Iowa produces nearly 20 per cent of the United States corn crop, and more than any foreign country. The average annual production for the years 1941–45 was 552,977,400 bushels.

3. Growing the Bumper Corn Crop

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ONE OF THE FIRST CROPS PLANTED BY THE WHITE SETTLER in Iowa was "sod corn." Already, in the period more than a hundred years ago, corn was a staple item in the diet of the Indians of the state. Their total production certainly must have been less than half a million bushels a year, but heralded the crop growths to come.

The "sod corn" of the white settler produced a crop of sorts the first year. Its main advantage was that it required no cultivation, leaving the settler free to clear land where necessary, build his house, and break more land for the next year's crop. Ground to be planted to corn was cross marked and planted by hand. Cultivation was done with a harrow, often homemade, and a double-shovel cultivator which cultivated only half a row for each trip across the field. In many cases this cultivation was supplemented by hand hoeing.

Under favorable conditions corn yields were obtained which compare well with those of today. A boys' one-acre corn-growing contest was sponsored by the Iowa State Agricultural Society. In 1857 this contest was won by Wilbert LaTourette. Sworn records state that the yield for this single acre was 95.5 bushels. His report follows:

The ground on which the following crop was raised is a black loam with a clay subsoil, and lies slightly rolling to the south. The location is four and a half miles west of Muscatine.

The ground was prepared about the 20th of May, by plowing six inches deep, with a common stubble ground plow. On the 26th day of May, it was marked in rows 3½ feet apart, then planted with a hand corn planter, 1½ feet apart in the row.

The seed was a large yellow corn (name unknown). The crop was cultivated by harrowing once with two horses and large harrow; once with a shovel plow, and layed by with a side corn plow.

Cost of cultivation as follows, viz.:

Breaking one acre	$1.50
Marking off and planting	.75
Harrowing	.37
Two plowings and thriving	2.50
Whole cost of cultivation	$5.12

The crop was gathered December 5, 1857. My age is 16 years and 6 months, and I am 6 feet 3½ inches high.

By 1860, Iowa's annual corn production was more than forty-two million bushels. Many changes occurred during the next twenty years. First was the change in motive power as more horses and mules replaced oxen (Chapter 13). As the horse replaced the slow-moving ox, it became possible for a farmer to plant and harvest more acres of corn. By 1880, farmers were harvesting some 231 million bushels, nearly a sixfold increase in twenty years. Of course this was largely due to plowing up of more prairie into crop land as the state became settled. More corn meant more livestock. Numbers of livestock rose in roughly the same proportion as the amount of corn. In this same twenty-year period, Iowa farmers increased hog numbers from 935 thousand to more than 6 million, and cattle from a half million to two and a half million.

By 1880, too, Iowans had turned from hand planters to wire-operated checkrow planters. It has been estimated that one man could plant about four and one-half acres of corn a day with the hand planter. With a two-row check planter he could plant fourteen acres a day. As time went on, tractors, four-row planters, corn pickers and tractor-mounted cultivators continued to increase the acreage of corn that one farmer could raise.

Methods of planting corn are vastly different today from those of one hundred years ago. The types of corn planted vary even more.

TYPES IN OLDEN DAYS

Corn is native to the Americas. The first immigrants who settled the Atlantic coastal region knew nothing of corn, or "maize" as it was then commonly called. The only strains available were those being grown by the Indians. These may be divided into three general types: flint, flour, and gourd seed. Dent corn as known today was practically unknown to the Indians and the early settlers. The "gourd seed" was a very late, rough type. It is believed by some that the dent varieties arose from crosses between the gourd seed and flint types; or it may be that the dent types were developed from the gourd seed by direct selection. At any rate, because of its extreme lateness, the gourd seed type was not extensively grown by the settlers who moved into what was to become the Corn Belt.

The Iowa settler had two choices as to the type of corn he could plant: local strains obtained directly from the Indians or relatively unadapted strains which he had brought with him from the East. The

Indian varieties probably were too early for maximum yield and the varieties brought from farther east were often too late. This led to an immediate interest in developing better adapted types.

