efficient manner . . . under the *general supervision* . . . and the other one-fourth . . . under the *special direction* of Professor Hougham." (J.S. Hougham was the College's first professor of agricultural science.) Denison added that the smaller portion "shall afford an illustration of better methods of culture, in the various departments of farming, gardening and horticulture."



Kansas State Agricultural College, late 1870s.

The legislature, however, appropriated only $200 in script – which Hougham sold for $160 in currency -- for all farm work in 1869. Lamenting that and pointing out that there was still no barn on the farm, no College-owned team, and few implements and tools, Professor Hougham nonetheless reported:

- Wheat sown in September 1868 matured well and yielded a good harvest.
- Six varieties of wheat and two of rye planted in October 1868 were destroyed by a freeze in February and March 1869, corroborating the opinion "that late fall sowing is apt to prove of little value."
- Spring wheat sown March 20, 1868, yielded "20 bushels per acre of first class grain."
- Garden seeds, plants, and shrubs put out in the fall of 1868 came through the winter in good condition.
- Four varieties of oats sown March 25 yielded 60 or more bushels per acre.
- Two varieties of barley sown April 6 yielded 52 bushels per acre.
- White corn planted April 22 grew slowly but matured well, yielding 55 bushels an acre.
- "King Phillip" corn (seed from Indiana) planted May 15 matured rapidly and yielded 50 bushels an acre.
- Experiments "do not favor early planting on upland."

Also mentioned were plantings of Irish potatoes, sweet potatoes, buckwheat, and forest trees.

In 1870 Professor Hougham reported planting half an acre of dwarf broomcorn, "high in favor in some parts of this country, and we can distribute seed to those who desire to test its merits." (That was the first record of the College distributing seed to farmers.) He also called attention to how the associate editor of Kansas Farmer evaluated five acres of wheat (planted in August 1869), which he and his party observed in October 1869: "We went over the different pans of the wheat sown, this fall, and we must say that we have not seen better wheat anywhere. One piece in particular, put in with the roller drill, excelled anything we ever saw, in evenness of distribution over the ground."

When Fred E. Miller, who had studied at Michigan Agricultural College (the country's first such school), became superintendent of the farm in 1871, there were still no facilities for complex scientific experimentation. So he suggested that until there were, "operations be confined to . . . preparing the soil, subsoiling, extra cultivation, etc. and these in time will open the way to higher efforts."

An opening came that year with the first major land acquisition for the College. The land, acquired through bonds voted by Manhattan Township, included 155 acres that in 1875 became the permanent site of the school's main campus. A piece of land largely neglected, it nonetheless was fertile, as indicated by a vigorous growth of weeds. Prompted by that action of Manhattan's citizens, the state legislature provided substantial appropriations in 1872 and 1873 for a barn and "to fence, improve, and stock the state farm and develop the agricultural department."

In his reports for those years, Professor Miller mentioned purchases of work animals, a saddle horse, plows, and various other work equipment. He gave rather detailed accounts of various crops grown under various conditions and farming practices in several fields, which he identified by number and acreage. Some of the principal crops grown were corn, oats, barley, buckwheat, potatoes, beets, wheat, rye, and clover and timothy hay. There were experiments on soil preparation, including subsoiling and other cultivation practices, on crop rotations and summer fallow, and on using gypsum and stable manure for fertilizer. And as an indication of his farsightedness, Miller emphasized more than 100 years ago the need to study "quality" of wheat.

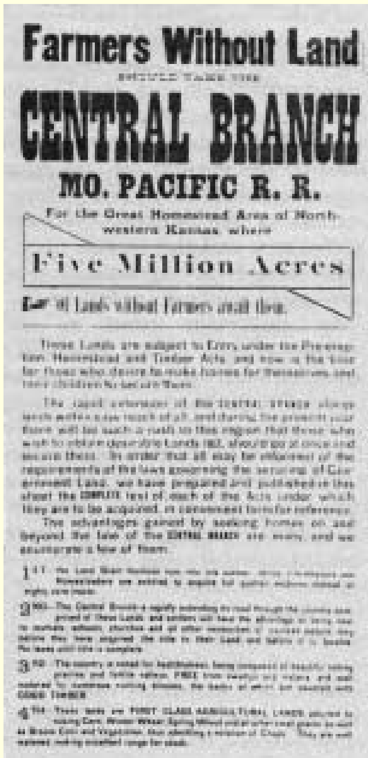
President Denison in his report for 1872 alluded to the importance of stock raising and to sums of money that could be saved "by selecting the proper herds and properly caring for and training them." Referring to the new departments of veterinary science and animal husbandry, he called for obtaining "as soon as the proper time arrives some of the best specimens of stock." In 1873 four breeds of purebred cattle, four breeds of purebred swine, and three varieties of chickens were purchased. Miller summarized the accomplishments on the farm by the end of that year: "Attention . . . has been given to a thorough organization of the farm department, and to its preparation for the peculiar work to which it is to be devoted, viz: That of an experimental station, at which methods of culture, new seeds and crops, breeds of cattle and other livestock, etc., can be tested."

Meanwhile, experiments in horticulture were progressing, with emphasis on fruit and orchard, forest tree and shelterbelt, and vegetable investigations. Elbridge Gale, professor of horticulture and botany, reported in 1871, "There are now in the orchard about 2,100 apple, pear, peach, cherry and plum trees," and in addition there were about 40,000 nursery trees of many varieties. Trees from the nursery were sold to the public. About that time the experimental forest totaled more than 30,000 trees and there were experiments on cultivating trees, on modes and times of grafting, and on adapting different varieties to Kansas climate and soil.

During the College's first decade, coinciding with the tenure of the first president, there were investigations and data-collecting in various branches of the natural sciences -- botany, chemistry, entomology. geology, meteorology, zoology -- that related to agriculture. One of the College's most "indefatigable workers" was the school's first professor of natural sciences, B.F. Mudge. As state geologist (Kansas's first) in 1864, two years before he joined the College staff, he had made a survey of and written a report on the state's geology and mineral resources, including its soils. As a faculty member, he continued his explorations during summer vacations along valleys and onto the plains where "staked claims" had not yet appeared or were only beginning to appear and herds of buffalo were still no novelty.

Besides collecting fossils, minerals, soil samples, and specimens of native plants and insects for the College

Chemistry laboratory, 1876. Remodeled building is now (1975) Holtz Hall, center for student development.



Railroads were leading promoters of land development in Kansas. Advertisement, 1881.

cabinets, Mudge studied prairie flora and fauna in their native habitat and took notes on the soil, water, and climate in relation to farming capabilities. His "lay" reports on his observations appeared serially in issues of the Kansas Farmer, and his work can be considered as one of the first expansions of agriculturally related research beyond the environs of Manhattan into the western part of the state. Of his collections, Leland Call in Agricultural Research at Kansas State Agricultural College (KSU) Before the Enactment of the Hatch Act (1887) wrote, "they constituted a major part of the specimens to be found in the museum at the time the Experiment Station was established."

Farmers' Institutes: A Kansas Innovation

Going hand-in-hand with the beginnings of agricultural experimentation in the state were the Farmers' Institutes. A Kansas innovation, they were started in the fall of 1868 and thereafter held annually, in Manhattan or in another Kansas town, throughout Denison's administration. The idea of the institutes originated at a College Board of Regents meeting June 23, 1868, at which this resolution was unanimously adopted: "That a system of lecturing on agricultural subjects at this College and its populous settlements of the several counties of the State should be continued, so that the benefits of farming according to correct agricultural principles may be disseminated throughout the State."

In a letter printed in The Industrialist November 20, 1905, Elbridge Gale confirmed that he proposed the idea at that June board meeting in 1868. He also commented that after the first two institutes, one at the College on November 14, followed by one at Wabaunsee a week later:

It was found at the very first that it was easy to secure the earnest and intelligent co-operation of the farmers, the work being limited only by the strength of the Faculty to initiate it. This is the record of the first farmers' institute. In a few days our action was headlined by the daily press of the east something like this: 'They are holding farmers' institutes out in Kansas. Why not' The whole thing was new to us; it was new to everybody. And if there is anything that the Kansas Agricultural College can claim as legitimately her own it is the creation of the farmers' institutes.

As a matter of curiosity, topics and speakers for the first institute were: "Relations of the Kansas Agricultural College to the agricultural interests of the state," President Denison; "Treeborers," B.F. Mudge; "Culture of forest trees," Rev. E. Gale; and "Economy on the farm," J.S. Hougham.

In the February 1, 1872, issue of the Kansas Farmer, the editor of that magazine said of the institutes, "From a small, and not altogether promising, beginning, these meetings have grown into a magnitude and interest hardly contemplated by their founders, at so early a period in their progress. We predict for them a popularity and usefulness that shall make them a State pride, and a recognized power for good."

Between 1874 and 1888 developments continued in a direction toward systematic research, even though retarded by controversies over the functions of a land-grant school and despite "hard times" brought on by grasshopper invasions, droughts, and other natural disasters.

To Train or to Educate the Farmer?

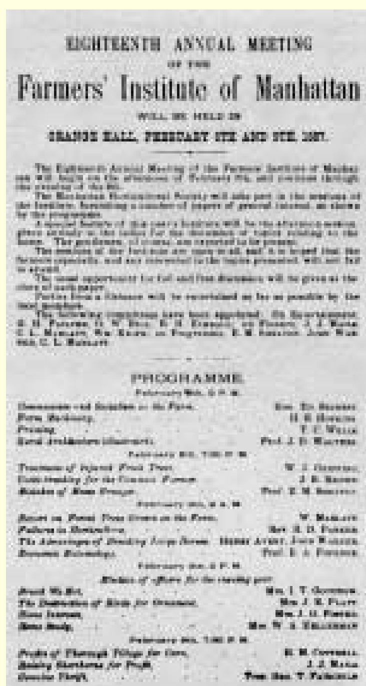
A major disagreement over policy between new members of the Board of Regents and the College administration in 1873 led to the resignation of President Denison, who believed that classical education had a place in the land-grant school. The helm then went to John A. Anderson, who adhered so strongly to trade-school maxims that during his tenure (lasting into 1878) he stressed practical or applied training almost to the exclusion of classical education. Following that change in administration, early in 1874 three of the College's leading faculty members were dismissed: B.E. Mudge, Fred E. Miller, and Dr. H.J. Detmers (who had been appointed professor of veterinary science in 1872). That sparked resentment among those loyal to those professors, especially Mudge, who had been on the faculty the longest and had a considerable following among students and the public. He also had a national reputation as a scientist; he had been called "prince of collectors in the West," and in 1871 the eminent naturalist Leo. Lesquereux said, "He is the only truly scientific geologist west of the Mississippi River." Replacing him with an equally competent faculty member seemed quite unlikely. After the dismissal of Dr. Detmers, the chair of veterinary medicine would not be filled again, regrettably, until the Experiment Station was organized.

It was fortunate, however, for continued progress on the farm and for preparatory work important toward establishing an experiment station, that the new professor of agriculture was E.M. Shelton, who like Miller was a graduate of Michigan Agricultural College, the country's oldest and at the time leading agricultural school. Furthermore, Shelton had recently returned from Japan, where he had been the first teacher of American agricultural methods and systematic farming in that country. That his tenure would last until 1890 put him "in the right place at the right time" to become the first director of the Experiment Station. Under his supervision, field experiments in progress in 1873 were continued and expanded, especially on varieties of wheat, corn, oats, millet, and many kinds of grasses; sorghums and alfalfa were two important additions. Other experiments included: harrowing wheat, deep and shallow plowing, manuring, subsoiling, thorough cultivation and thick seeding of corn, shrinkage of wheat and corn in the bin, use of different fertilizers applied to wheat and corn.

Livestock investigations were increased. In connection with breeding experiments, animals of College stock were sold to farmers throughout the state. Livestock feeding experiments included estimating the value of feeding whole milk to growing pigs, comparing the value of cooked and raw corn for fattening pigs, pasturing hogs on alfalfa and orchard grass, comparing corn meal with corn-and-cob meal as steer rations for beef-making, and determining the value of giving cows warm drinking water. Some projects were concerned with animal housing. The gestation period for cows was studied. And there were even experiments on producing carp in farm ponds.

Joining the staff at the same time that Shelton joined was W.K. Kedzie, also a graduate of Michigan State College and son of a veteran teacher of agricultural chemistry at that school. Though he remained on the staff only until 1878, he collected and analyzed many soil samples. Succeeding chemists extensively studied the sugar content of sorghums and the suitability of different varieties for producing sugar. At the request of many farmers, they examined corn smut to determine the supposed poisonous qualities of the fungus.

Agricultural investigations progressed in a relatively orderly manner from the administration of Anderson (who resigned in the fall of 1878), through that of acting president W.L. Ward, into that of George Fairchild, who took office in December of 1879. Fairchild held that training was for those who wished to be occupied in agriculture and other areas but that the training should be designed "not to make men farmers but to make farmers men." His was a moderate view, and by the time the Experiment Station had become a reality, the scales tended to show a balance between the vocational and cultural approaches, with agricultural research in proper perspective.


EIGHTEENTH ANNUAL MEETING

Farmers' Institute of Manhattan

PROGRAMME

Farmers' Institutes were initiated in 1868, discontinued briefly in the 1870s, and reactivated in 1881.

Up to 1875 results of research were published mainly in the College's annual reports, which were freely distributed. In 1875 the principal organ became The Industrialist, published weekly (at first) by the faculty, the first issue appearing April 24. The Transactions of the Kansas Academy of Science and the reports of the State Board of Agriculture also were early publication outlets.

An important boost to experimental work during Fairchild's administration was the purchase of land for experimental work, using funds appropriated specifically for that purpose by the state legislature. Another forward move was the reorganization of the Farmers' Institutes, which had been discontinued during Anderson's regime. An article in The Industrialist of November 26, 1881, enthusiastically announced the return of the institutes and explained their expanded role:

> The proposition to organize a series of annual institutes, through which the state Agricultural College and the farmers of the State may work together for the promotion of agriculture, has been received with favor upon all sides. . . . The professors will . . . take part in six farmers' institutes, in as many portions of the State, provided sufficient engagement is given by application from local organizations. . . . The institute should be organized on the evening of one day. and closed on the evening of the next day, giving four sessions of from two to four hours each. Pains should be taken to call out full discussions of the various topics presented, so that the practical experience of farmers may be truly presented. Every question has its many sides, and is better understood when carefully considered in all of its hearings. All are but learners in this wide field of research, and may profit by each other's experience.

The institutes were to continue long after the Experiment Station had become a reality. They in fact were to serve the Experiment Station as its main direct route of getting research results to the public until Cooperative Extension was created in 1914. They did much to orient the farmers of the state and their representatives toward agricultural research before the Hatch Act was enacted.

Not surprisingly, then, the Kansas legislators, in session when the Hatch Act was passed, March 2, 1887, almost immediately, on March 4, 1887, accepted its terms, thus making Kansas the first state to do so. But because of a defect in the bill, no federal appropriation (of $15,000 annually) was made until 1888. The Kansas Agricultural Experiment Station, therefore, was not organized until that year.

Kansas State Agricultural College and grounds north of main campus about the time the Agricultural Experiment Station was established.

The Kansas Agricultural Experiment Station--Since 1808

The First Decade: A Program for Systematic Research

Facts, real or supposed, obtained hap-hazard, by luck or chance, have so far been principally the foundation of agricultural practice. It is the dernand for better knowledge than this -- the something known, not "guessed" -- that has called into life the Experiment Station.

-- Bulletin No. 1, Agricultural Experiment Station,
Kansas State Agricultural College, April 1888

Meeting in special session February 8, 1888, the College Board of Regents adopted resolutions organizing the Agricultural Experiment Station at Kansas State College and defining the work of its several departments. The Station was placed under the management of a Council consisting of the President of the College (ex officio chairman), the Professor of Agriculture (ex officio director), and the Professors of Horticulture and Entomology, Chemistry, Botany, and Veterinary Science. In addition to the Council, there were six assistants; so the Agricultural Experiment Station at first had a staff of 12.

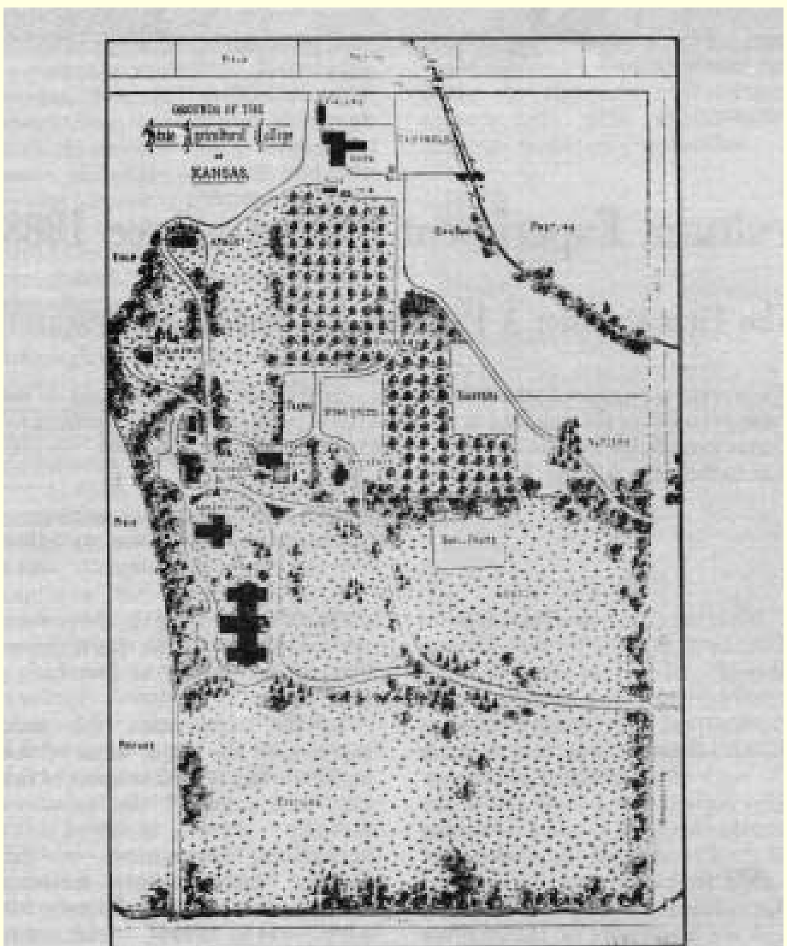
In its composition the staff represented the major areas of the agriculturally related sciences of the day, and most of the members already were involved in agricultural experiments at the College, despite heavy teaching loads and a paucity of funds for such work. Now, with appropriations for research forthcoming, their efforts in that area could be strengthened. So the first task of the Experiment Station was not to "begin at the beginning" but to bring together "all the beginnings" of agricultural research at the 25-year-old College into a continuing, systematic, integrated program.

Of the Council members, perhaps E.M. Shelton would contribute most toward that goal. Professor of agriculture since 1874, he also supervised the operation of the experimental farm, which at that time consisted of 315 acres, was reasonably well equipped, and was stocked with the leading breeds of cattle and swine. Shelton had initiated, continued, and added to agronomic and livestock investigations on the farm. He took part in the Farmers' Institutes. He kept good records and periodically issued pamphlets on various phases of farm experiments in addition to releasing information to the public through the College annual reports, The Industrialist, and various outside publications.

Although their service at the College did not span so many years as did Shelton's, three other members of the original Council had done, in their disciplines, credible research: George H. Failyer, chemist; E.A. Popenoe, horticulturist and entomologist; and W.A. Kellerman, botanist. On the faculty since 1878, Failyer worked principally on the sugar content of sorghum varieties and was one of the first scientists to examine corn smut to determine its poisonous qualities as related to losses. Popenoe, after joining the faculty in 1879, built on the work of his predecessors, giving special attention to tests on many varieties of fruits and ornamental shrubs. Kellerman, a faculty member since 1883, became known for his scientific writings; one was a text book on Kansas flora -- for which he had access to a herbarium of plant specimens collected and classified by Mudge 20 years previously.

Only R.F. Burleigh, a doctor of veterinary medicine, had no previous experience at the College. Except for two years, 1872 and 1873, when the veterinarian Dr. Detmers was on the faculty, there had been no instruction in that science. So the Department of Veterinary Science was the only department that had to be created outright.

Even so, progress in agricultural experimentation in the early years had been hampered not only by lack of funds but also because information in the then new area of agricultural science was meager. Much still depended on trial and error. And the few persons



College farm about 1890.

Farm work crew in the 1890s.

trained in agricultural science, including those on the faculty at Kansas State College, were overworked. All of which had worried President Fairchild, chairman of the first Experiment Station Council. In an article on "Farm Experiments in Agricultural College," appearing in the October 29, 1881, issue of The Industrialist, he had pointed up the need for accurate and complete experiments in agriculture, even as he posed the question of how far the agricultural college should go in prosecuting experiments. He noted that "to teach and to investigate are separate undertakings, either of which may take the whole man"; he then added that "no means for special experiments have been provided, and no adequate opportunity has been afforded, while the people have looked for results far out of proportion." Yet he kept a positive attitude, predicting, "Sometime, in the not too distant future, endowed experiment stations will work out problems impossible of solution in College work."

By 1888 Kansans were more than ready for an agricultural experiment station. By then Kansas farm claims were being "proved up" all the way to Colorado, and farmers becoming established on self-sufficient homesteads were asking more than simply, "What crops shall I plant, and how, on this subhumid to semi-arid land?" Increasingly they were seeking from their land-grant school help in securing better crop varieties and improved livestock. They welcomed demonstrations on improved farming practices. They wanted to know about soil conditions. They asked for remedies for plant and animal diseases, for advice on controlling insect pests.

During the first two years of the Experiment Station, Station staff devoted considerable time to improving farm grounds and reorganizing or setting up new laboratories. Emphasis, however, was on designing or redesigning experiments to fit a long-term plan. As explained in Bulletin 1, that was necessary because "an agricultural principle can only be established as the result of repeated trials under the agricultural conditions." Thus, attention was given not only to current agricultural problems but also to the future of the Station and the state's agriculture. Besides answering questions of immediate interest to Kansas citizens, Station staff accepted a responsibility for helping to educate the Kansas farmer: for example, to encourage him to cultivate "not much but well," to grow not one crop solely but to diversify; to inspire in him an attitude toward "permanent improvements" in agriculture.

Corn (10,000 bushels) harvested on a Norton County farm about the time corn production in the state reached its peak, 1889.

With that start the Experiment Station staff became pioneers in the interdisciplinary approach toward solving some of the state's agricultural problems. Nine bulletins plus annual reports containing resumes of departmental activities were issued during the first two years. Distributed free to the public, they not only gave results of experiments during those years but also summarized previous work (if any) in the various research areas and indicated what should be emphasized in the future. The published information partially answered and provided background for future answers to such questions as:

What varieties of wheat so far tested are best for yield, hardiness, resistance to diseases such as smut and to such insects as the chinch bug?

What are best planting dates? How and when should wheat be rotated with other crops, pastured, cultivated? Should fertilizers be used? What? When applied and how? Which varieties suffer least from winterkilling?

What are the best methods of planting, cultivating, and harvesting corn? Oats? What varieties of these and other grains are recommended for yields?

What are arguments for raising wheat in Kansas? For raising corn?

Can smuts in cereal grains be controlled or avoided? Are fungicides effective?

What do experiments in cross-fertilization of corn show ? How do fungicides affect germination of corn?