The development of adapted types falls roughly into three periods, 1846–90, 1890–1920, and 1920 forward. The limits assigned to these periods are somewhat arbitrary. In the first period, corn breeding was almost exclusively in the hands of practical farmers. In the second period the experiment stations assumed the leadership and the corn show and corn yield test came into prominence. The third period also was dominated by the experiment stations and commercial hybrid seed producers, the emphasis being shifted to the isolation and testing of inbred lines and the commercialization of hybrid corn.

We know little as to the varieties commonly grown during the first period. In a survey made by the Patent Office in 1850, the only named variety mentioned as being grown in Iowa was "Elkhart," although mention also was made of "a South Carolina variety which was gaining favor."

Calico and Bloody Butcher were two types, commonly grown by the early settlers, which persisted on a small scale to the end of the second period. Strains known by these names were constant in only one characteristic, their color. The Calico strains had a variegated red and white seed coat; the Bloody Butcher types were solid red. It is probable that both types represented hybrids between strains of corn brought in by the settlers and highly colored Indian types.

PIONEERS IN DEVELOPMENT

During this period many men were interested in corn. Relatively little is known, however, as to their achievements unless the strain they developed achieved some degree of popularity. Many varieties which later became very popular had their origins in the 1850–60 period. One of these, Reid Yellow Dent, became one of the most widely grown varieties in Iowa, so its mode of origin deserves some mention. Wallace and Bressman, in their *Corn and Corn Growing,* report that:

> Reid Yellow Dent was originated by an accidental cross between a rather late, light-reddish colored corn and a small, early yellow corn. Robert Reid, the originator, brought the reddish colored corn, known as Gordon Hopkins corn, to Illinois from Brown County, Ohio, 1846. Because of a poor stand in 1847, a small yellow corn, probably a flinty type, was used in replanting the missing hills, and so the cross occurred. James L. Reid, a son of Robert Reid, improved the hybrid by selection, his best work being done from 1870 to 1900. He won a prize with it at the World's Fair in 1893, and as a result it soon became widely distributed.
>
> Reid Yellow Dent requires from 110 to 120 days to mature and should be classed as medium late. At present, due to wide adaptability, it is the most common yellow

variety in the Corn Belt, although the type necessarily has been modified to fit many different conditions. The type as now generally grown is rougher than the type which Reid originally preferred.

Outstanding strains of Reid corn are Iodent, Black, McCulloch, and Krug. Iodent is an early Reid developed by L. C. Burnett after years of painstaking ear-row work at the Iowa Station. Black has resulted from a cross of Iodent and a late show type of Reid, made by Clyde Black, of Dallas County, Iowa. McCulloch was produced by selection from a cross of a small amount of Pride of the North with a large amount of Reid. Fred McCulloch, of Iowa County, Iowa, was the originator. George Krug, of Woodford County, Illinois, in 1903 crossed Gold Mine with a Nebraska strain of Reid and has developed Krug corn by selecting continuously for a smoother, rather small-eared type. All of these strains have demonstrated their ability to yield.

Another variety which achieved considerable prominence was Leaming. J. S. Leaming began his selection work about 1856. The variety "Leaming" became popular in the eighties and nineties largely because of the publicity it received in winning prizes at the World's Fair in 1878. Other varieties which received prominence were developed at a somewhat later period. These include such varieties as Boone County White, Johnson County White, Silvermine, and Silver King.

Many men whose names are not linked with some variety did much to improve the open-pollinated varieties of corn, among them P. G. Holden, H. D. Hughes, L. C. Burnett, and the late "Uncle" Asa Turner.

Asa Turner was a devout man. He was also keenly interested in corn improvement—more so than some of his fellow churchgoers thought desirable. One Wednesday, as tradition has it, he attended prayer meeting at Maxwell, in a little village church which was later named for him. The congregation was small. One old lady bowed her head in deep concern and prayed, "Oh God, help Brother Turner pay a little more attention to the Lord's work and a little less attention to corn." Whether the criticism was justified or not, Asa Turner was credited by his neighbors with helping farmers in his community learn better ways to select and store seed corn.