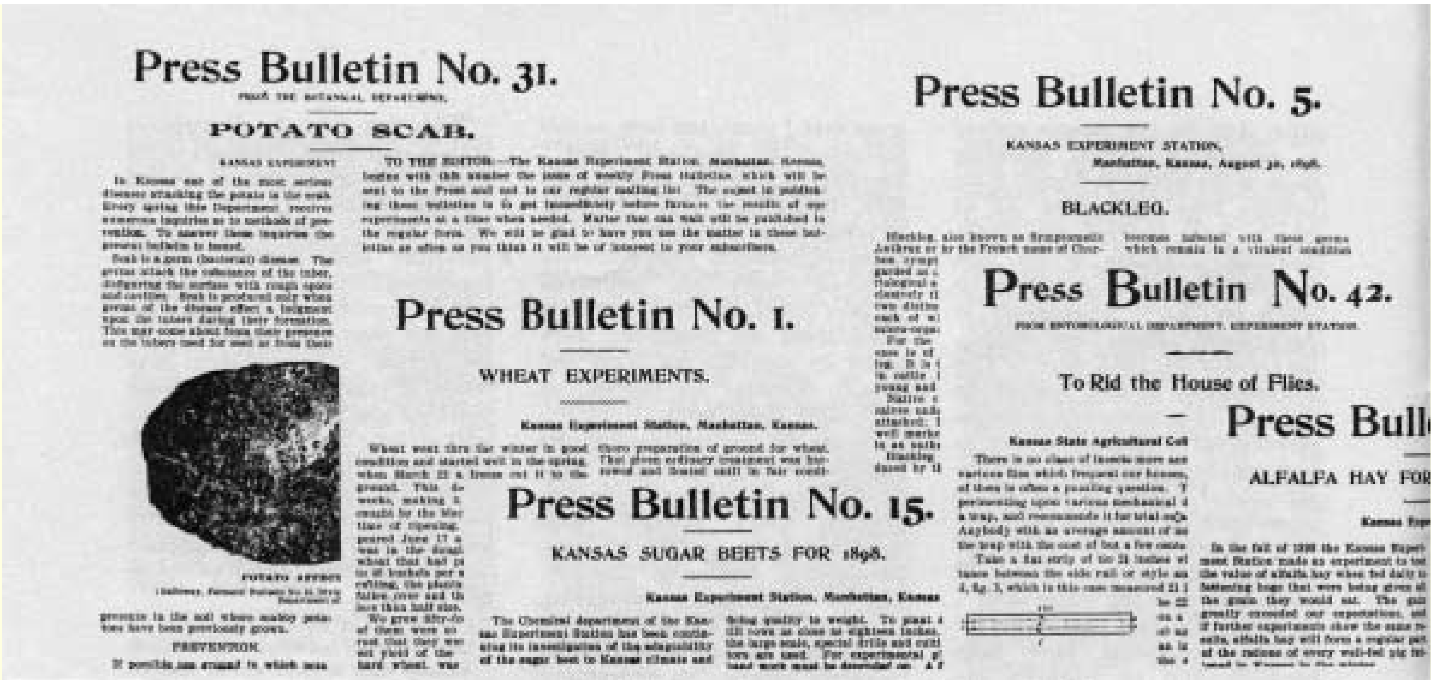
How do sorghum varieties compare in feeding value for stock, for making syrup or sugar? For resistance to sorghum blight ?

In Kansas, where growing plants are whipped by prairie winds and mature stalks tend to become dry and brittle, is there an advantage in storing corn and sorghum fodder as ensilage (in silos) over stacking it in the field?

What tame grasses and clovers, based on 14 years' experience, are adaptable to various Kansas regions? On what types of soil, how prepared? When should seeds be sown?

What fodder plant is most likely to survive a "dry spell"? (Among grasses tested over a period of years, alfalfa, orchard grass, and red clover rated well.)

What are the results of garden trials for different varieties of potatoes and other vegetables? What are the yields? How should seed beds be prepared?



Press Bulletin No. 31.

POTATO SCAB.

Press Bulletin No. 1.

WHEAT EXPERIMENTS.

Press Bulletin No. 15.

KANSAS SUGAR BEETS FOR 1898.

Press Bulletin No. 5.

BLACKLEG.

Press Bulletin No. 42.

To Rid the House of Flies.

ALFALFA HAY FOR

What are the merits of natural and artificial fertilizer? When should barnyard manure be applied? How stored?

What are the characteristics of some insects injurious to crops and orchards? What are practical ways of destroying them?

What are some useful insecticides? What do experiences in spraying reveal?

What are the common types of weeds? How do seeds germinate?

What is the difference in meat (quantity and quality) produced by pigs fed shorts-bran compared with that produced by pigs fed corn meal?

Are there advantages in producing pigs from immature, as opposed to mature, parents?

How does grain ration, when fed along with ample pasturage, affect the milk and butter products of the dairy cow?

After Shelton resigned in 1890, the Station during the rest of its first decade operated under the Council without a director but adhered closely to procedures of the first two years. Through annual reports and bulletins (issued periodically) the public was informed of Station activities and progress of long-term and new experiments.

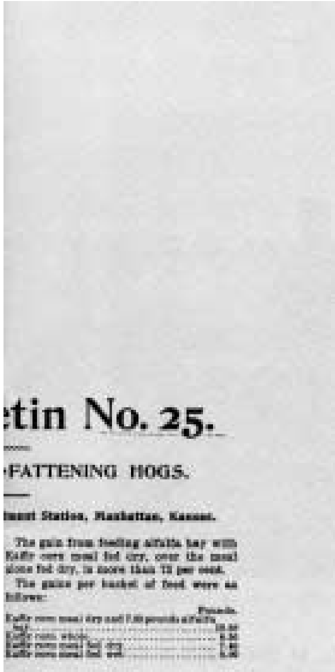
In 1890 Station agriculturalist C.C. Georgeson introduced into Kansas -- and the United States -- the soybean as a drought-resisting plant; seeds were offered gratis to farmers. Early in the 1890 decade experiments were begun on sugar beets as a crop for western Kansas. An important payoff for Station research was the recognition of alfalfa as a Kansas crop; soon seeds were being exported in large quantities.

Station agronomists did reconnaissance work on soil moisture and its conservation, and in the mid 1890s irrigation experiments, using windmills to pump water from wells, were conducted briefly at Garden City, Oberlin, and Oakley. Station botanists studied grain rusts. Entomologists studied plant-attacking canker worms (and associated caterpillars) and tree borers, and also cattle hornflies and stable (house) flies.

Though emphasis was still on crop culture and crop varieties, livestock investigations continued to increase as family-unit farms spread across the state and increased production of grain and forage crops merited purchases of more stock. Experiments in veterinary medicine made their debut. “Loco” weed, which affected animals of the Great Plains, was investigated, as were other plants reportedly poisonous to stock. Research was initiated to determine the cause of “mad staggers” of the horse and “lumpy jaw” and “cornstalk” diseases of cattle. Station veterinarians prepared a vaccine to halt blackleg, then one of the most important diseases causing losses to the cattle industry. In 1897 the Station published detailed accounts of that and several other stock diseases, including Texas itch, Texas fever, and bovine turberculosis; treatments or preventative measures were suggested.

Dairying had a great revival in this country and Kansas in the 1890s, leading to greater attention to care of dairy herds and to the quality of dairy products. In 1893 the Secretary of Agriculture sent Georgeson to Denmark, leader in the dairy industry, to observe dairying practices there and especially to learn why Denmark marketed superior butter.

The Kansas Agricultural Experiment Station during its first decade, the end of which almost coincided with the close of the 19th century, thus established a framework for future research. Long-term experiments were in progress in several basic areas of agriculture, and the framework was flexible enough to permit additions not only in those areas but also in related areas. The Station was structured to encourage interdisciplinary research, which would prove to be one of its greatest strengths.



Dairy unit at Fort Hays Branch Station, 1914.

From the Turn of the Century to 1920: Growth

When tillage begins, other arts follow. The farmers therefore are the founders of human civilization.

- Daniel Webster, On Agriculture, 1840

During the next two decades, essentially from the turn of the century to the end of World War 1, some new dimensions were added to Station activity. The center of the state's population was gradually moving toward the center of the state as farms and farming communities appeared in greater numbers on the western plains. In that climatic conditions, altitude, and soils in that part of the state differed from those in the Manhattan area, it became imperative that the Station carry out research in central and western Kansas. That was accomplished partially by cooperating with farmers on field experiments. A more permanent arrangement was the establishing of branch experiment stations: Fort Hays Branch at Hays, west-central Kansas, in 1901, on half (3,500 acres of the land in Ellis County that had been the Fort Hays Military Reservation; Garden City Branch in Finney County southwestern Kansas, 1907; Tribune Branch in Greeley County, far-western Kansas, 1911; and Colby Branch in Thomas County, northwestern Kansas, 1914.

Concomitantly, research results were being disseminated to all parts of the state, through face-to-face contacts between Station personnel and the state's citizens, in publications,

Experimental calves, 1904.

Case 20-30 tractor pulling three-gang plow, summer fallow for wheat.

including newspapers, and by various other means (not excluding rural telephone, which was beginning to appear). The number of farmers' institutes held annually at various towns along the railroad lines increased quite dramatically near the beginning of the 20th century: from 19 in 1896 to 150 in 1900-01. Special appropriations by the state legislature for the institutes made that possible. Also, in the early 1900s the railroad companies began providing special trains equipped to carry Station staff, along with equipment for lectures and research demonstrations, to towns along their routes; most were corn and wheat specials, but there were at least one alfalfa train, one or two dairy trains. and a few others. In 1898 the Station began preparing press bulletins, or digests of research, for release to the state's newspapers Beginning in 1912 county agricultural agents became an avenue for getting to the farmers information applicable to various counties. In 1914, when Cooperative Extension was established under the Smith-Lever Act, that division became, and has remained, the principal distributor of Station research results to the people of Kansas.

Federal and state governments provided more generously for agricultural research as benefits from Station-sponsored experiments were demonstrated and future needs became apparent. The Adams Act of 1906 significantly increased annual federal appropriations for fundamental, or basic, research, at that time a new concept. About that same time the Kansas legislature provided funds for special projects (the aim of one of the first was to find ways to destroy prairie dogs and gophers); for research at the new Fort Hays Branch Station (one of the first experiments was on eradicating bindweed); and for work at the Manhattan Station ($15,000 in 1909, with substantial sums annually thereafter).

The time had arrived for cooperative research with other agencies, and some permanent arrangements were made between the Kansas Agricultural Experiment Station and the United States Department of Agriculture (USDA). Some of the first cooperative projects concerned range management in Harper County, and (with the Fort Hays Branch): wheat and rye varieties, crop rotation and tillage practices under

Deep-tillage dish plows at work, early 1900s.

Harvesting wheat, nursery at Fort Hays Branch, 1914.

Laboratory force engaged in work on improving wheat by selection.

limited rainfall, and collecting reliable information on moisture conservation and soil management in western Kansas. There were copperative projects with the State Board of Agriculture on analytical studies of livestock feeding stuffs, livestock remedies, fertilizers, dairy products, and seed testing; with the Livestock and Sanitation Commission on the study of livestock diseases; and with the Entomological Commission on weed and plant-disease control.

Within the first six years of the new century, the Station's administrative structure changed from that of a Council with an ex officio director (J.T. Willard. 1900-1906) to that of permanent director, after ,which the Station Council essentially was dissolved. The first permanent director was C.W. Burkett (1906-1908); followed by (up to the end of World War I) Edwin W. Webster (1908-1913); W.M. Jardine (1913-1918); and F.D. Farrell (1918-1925).

Burkett during his two years as director was instrumental in getting two important laws passed by the legislature in 1907: one governing the sale and inspection of fertilizers; the other, the sale and inspection of feeding stuffs. He supported another law, designed to encourage the discovery of superior varieties or strains of wheat in foreign countries and make them available to Kansas farmers. As a result of that legislation, the Board of Regents sent Burkett on a four month trip to Turkey and Russia, where he collected wheat seed from 17 sources. A Station agronomist also was sent to Alberta, Canada, to study characteristics of wheat grown there (the wheat was found not acceptable for Kansas), and a Station botanist went to Europe to investigate methods of wheat breeding.

Wheat already was well on its way to becoming "king of Kansas crops." Before World War I agronomists had developed Kanred wheat variety, which showed certain resistance to winterkilling and rusts (wheat troublemakers) and soon was responsible for boosting the state's wheat production by as much as five bushels an acre. That stimulated Station plant breeders to intensify research to develop strains that were even hardier, more resistant to rusts, and higher yielding. Station entomologists intensified their studies

Cutting kafir corn with a Deering corn binder, August 1906.

Threshing headed wheat using Reeves engine and Avery separator, from the stack, September 1912.

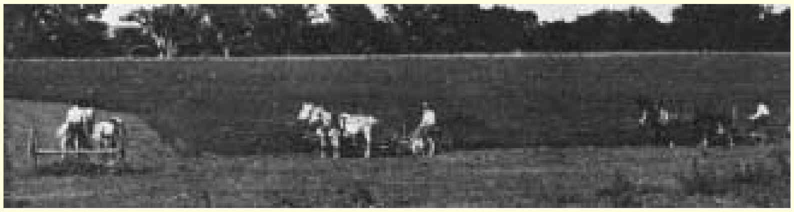
on one of the chief insect troublemakers -- the Hessian fly.

Corn, alfalfa, sorghum, and other grain and forage crops, however, were not neglected; and much copperative research with farmers was concentrated on soil fertility, tillage requirements, and crop adaptations to suit various climatic conditions. There were studies on soil bacteria, coordinated with studies of typical soils from representative regions. A major service was distributing pure seed of grains and forage plants to all Kansas counties; that service became easier when county agricultural agents became established in county-seat towns.

Feeding trials continued to be important livestock investigations; digestion, balanced rations, and animal growth and nutrition were emphasized. (The nutritive value of Vitamin A, discovered during that period, was being studied.) Considerable attention was given to care of the dairy cow and milk production; to quality of beef, and to livestock diseases. The blackleg serum veterinarians had developed by 1915, if universally used, they claimed, could entirely check outbreaks of that disease in cattle.

During World War I, Station researchers remaining on the home front joined the national effort to find effective ways to increase food production to meet the country's needs. By the War's end, Station efforts had a double focus: not only on production research but also on marketing of farm products and on associated economic problems. By then trends toward power farm machinery (and increased production) and expanded road networks for automotive travel (and wider distribution of farm products and greater mobility for rural residents) were obvious. Simultaneously, no longer a local affair, the Station had matured to become a part of a national organization with responsibilities extending beyond the borders of the state.

Sugar beets, Fort Hays Branch Station, early 1900s.



One of the first projects at Fort Hays Branch Experiment Station: sowing alfalfa seed on fresh sod, carefully prepared. Alfalfa 57 days after seeding on sod. 1903 (left)

"Roundup Day" at Fort Hays Station, 1917.

Farmers attending a session of the National Dry Farming Congress at Fort Hays Experiment Station, June 1910.

FORT HAYS BRANCH (1901)

Main areas of research:

- Beef cattle grazing, feeding, breeding
- Crop management
- Soil management
- Weed control
- Entomology
- Plant breeding

Garden City Branch Experiment Station (above). View of grounds in 1915; trees shown were planted in 1914. The Station's first pumping plant; irrigation well drilled in 1911.

Colby Branch Experiment Station (top photo) and Tribune Experiment Station, 1914.

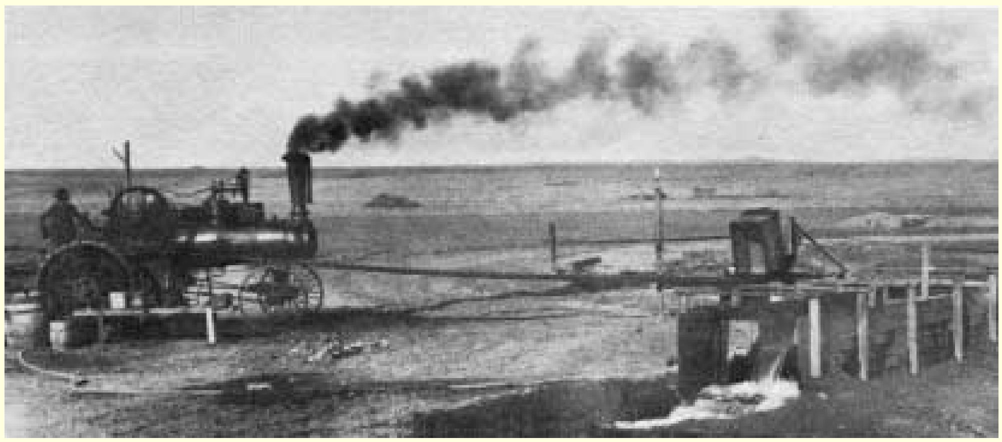
GARDEN CITY BRANCH (1907)
Main areas of reasearch:
- Irrigation
- Dryland farming
- Dairy and beef production
- Lamb feeding
- Crop improvement
- Weed control

TRIBUNE BRANCH (1911)
Main areas of research:
- Field and speciality crops
- Irrigation
- Soil and water conservation

COLBY BRANCH (1914)
Main areas of research:
- Crop improvement
- Soil and crop management
- Irrigation
- Horticultual investigations
- Beef cattle feeding
- Swine and sheep production

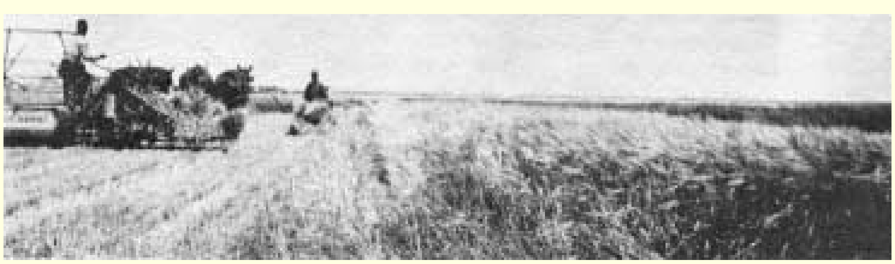
SOUTHEST KANSAS
BRANCH (1949)
Main areas of research:
- Soil fertility
- Crop science
- Dairy nutrition
- Beef cattle grazing and feeding

Puddling reservoir, Garden City Branch Station, 1914. Puddling was necessary to reduce water loss by seepage.



Pumping water for irrigation from a well near Big Creek in Hays vicinity, Ellis County, early 1900s. A centrifugal pump operated by a steam engine, using a thresher belt.

Haying operation, probably well before World War I.



Horse-drawn reaper, fitted with binder.

View north of main College campus, about 1925. Buildings (left to right): veterinary clinic; animal husbandry barn, erected in 1914; and one of the barns used in experimental feeding.

From 1920 to Mid 20th Century: New Dimensions

All taxes must, at last, fall upon agriculture.
-- Edward Gibbon, Decline and Fall of the Roman Empire, 1776-1788

Arbitrarily, we might designate 1920 as the year that the Kansas Agricultural Experiment Station grew up and entered an adult stage of operation. By then the headquarters station in Manhattan had been greatly expanded by several major land acquisitions, making possible expansion of physical plant facilities, with laboratories and experimental fields and orchards for a broad spectrum of research. More than 60 staff members were working on more than 60 primary projects with many subdivisions that crossed disciplinary boundaries of 13 departments: Agricultural economics, agronomy, animal husbandry, bacteriology, botany, chemistry, dairy husbandry, entomology, horticulture, milling industry, poultry husbandry, veterinary medicine, and zoology. In addition there were four permanent branch stations (at Hays, Garden City, Tribune, and Colby), and in most counties of the state, field experiments were in progress in cooperation with farmers.

East wing, Waters Hall.

Annual appropriations then were in the neighborhood of $200,000, a greater portion from the state than the federal government. Station publications, not counting annual reports, issued since the Station was established totaled more than 300. A scientific attitude pervaded, and many staff members were contributing scientific articles regularly to the nation's leading scientific journals. (F.D. Farrell was still director, but when he was elevated to the presidency of the College in 1925, Station operation continued uninterruptedly under veteran staff agronomist L.E. Call, who remained director until he retired, after World War II in 1940.)

By 1920 the land frontiers in Kansas were gone or almost gone. So if theStation had come of age, so had Kansas. That was fortunate, however coincidental, for the Station and the state together were known entities entering a new phase of scientific agriculture. Trends toward mechanization on the farm, larger farming units, and expanding markets for farm goods were unmistakable. Labor-saving machines steadily were replacing man and draft-animal labor -- already a farm tractor with power take-off was on the market, power-operated milking machines were coming into use, multi-purpose gasoline engines were being bought by farmers, and soon self-propelled combines would be venturing into Kansas wheat fields ready for harvest.

Threshing flax near Thayer, in the early 1920s, using Model T to provide belt power for thresher.

Automobiles, which were becoming commonplace, and improved roads -- there were several thousand miles of cross-state roads by 1920 -- together were destined to have a dramatic effect on farm operation, rural living, and mobility of the farm population. As machines and transportation networks brought farm and town closer together and linked community with community, the self-sufficient family farm tended to become obsolete. A migration pattern from farm to instate and out-of-state urban centers was in a forming stage. Larger farms and expanded markets were developing side by side. All such changes, along with associated problems, would have a decided impact on the Kansas economy and its agricultural emphasis within the next three decades.

As the 1920 decade opened, the Station began responding to the growing complexity of social and industrial relationships that were beginning to affect farm life. Through the new department of agricultural economics, the state began probing such economic features as farm tenancy, credit, and land tenure; type-of-farming areas; cooperative marketing by farmers; farm organization and management; and taxation as related to agriculture (Kansas was a pioneer in that area). After the Purnell Act of 1925 had increased the endowment for research in agricultural economics and related areas pertaining to rural life, Station-supported projects were extended to include two additional departments: home economics and agricultural engineering.

Alongside high-priority investigations on improvements in the crop and livestock industries were

Custom-tractor outfit for wheat smut control in Sumner County, 1926 (upper photo). Mode of travel and equipment to control sorghum smut, Ness County, 1926.

College dairy herd on fall-planted sweetclover, 1940. Pasture-improvement study.

studies on the distribution, storage, and marketing of wheat and other farm products and on the handling of farm surpluses. Cereal investigations and flour milling were moving into priority positions, as were studies in human nutrition and home management, and basic information on Kansas soils was being accumulated toward building a sound land-use program for the state.

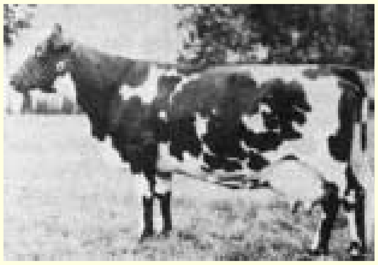
To reverse the trend of half a century of exploitive use of land by agriculture, Station soil scientists and crop specialists initiated a soil conservation program that has continued, with cooperation of the USDA. to date. It has evolved into a number of integrated projects on soils and crops, with main focus on soil fertility, tillage, and plant nutrition. Originally, studies were carried out principally on experimental fields at the main station and branch stations, but also cooperatively with farmers in various localities. To assure longterm experimentation on various types of soils, in 1923 the Station requested (and received) annual appropriations for work on five experimental fields in southeastern Kansas, where soil conditions differ considerably from those of other Kansas regions. (Later, experimental fields for long-term research were established in addition in other state regions.)

It was fortunate -- no, it was essential -- toward securing a healthy future for agriculture in Kansas that interdisciplinary studies should be concentrated on proper care and use of land at the same time that high crop yields per acre and large scale production were major aims. In a sense the parallelism was also ironic. Station director Call, in his report for 1924-1926, commented somewhat apprehensively on the rapid development of agriculture throughout western Kansas and especially in southwestern Kansas, where a level tract of fertile sod land could be easily adapted to power machinery; combined harvester-threshers made it possible to produce, on a large scale and rather cheaply, varieties of wheat and other crops that research had shown to be adaptable there. Noting that climatic conditions at that time were more favorable than average, Call stated that continued development:

> . . . may result in too rapid a change in agricultural practices, thus leading to undesirable economic and social conditions. Meantime, the Agricultural Experiment Station is endeavoring to secure facts which will help to place the agriculture of the region on a permanently safe and sound basis.

The time of reckoning came scarcely a decade later, when western Kansas turned into a "dust bowl" as the country plummeted into one of its worst depressions ever. Here for all to see were consequences of a drought compounded by over-cultivation of fields and over-grazing of pastures. Tons upon tons of top soil, stripped of vegetative cover, had been borne aloft and widely dispersed by wind. Most persons not already converted to the merits of soil conservation soon were. And the Agricultural Experiment Station, which by now had amassed much information on Kansas soils and land use, was in a position to help farmers solve some of their problems and suggest ways to restore their land.

The Experiment Station provided many data for recovery programs not only in Kansas but also nationally, and several staff members were granted leaves to work with the Soil Erosion Service or the Farm Credit Administration of the United States Department of Interior. When the Bankhead-Jones Act of 1935 provided for regional research laboratories, the Kansas Station, along with other state experiment stations, began participating in cooperative projects having application in particular to the



"Cow No. 29," Colby Branch Station. Established world's milk-producing record -- 150,000 pounds in her lifetime.

Field Day, southeastern Kansas experiment field near Moran, September 1926.

country's north-central region. Within the next decade several Station and USDA scientists developed a methodology for studying wind erosion by applying climatological, aerodynamic, and soil physics to the problem; they began securing basic information on the role of wind erosion in the agriculture of the Great Plains. As a sequel to the project, the chief investigator was granted a leave to work on wind-erosion control with shelterbelts in North China.

In western Kansas, where dryland agriculture was a way of life, the branch stations intensified their studies on tillage practices, along with crop rotations and summer fallow, conducive to conserving soil moisture and holding the soil in place. After the Soil Conservation Service of the USDA was established in 1935, cooperative experiments were commenced at the Fort Hays Branch Station on soil erosion, sedimentation, and water conservation as well as on the propagation of grass for erosion control. Range specialists helped ranchers establish good grazing practices, and as a hedge against water shortages in the future, many stock ponds were built, especially in the Flint Hills, with advice from agricultural engineers and geologists.

Irrigation in western Kansas previously had been attempted, especially in the Arkansas River valley, and almost from its inception the Garden City Branch Station concentrated on growing specialized crops irrigated with water pumped from wells. The appearance of irrigation wells was on the rise in the 1920s, but it was in the late 1930s and early 1940s, near the end of a long drought, that irrigation farming began to spread rapidly. (In 1920, about 95,000 acres were under irrigation in Kansas; by 1975, about 2,500,000.) Then irrigation experiments became an important and permanent aspect of research at other branch stations. In areas underlain by large ground-water supplies, as delineated by Kansas Geological Survey studies, irrigation farming (using well water) by mid-century had become big business. (So big in fact that exploitation of and overuse of ground water soon could pose a threat to area economy as did unwise use of land in the 1930s.)

In the 1940s, even before the effects of the depression of the 1930s could be assessed, World War II complicated research efforts and dictated adjustments. Stress was on providing information to use in producing an abundance of food and other material needed by the nation. Practical application of research took precedence over basic research. Some work was of an emergency nature, and several departments (horticulture and home economics especially) concentrated on victory gardens and nutritional work. Changes in research emphasis resulted in such projects as: producing starches from grain sorghum (to replace root starches formerly imported from the East Indies); using native and introduced plants for medicinal purposes or for potential rubber production; and studying flax and soybean varieties for oil production. In recognition of the fact that basic research would contribute importantly toward solving many postwar problems, certain long-term projects were not abandoned. Some of the major ones were in the areas of

Plots at Garden City Branch Station used in research on soil and crops, 1930.

Soybeans in shock, on experiment field near Columbus, southeastern Kansas, September 1931.

Dust storms in western Kansas, 1935. Town shown: Hugoton.

Drifting sandy soil in northwestern Kansas (near Collyer), March 1935 (upper photo). Sand from uncontrolled field in southwestern Kansas (near Rolla, Morton County), 1941. Recommended treatment: stabilize with cane cover and sow to native grasses.

production and marketing economics, plant and animal genetics, crop rotation and fertility, nutrition (important to human welfare), plant and animal diseases, and insects and other predators.

Nonetheless, during the post-war period up to 1950, the Agricultural Experiment Station (with R.I. Throckmorton as director, L.E. Call having retired in 1946) was confronted with some complications in sorting out research priorities: inadequate facilities and land, difficulty in obtaining certain types of equipment and well-trained researchers, and an unusual demand for services by the public. Some of the most obvious needs were for dependable information on marketing; ways to produce, more economically, plants and animals of high quality; finding industrial uses for agricultural products; improving human, plant, and animal nutrition; and studies on social well-being of rural people.

Kansas agriculture during the three decades between 1920 and 1950 had advanced via technology and mechanization from many loosely knit small farms to fewer but larger farms capable of producing enough food to feed many times the state's population. Some of the highlights of the period, as listed in the State Board of Agriculture's Centennial Report (44th) were:

In the 1920s: Wheat replaced corn as the major state crop. Kansas became the largest producer of hard winter wheat of any political unit in the world. The first commercial hybrid corn was grown. First self-propelled combine was in use near Hutchinson. Mounted-type tractor implements were introduced. Federal meat grading began. Pure seed law was passed. U.S. Agricultural Marketing Act was passed.

In the 1930s: Multiple-row cultivators, corn planters, and pickers came into wide use. Hybrid seed corn was in general use in the corn belt. Strain 19 vaccine for Brucellosis was developed. Diesel-powered crawlers came into use. First hybrid hogs and first successful hybrid chickens were produced. The frozen food industry was developed. Agricultural Adjustment Act was passed. High-compression engine was introduced. Vitamin E was discovered. Shelterbelt tree planting was started in the Great Plains.

Rural Electrification Administration was organized. Kansas Noxious Weed Law was passed. Phenothiazine was used to remove internal parasites of livestock. First artificial dairy breeding association was established in the United States. The airplane was first used to control grasshopper outbreaks in Kansas.

In the 1940s: Automatic, self-tying pickup baler was introduced. Wilt-resistant alfalfa was released. Combine -sorghums became a major cash crop. Commercial LP-gas tractors were introduced. DDT insecticide was developed, starting an epoch in insect control. Kansas law governing water rights was passed. Organic phosphates were introduced as insecticides. Self-propelled corn picker was available. Research and Marketing Act was passed. Chemical weed killers were used in cereal crop production. Equipment to apply fertilizer in vapor form (anhydrous ammonia) was introduced. 2,4D was released for experimental trials in weed control. Anticoagulant rodenticides were introduced. Chlordane and toxaphene for grasshopper control were marketed. Kansas had more than 10,000 self-propelled combines, 9,000 airplanes on farms and ranches, and approximately 100 flour mills.

Despite setbacks of a major depression and a world war, by mid 20th century Kansas had achieved status as one of the world's leading agricultural regions. Exports of wheat and other farm products would ever after be a must in the state's economic well-being. That achievement, however, would have been next to impossible -- even with all of the labor-saving devices put to use -- had the state's farmers not applied, thereby benefitting from, the results of crop and soil and related research of the Kansas Agricultural Experiment Station. As Harold Myers, associate director of the Experiment Station at mid-century, expressed it, "The increase in crop value in any one year attributable to the agricultural experiment station in whole or in part would more than pay for the total cost of the experiment station since the Hatch Act of 1887."

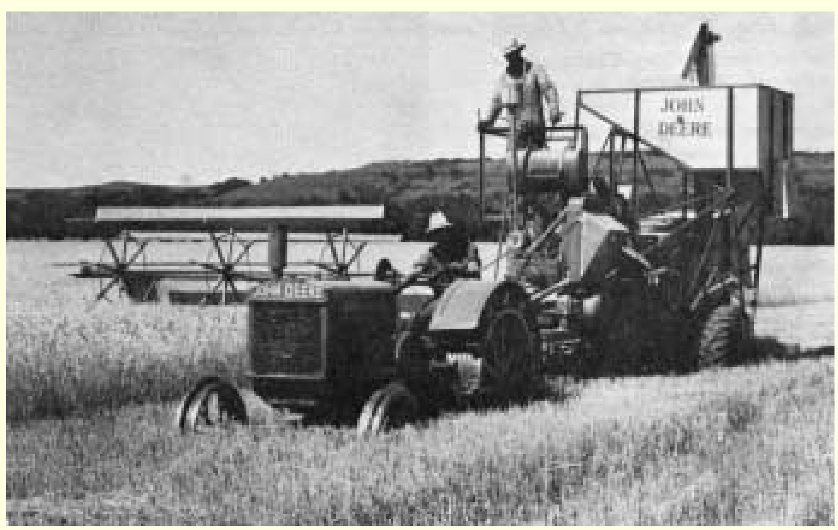
At mid-century Kansas agriculture was a modern enterprise. With goals to be adjusted. And new problems to solve. The Kansas Agricultural Experiment Station likewise had modernized. And had goals to adjust. And new problems to face.

Gully, former livestock lane, in Franklin County, eastern Kansas, being prepared for tree planting (left). Same location (right), June 1940.

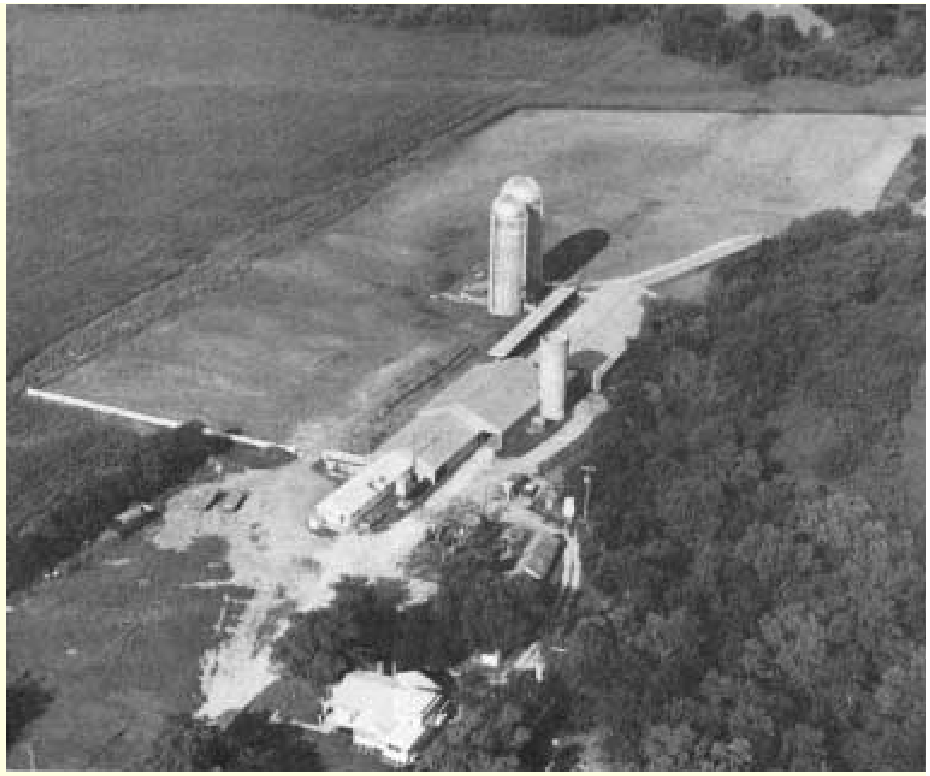
Stand of oats on Experiment Station agronomy farm near Manhattan, 1947.

Automatic hay-bale pickup and loader designed and built at Fort Hays Station, 1946. (About the same time the Station designed and built a self-propelled field silage cutter that reduced cost of putting up silage 62 percent.)

Basin-listed ground 12 hours after a three-inch rain, Hays.



Combining Kanred wheat, Fort Hays Station. Kanred was the only variety grown and distributed at the Station between 1919 and 1932.



Farm in Saline County, central Kansas, 1975.

The Third Quarter of the 20th Century: Research with International Orientation

The quality concept for Kansas agriculture deserves special attention in these trying times. A paramount need is quality foods from quality farms. Recent developments in Kansas agriculture have attested to the soundness of this concept, as for example . . . advantages of the wheat varieties of top milling quality.

--A.D. Weber in an address to the 85th Kansas Agricultural Convention. 1956

Entering a modern phase of operation at mid 20th century, the Kansas Agricultural Experiment Station was supporting research by almost 300 scientists from 18 departments (home economics, agricultural engineering, chemical engineering, physics, and statistics having been added since 1920) and five branch experiment stations (the Mound Valley Branch was established in 1949). Research also was being conducted on more than a dozen experiment fields and more than 500 privately owned farms in 95 of the state's 105 counties. Primary projects totaled well over 200; included were a number of long-term projects cooperative with the United States Department of Agriculture, other federal agencies, several state agencies, and experiment stations in the northcentral region and in the Great Plains (stimulated by the Marketing Act of 1946). Experiment Station publications were averaging about 20 a year, and more than 100 scientific articles based on Experiment Station research were appearing annually in national scientific journals and other sources.

The operating budget had almost reached and soon would exceed $2 million. The complexities of modern agriculture made it imperative to broaden the scope of research and to initiate new programs, which in turn required periodic if not almost continuous expenditures for facilities and improvements, equipment, and land acquisitions. Station land holdings for research and buildings to house laboratories, offices, and livestock had increased greatly since 1888. In 1950 the Station had headquarters in a completed wing of Waters Hall, which was being added to at the time and would have some permanency as the Station's main administration building; it is still serving that purpose in 1975. (In 1952 Arthur D. Weber succeeded R.I. Throckmorton as director; in 1956 Glenn H. Beck succeeded Weber; in 1962 Peairs Wilson succeeded Beck; and since 1965 Floyd W. Smith has been director.)

If not at the beginning of the 1950s, then by the end of that decade, Kansas farms had made an almost complete shift from animal to mechanical power. (The State Board of Agriculture ceased tabulating horses and mules on Kansas farms in 1960.) With machine power for farming came increased application of science and technology to crop production and livestock raising. As his capabilities to manage larger acreages to produce more food and feed grains and meat and other farm goods increased, the farmer sought -- in fact was compelled to seek to offset capital expenditures and increased operating costs --wider markets for his farm products. Inevitably small farm units combined into larger farm units to form modern, commercial operations serving at first national and then international markets. (By 1975 Kansas farms had dwindled to about half the number in 1920. Moreover, Kansas farms today can produce enough to feed more than 70 million people, about twice the capability of 1920. In that the population of Kansas in the mid 1970s is scarcely 2,300,000, and in that the domestic market is relatively stable, the world must be the Kansas farmer's market for a certain percentage of his produce.)

Kansas has ranked second only to Texas in cropland acreage at least since 1920 and has consistently been the leader among states in wheat production and flour milling. In addition the state has maintained high rankings in other crop productions and agricultural pursuits. Kansas soils, terrain, and climate are conducive to the production of a variety of grains and forage crops, and Kansas rangelands contain some of the world's most nutritive native grasses. Those observations suggest that Kansas's welfare will continue to depend mainly on agriculture and agriculturally related industries. That state of affairs also means that during the latter half of this century foreign markets for wheat and certain other major farm products must be developed and maintained. That in turn requires greater sophistication of farming practices, greater attention to efficiency of production and marketing, as much attention to research on quality as on yield potential of product, constant effort to maintain soil fertility, continued control of plant and livestock diseases and pests, and active programs to conserve soil and water.

In the 1950s farmers increasingly became aware of the value of fertilizers. That in turn intensified Experiment Station research on types of fertilizers to use for various crops, when to apply them, at what rates, and how.

That the unpredictability of weather has to be taken into account was forcibly demonstrated in the 1950s. In 1951 Kansas had one of its worst floods in history, but before the decade was over there was a drought reminiscent of the 1930s. The need to predict the occurrence of such natural events and to cope with them emphasized the importance of long-range meteorological studies. Increased use of water for irrigation (about 300,000 acres were irrigated in 1950, more than three times that in 1960 and by the mid-1970s more than double that of 1960) underscored the urgency of investigations on water-use efficiency. Simultaneously there was a clear research responsibility to help devise a system of flexibility of land use to cope with economic and weather changes.

Though the state's population had been gradually increasing over the decades and in 1955 passed the two-million mark, farm consolidations and mechanized agriculture triggered some outmigration, especially of rural farm youth who, no longer needed on the farm, were being enticed elsewhere to seek employment. That observation alone pointed up the need for research to help develop agriculturally related industries within the state; to integrate agricultural production with processing and distribution; to seek new uses for farm products and new markets; to study rural institutions and population trends and sociological aspects of rural living; to find ways to keep rural families fully employed.

Harvesting sorghum at Station's agronomy farm, near Manhattan, 1970s.

Not overlooked was the increased use of oil and gas and other nonrenewable fuel resources required to keep farm tractors and combines and vehicles of transportation moving, farm equipment working, and homes heated. Station scientists, anticipating the day that traditional resources would be gone or in short supply, initiated research to develop substitute sources.

Paralleling the farm shift from independence to interdependence, a revolution that introduced agribusiness into the state's farming schemes, the Kansas Agricultural Experiment Station in the 1950s and 1960s strengthened programs in basic research. That was necessary to provide new facts and develop new tools to solve practical problems associated with the state's new type of agriculture. The "quality" concept became ever more important in research, particularly in grain research, with increasing emphasis on cereal chemistry in connection with flour milling and bread baking. In recognition of the importance of cereal grains in Kansas agriculture and the value of cooperative research, the U.S. Grain Marketing Research Center was

Plant pathologist collecting wheat-leaf rust spores for study. (Wheat losses from leaf rust have been considerable.)

Electron micrograph of Banks grass mite, about 300 times actual size. The mite attacks corn and other crops. Use of the scanning elctron microscope greatly aids research.

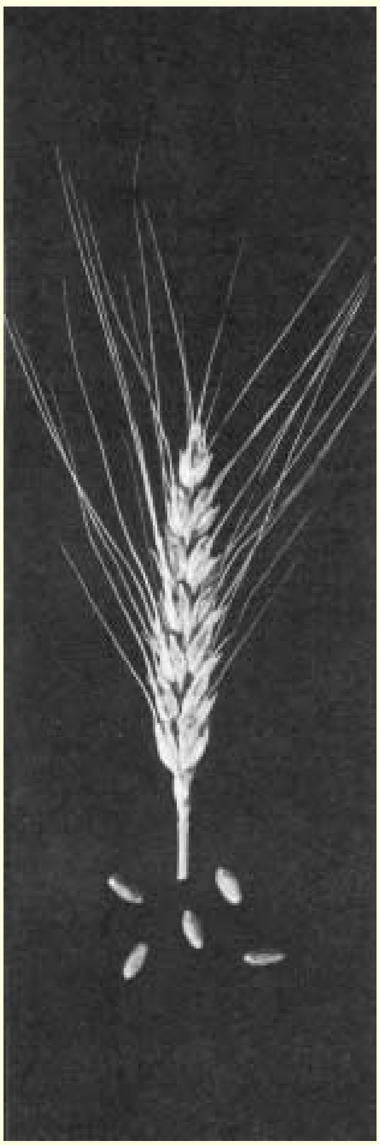
Measuring stomatal resistance at Station's agronomy farm.

Genetically superior black walnut tree in natural forest on Fort Leavenworth Reservation. Twigs from the 55-year old tree are being propagated at Kansas State University's seed orchard near Milford Reservoir.

located in Manhattan in the mid 1960s. Its location has facilitated research in evaluating quality of grain, improving milling techniques, storing grain, and improving grain handling and transportation.

In the mid-1950s two not unrelated happenings, the AID program and the Soil Bank Act, had an impact on Experiment Station research. In 1955 Kansas State University and four other American universities became involved in an overseas technical assistance program under an Inter-University Contract to assist several colleges of agriculture and veterinary medicine and research institutes in India. That was the beginning of the international agricultural program at the university in connection with the Agency for International Development (AID). The programs since have supported research teams not only in India but also in several underdeveloped countries in Africa and South America and from the beginning have involved Station participation.

Triumph wheat variety.



In 1956, when grain surpluses were making readjustments in land use imperative, Congress enacted the Soil Bank Act: to help farmers reduce the production of excessive supplies of agricultural commodities and to help in carrying out soil and water conservation measures on the land. Both the international development program and the Soil Bank Act had international implications for Kansas agriculture and agricultural research.

By the 1960s there were many evidences of how research of the Kansas Agricultural Experiment Station was benefiting the state, not only in marketable farm products but also in contributions to industrial development. An estimated 37 percent of all workers in the state were employed in farming or agricultural industries. Throughout the 1900 decade and into the 1970s, efficiency of agricultural production was apparent, and consumers were benefiting from an abundance of high-

Wheat variety test plots. Triumph 64 compared with Eagle, Kansas variety developed in 1970.

Modern wheat field, Pawnee County, western Kansas.

quality food at low cost. Gross agricultural income in Kansas had exceeded $4 billion by 1973. Net farm income in the early 1970s improved, with cash income from international sales of foods a major factor in that improvement. International marketing of wheat in the early 1970s demonstrated the importance of maintaining such sales, and the realization that two out of every three bushels of Kansas wheat must be marketed abroad was accepted by Kansas researchers as both a challenge and a hope.

To allude to the Experiment Station's role in wheat research, new varieties (Cloud and Sage being among the newest) developed by Station plant-breeding and improvement programs have been largely responsible for increasing average yields per acre from less than 16 bushels in the 1940s to more than 34 bushels per acre in the 1970s. Of the $1.3 billion Kansas realized from its 1974 wheat crop, for example, Experiment Station research amounted for about $300 million -- an amount that alone exceeds all state appropriations to Kansas State University since its founding in 1863.

Other gains in crop-production efficiency resulting from Station research could be cited. For example, corn yields seldom averaged as much as 40 bushels an acre before 1960, but thanks to Station-sponsored testing programs and release of new hybrids, yields per acre since 1960 have doubled. Grain sorghum, generally averaging under 30 bushels an acre before 1960, likewise because of new hybrids, has greatly increased in annual yields - to an average of 60 bushels an acre in 1972.

Besides emphasizing the importance of international marketing of wheat (and other grains) and efficient agricultural production, the Experiment Station had several other priorities during the first two bienniums of the 1970s. Attention was given to: protecting the environment and natural resources (including research to demonstrate that agricultural production can be accomplished with relatively small amounts of pesticides); efficient meat production; controlling such pests as the alfalfa weevil and southwestern corn borer; and rural economic development (including analysis of impract of changes of tax structure on financing state and local government units and of factors affecting the living of disadvantaged families).

Much effort was expended on conserving soil and water. That concern is not new, as evidenced by the creation of a number of watershed districts since the mid 1950s, of the Water Research Institute in 1964, and of the Evapotranspiration Laboratory in 1968. Increased use of ground water for irrigation in western Kansas, where in places water is being pumped from wells faster than the underground reservoirs can be replenished, however, adds urgency to the concern.

The Russian-American wheat deal, food shortages aggravated by natural disasters in underdeveloped countries, the energy crisis, and other events in the 1972-1974 biennium elevated some other ongoing research to the fore: especially studies on nutrition of various foods for human consumption, including high-protein cereal grains and forage crops, and the attempt to convert animal and other agricultural wastes into usable energy resources.

In 1974 Kansas agriculture, the state's most important industry, contributed $12 billion to the Kansas economy. And the Kansas Agricultural Experiment Station, the state's largest research agency, served that industry (represented by about 85,000 farm units and associated production and marketing agencies and processors), and all state citizens as well, on a budget of less than $12 million (only a thousandth of the amount contributed

Important research in grain science is directed toward improving baking quality of bread and other cereal products.

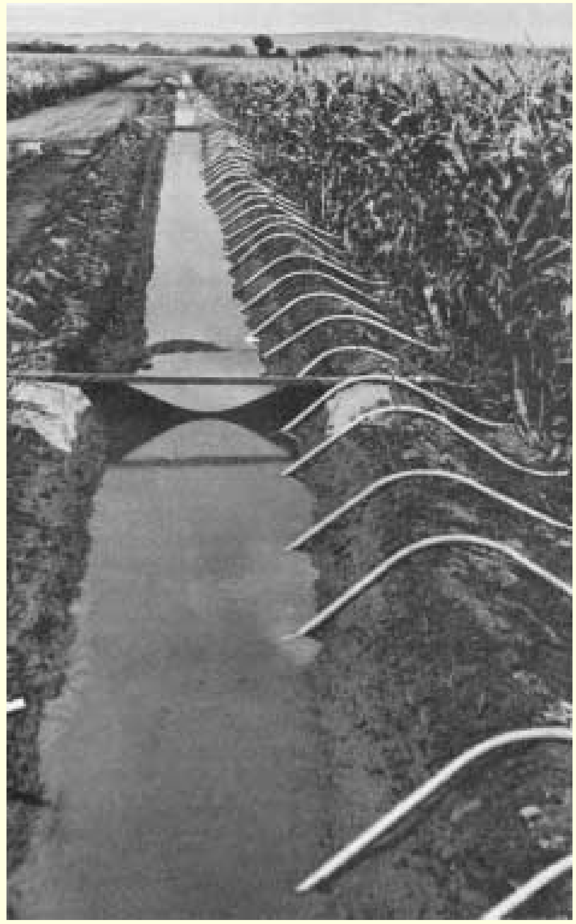
Elevators at Hutchinson (shown here) and elsewhere in Kansas wheat belt provide storage for millions of bushels of wheat.

by agriculture to the state's economy).

The Kansas Agricultural Experiment Station, which began in 1888 with a staff of 12 scientists from six departments, in 1975 has a research staff of more than 400 representing 33 science departments in six colleges, five branch stations, and 13 experiment fields. More than 600 research projects, many divided into sub-projects and including many disciplines, currently are in progress. Station publications, counting from the beginning, have totaled more than papers in scientific journals and research papers have exceeded 10,000.

That brings up to date the status of the Kansas Agricultural Experiment Station, officially 87 years old in 1975 but including more than 100 years of continuous research.

Now what of the future?

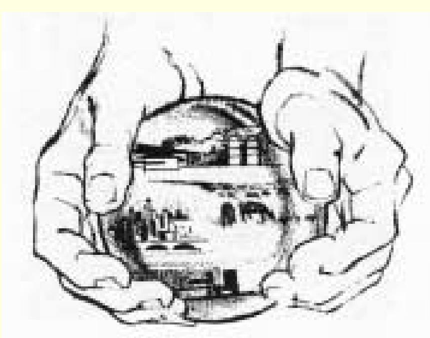


Irrigating corn,
Osborne County, 1975.

The Future

No race can prosper till it learns that there is as much dignity in tilling a field as in writing a poem.

-- Booker T. Washington, Up from Slavery, 1901



No one can predict precisely the future for agricultural research. It is possible, however, to examine current issues and major concerns in an attempt to delineate possible courses of action for the remainder of this century.

Energy Crisis

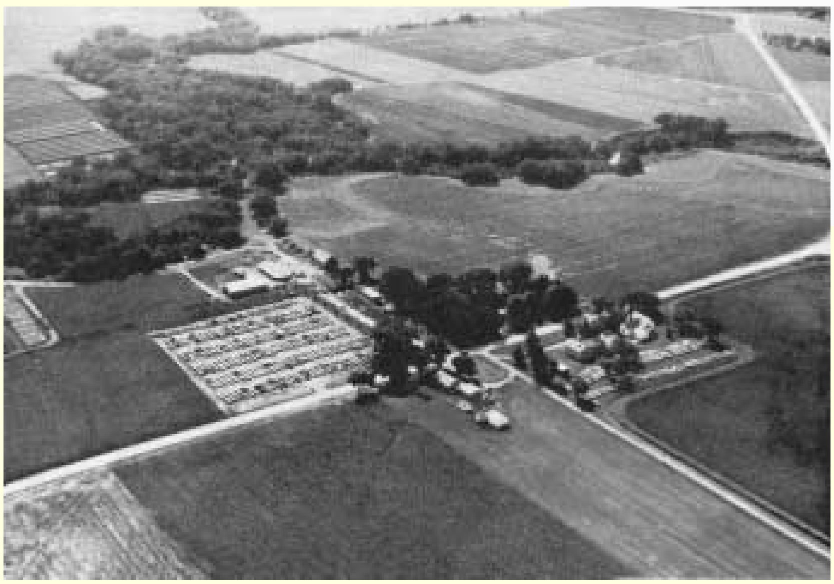
Advent of the so-called energy crisis in 1973 presented to agricultural researchers the greatest challenge to date. Previously gains in production efficiency came about mainly because of greater and greater use of fossil fuel reserves. In effect, energy was literally substituted for land resources and for both man and animal power.

Prospective total loss of natural gas supplies and reduced availability of gasoline and diesel fuel present agriculture with a "brand new ball game" as U.S. land-grant agricultural stations complete their first century of research. Loss of those "cheap" energy sources removed the most important tool that production agricultural researchers had.

Basically, we have seen the

Beef and swine research center, Agricultural Experiment Staion, Manhattan, 1975.

Poultry-research unit on Experiment Station grounds, Manhattan, 1975.



Experiment Station's agronomy-research farm southwest of Manhattan, 1975.

disappearance of cheap nitrogen fertilizer and of low-cost drying (alfalfa dehydration and grain drying). At the same time increased costs have been applied to processing food, and low-cost livestock feed has become less available.

Reduced availability of power fuels and higher costs occasioned by dependence on imported petroleum compel us to seek ways to reduce energy expenditures. In the near future, it appears that we will substitute electrical energy for both natural gas and petroleum derivatives. But we must increase efforts to develop alternative energy sources to be used in synthetically fixing nitrogen for fertilizers. While coal is neither so cheap an energy source or so easy to manage, it seems a likely candidate for fixing nitrogen. And through research we also hope to provide synthetic fuel gases that can be substituted for natural gas in many applications.

Production Agricultural Research

Great challenges confront production researchers. With production capability exceeding availability of many kinds of necessary inputs, the striving for higher crop yields and animal grain is losing appeal.

Production research undoubtedly must undergo major changes in resource allocation. Attempts to achieve higher crop and livestock production simply to establish new records appear to be ending.

Production research logically will be directed toward protecting plant and animal production to insure maximum economic returns with minimum investment in production inputs.

Environmental Protection

Even before the energy crisis was recognized, environmental protection was a major concern. Now that the crisis has become evident, concern has intensified worldwide; the United States and other countries are re-examining, for example, the environmental aspects of coal as a primary energy source.

Water quality in Kansas streams and reservoirs, sediment dislodgment and transport in streams, animal-waste disposal, and contamination of soil, water, and food with residues of lethal pesticides concern all of us. It is clear that increasing emphasis in future research programs will have to be placed on such key issues as:

1. Controlling and alleviating nonpoint pollution.
2. Developing better systems to control feedlot runoff.
3. Substituting more animal wastes as an alternative to high-cost fertilizers.
4. Using other than lethal pesticides to control insects and other pests.
5. Breeding varieties and hybrids with genetic resistance to insects and diseases.

Kansas already has established its reputation for coping effectively with several of those issues. But future efforts must be intensified and broadened.

Feeding the World

Many words have been spoken about the capability of the United States to bring about solutions to world hunger. All too often little indepth perception preceded such statements. We need realistic answers to many questions, including the following:

1. How many persons can Kansas agriculture realistically feed?
2. How do Kansans perceive that they should allocate precious energy resources?
   a. to produce food for the world,
   b. to supply human-comfort needs at home (for heating in winter or cooling in summer),
   c. to produce nitrogen fertilizer to increase the world food supply?
3. How much can Kansans produce if they are insured an adequate profit?
4. How much will Kansas be expected to contribute to foreign assistance?
5. Will Kansas be producing food for part of a world food reserve? If so, who will control the reserve?

International Marketing

Experiences of the last three years (1973, 1974, and 1975) have made Kansas agricultural producers extremely conscious of new concepts:

> They have come to appreciate that "marketing" does indeed relate to net profits on the state scene.
> They appreciate that "orderly marketing" means better returns to the producer.
> They have recognized that Kansas agriculture plays a worldwide role in helping the United States achieve a positive trade balance.
> They recognize that international grain sales, especially those of wheat, have brought new rural economic development to the Great Plains.

Thus, we need to ask over and over questions that relate to allocating research resources, toward accomplishing all that we can to insure that Kansas and Kansas communities continue to benefit from the state's role in national and international food production.

Human Social Concerns

Human concerns have received more attention during recent years than ever before. No doubt that trend will increase, so the human factor will be an important variable in all research.

By substituting land and machines for human labor, we eliminated slavery and nearly eliminated drudgery from rural America. In the process we moved many agricultural jobs from rural America to its industrialized cities. From the cities then came machines, fertilizers, pesticides. and other substitutes for animal and human labor on our farms. The substitution also sent our raw food products to metropolitan centers to be processed, packaged, and then distributed throughout the land.

Early in this century Carl Sandburg described Chicago as "Laughing the stormy, husky, brawling laughter of Youth, half-naked, sweating, proud to be Hog Butcher, Tool Maker, Stacker of Wheat, Player with Railroads and Freight Handler to the Nation."

But while we seemed to be improving the quality of human life by eliminating slavery and drudgery from rural America, the quality of life soon began to deteriorate in our great cities.

Now, instead of bragging about our great cities, we worry about their future. Many people in them would prefer to work in less-congested areas --where grass, trees, animals, open space, and sounds of nature can be substituted for city noises, tensions, traffic mazes, and concrete -- in the hope of improving the quality of life for themselves and their children. People in smaller places prefer to live outside congested areas to the extent that they accept lower salaries and wages than are paid for the same work in the congested areas. The difference in quality of life is important to them. Likewise, quality of life is becoming increasingly important to researchers at land-grant universities.

Probable topics for future research that will influence quality of life in Kansas are both numerous and varied. They likely will include:

Rural-urban relationships.
Nutritional quality of institutional foods.
Land-use zoning.
Ways to solve civic and community problems.
Taxation to provide local services.
Plant genetics to improve quality and nutritive value of foods.
Revenue sharing.
Low-cost, nutritious meals.
Rural industrialization.
Rural housing.
Family gardens.
Provision for medical and other needed services.
Use of textiles (clothing) to conserve energy in homes.
Population shifts.
Clothing for comfort, satisfaction, and safety from fire.
Delivery of continuing education.
Indicators of quality of life.

KANSAS AGRICULTURAL EXPERIMENT STATION SUPPORTS RESEARCH IN:

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Agricultural Economics
Agronomy
Animal Science and Industry
Biochemistry
Biology
Chemistry
Computer Science
Dairy and Poultry Sciences
Economics
Engineering ------------------------
- Agricultural Engineering
- Chemical Engineering
- Nuclear Engineering

Entomology
Geology
Grain Science and Industry
Home Economics ------------------
- Clothing and Textiles and Interior Design
- Family and Child Development
- Family Economics
- Foods and Nutrition
- Institutional Management

Horticulture and Forestry
Physics
Plant Pathology
Political Science
Sociology and Anthropology
Statistics
Veterinary Medicine ---------------
- Diagnostic Laboratory
- Infectious Diseases
- Pathology
- Physiological Sciences
- Surgery and Medicine

Human Nutritional Concerns

While much attention will be devoted to world food requirements, additional emphasis also will have to be devoted to nutritional improvement of food consumed by various components of society affluent or otherwise. As various other countries develop and as better understanding of needs results, the following concerns likely will emerge:

Meeting total caloric requirements.
Protein adequacy.
Improved protein quality.
Nutritional improvement of cereal-based diets:
 Improved amino acid balance.
 Fortification with superior proteins.
Possible substitution of vegetable proteins for significant portions of animal protein, including both meat and milk.
Recovery of higher percentages of cereal kernels in the milling process.
Development of alternative market classes of wheat.
Utilization of whole-wheat kernel to insure adequacy of fiber.
Search for other plant protein sources.
Development of new cereal hybrids.

Conservation of Natural Resources

Agriculture generally has exploited natural resources. As already noted, accelerated use of fossil fuel reserves has been correlated with reduced use of land and animal power. Likewise, ground-water reservoirs in western and south-central Kansas have been used for full irrigation rather than for the minimum water needed for effective crop production. Adapting to an alternate crop and fallow system for wheat production has done much to stabilize Kansas as the world's foremost producer of hard red winter wheat.

Can stable agriculture be continued in Kansas? If the answer is to be positive, we must concentrate on such objectives as:

Managing ground-water supplies wisely.
Achieving fullest possible benefits from natural precipitation.
Developing better understanding of evapotranspiration.
Remaining alert to uses of solar energy and wind power.
Developing alternative energy sources from coal, from the biomass, and especially from animal wastes.

Applied versus Basic Research

Comparative allotments of resources to applied and basic research (or to direct and indirect approaches to needed knowledge) have been discussed for many years. It has been generally agreed that somewhat less than a third of Kansas agricultural research qualifies as basic. Even with that rather limited allocation, many believe that too much effort is being diverted from practical applications.

There is evidence that federal agencies, which provide about 10 percent of the station's current research obligations in sponsored projects, are turning more and more to applied research. No doubt that is in response to suggestions from Congress -- a trend that quite likely will continue for some time.

On the other hand, however, with the advent of numerous new crises and concerns, it is becoming more obvious that basic research will be needed. Otherwise, opportunities for applied research will be reduced. Knowledge must precede its direct application to improving the human condition. It therefore seems probable that basic research will become even more evident in the near future.

Agricultural scientists, starting their second century of research in land-grant experiment stations, are faced with their greatest challenge ever: the energy crisis, which is devastating to consumers, businesses. and governmental units. However, the unfavorable circumstances could be turned into an asset for Kansas in relation to other states.

An Economic Advantage

As food becomes more important internationally and nationally, states that produce energy efficient crops and animals will have a comparative economic advantage. Only Texas has more cultivated land than Kansas. Kansas crops are among the most energy-efficient grown anywhere. Kansas's efficient use of energy in food production provide opportunities not only for farmers and ranchers but also for firms that provide inputs for agriculture and those that process and distribute agricultural products.

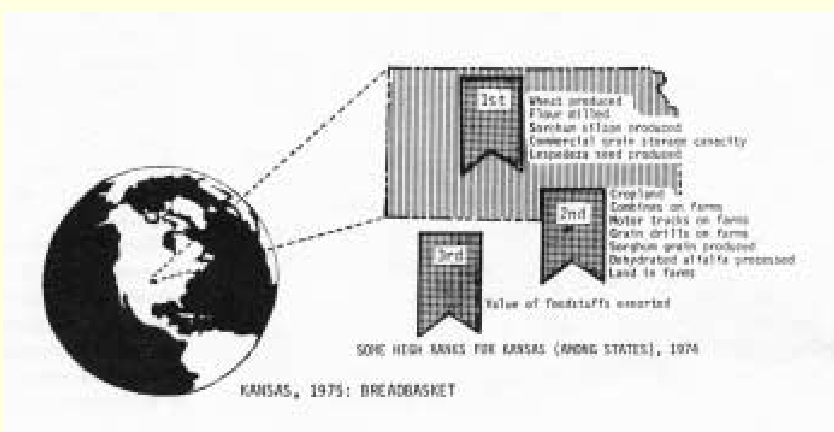
Already the long out-migration of citizens from Kansas has reversed. Forty-five Kansas counties that had been steadily losing population now are gaining. Research and development programs to keep agriculture and industries related to agriculture both energy- and labor-efficient should provide many new opportunities in Kansas -- all related to improving human conditions here and abroad. Energy used in transporting wheat, for example, suggests that we should process more of it in Kansas and ship the finished product. Our meatpacking plants have demonstrated economies in processing near the point of production -- with tremendous economic benefits to Kansas. Because of the energy crisis, segments of our meat industry demand expanded research now. On rangeland, livestock are the most efficient users of energy Kansas has, but in feedyards they are heavy users of energy. Irrigated crops, which stabilize feeding, also are heavy users. Research on irrigation only, drip irrigation, and ways to increase feedyard efficiency are needed immediately.

Using only enough irrigation water to stabilize crop production, rather than to produce highest yields possible, appears to be both wise and necessary for the future.

The Search for Efficiency

Our search for crops that use solar energy, water, and plant nutrients efficiently must be expanded and accelerated.

Energy and food shortages around the world present a bigger challenge now than turning a "desert" into a breadbasket did 100 years ago. We face the future with a broad scientific base -- thanks to our predecessors who saw the need to establish agricultural experiment stations. Emulating our early scientists, by applying and building on accumulated knowledge, should permit us to continue to serve society well and to reap both personal satisfaction and economic benefits as we enter the second century of land-grant experiment stations.



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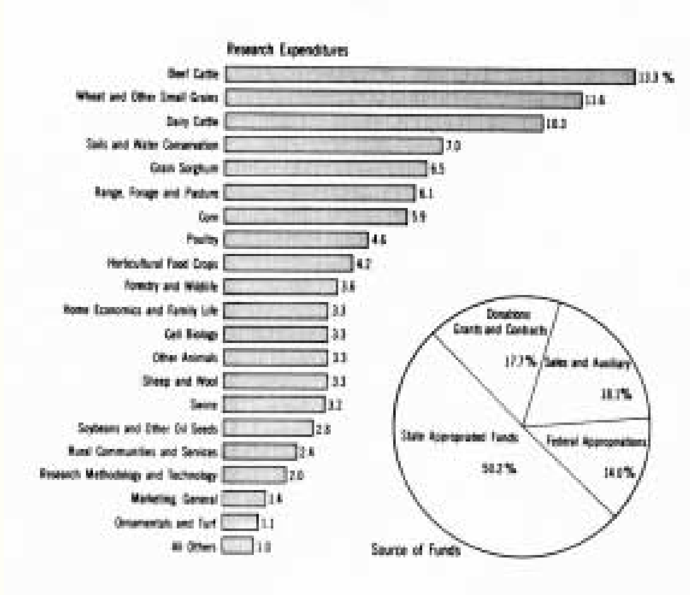

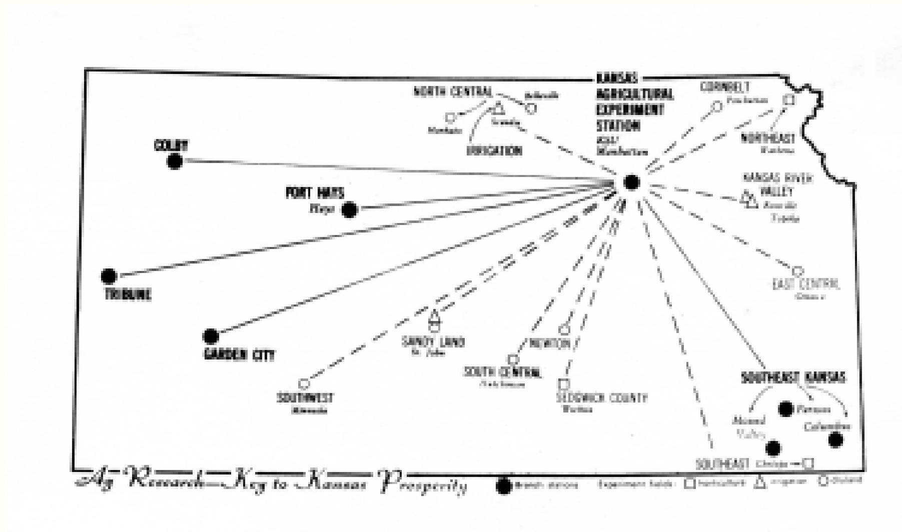

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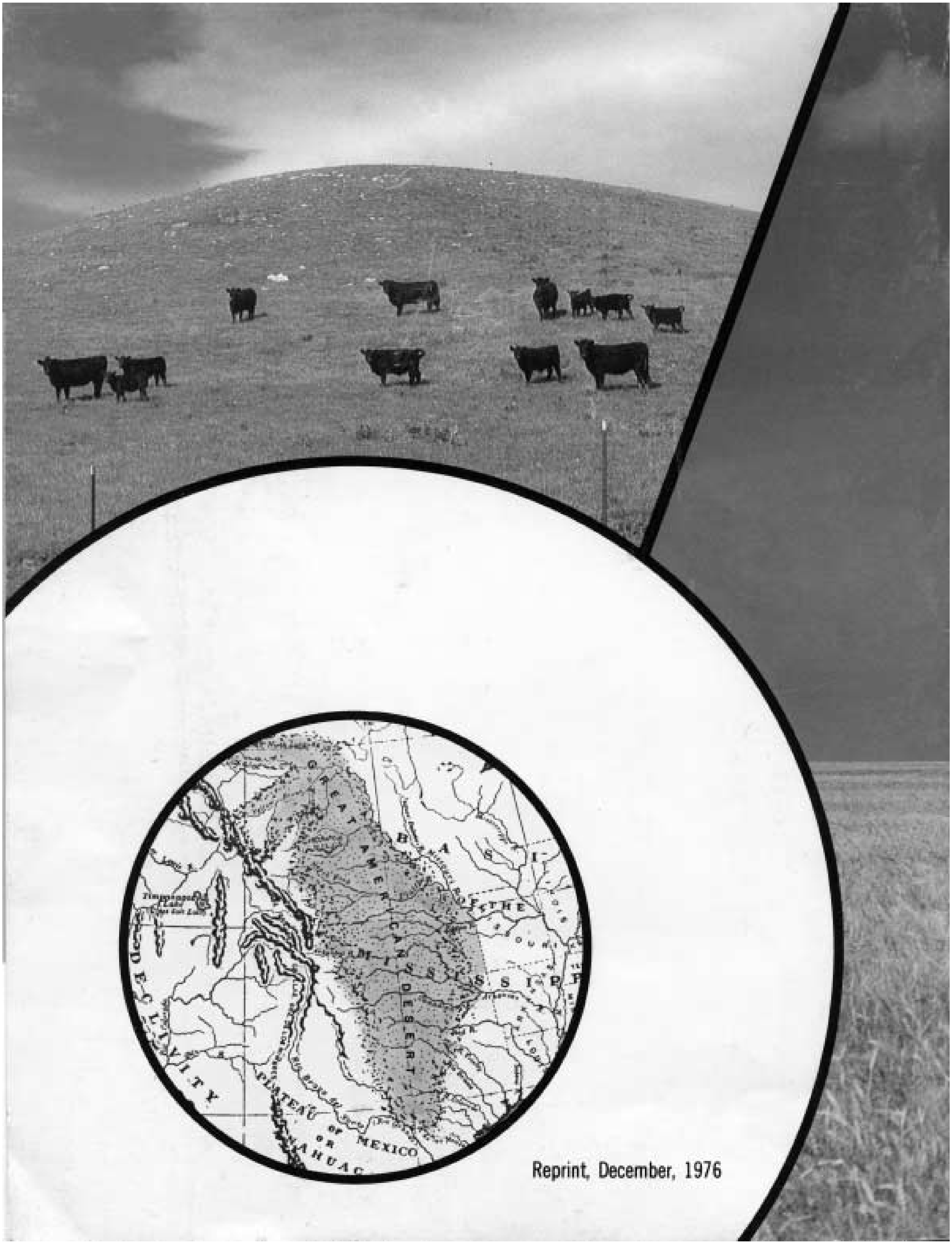

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