EXPERIMENT STATIONS

During the second period, 1890–1920, experiment stations in the various states assumed the lead in corn breeding. Mass selection had been used extensively by the farmer-breeders. This method of breeding had been in use since the domestication of the corn plant. A second method of breeding—varietal hybridization—was suggested by W. J. Beal, of the Michigan Station, about 1880. In two out of three tests

he obtained varietal hybrids which were higher yielding than either parent. The method aroused little interest at that time. It was further explored during the period 1908–16, but never came into general use.

Rather widespread interest was aroused by a quite different breeding method called ear-to-row breeding. This method was introduced by the Illinois Station about 1896. It was a combination of selection for appearance, which had dominated corn breeding up to this time, and progeny performance. Carefully selected ears were planted, one ear to a row, and records obtained on their performance. The first results appeared promising and the merits of this scheme were vigorously explored.

CORN SHOWS

This period was really dominated, however, by the corn show and later by the corn yield test. As previously mentioned, winning awards at state and world fairs brought such varieties as Reid, Leaming, and Johnson County White into widespread prominence. A score card for judging corn was prepared by Orange Judd for the Illinois State Fair of 1891. This idea was quickly adopted and the corn show was in its "heyday" about 1900–10. Valuable prizes were offered for the best ear and the best ten-ear samples. Often these winning samples were sold for fantastic prices. An example is D. L. Pascal's prize winning single ear. This beautiful ear is now the property of Iowa State College. It won first prize in the 1907 Iowa State Corn Show and after the show brought $150 at auction. By accident or design one or two kernels were lost from this ear. Pascal felt this loss marred the beauty of the ear to such an extent that he offered $5 to anyone who would supply the missing kernel. In other shows, winning single ear entries have sold for as much as $250.

A prize winning sample at a major corn show was not a good measure of the value of that particular variety or strain. It was really a measure of the showman's ability and patience in sorting over hundreds of bushels of corn to find a ten-ear sample corresponding with the score card ideal. Winning a corn show prize became a profitable side line for some farmers. It greatly increased the sale of their particular strain or variety, and the premiums won often amounted to a considerable sum. It is estimated that the premiums won by E. R. and J. C. Mawdsley of Burt, Iowa, in local contests, the state corn show, and the State Fair amounted to at least $1,200 during a five-year period.

Another important development occurred during this "Corn Show" period. P. G. Holden became impressed by the general poor

stands which were being obtained by farmers. About 1905 he began to accumulate data on this point. Samples of corn were obtained from the farmers' planter box and these lots were compared in test plots located on county farms throughout the state. The results indicated quite clearly that the yield of corn was closely associated with the number of plants per acre. Holden became so convinced of the necessity for bettering stands if high yields were to be produced that he solicited the co-operation of the various railroads operating in Iowa. Special corn tours were organized and lectures and demonstrations were given at every stop on the value of good seed and the relationship between good viability and high yields. This work undoubtedly was responsible for increasing Iowa's total corn production by several million bushels.

In spite of the popularity of the corn show, many people remained skeptical as to its value. As early as 1895 Plumb stated that the corn score card has no more value than a scale of points in judging butter when the breed of cow or her profitable character are not considered. This skepticism increased when various experiment stations began to present data indicating the various score card points were not closely related to field performance. Consequently, more and more emphasis came to be placed on field performance. In many states this took the form of a state yield test. This was true in Iowa where Henry A. Wallace and Professor H. D. Hughes were responsible for starting the Corn Yield Test in 1920. This test disclosed a number of high-yielding strains of corn which became widely grown over the state. Most of these varieties were developed by farmer-breeders and represented selections from Reid Yellow Dent or various Reid hybrids. Included were the familiar names of Clyde Black, H. F. Osterland, Fred McCulloch, George Steen, George Krug, and a score of others who developed superior strains with proven performance and show type characteristics to a marked degree. In spite of apparent progress, the days of these open-pollinated varieties were numbered, although few realized it at that time.

INBREEDING AND CROSSBREEDING

The third period could be designated as starting in 1905 with the systematic beginning of studies on inbreeding and crossbreeding corn. Or 1933 might be chosen, when hybrid corn began to grow on a small but significant scale. However, 1920 was chosen because it was at about that date that the Cornbelt experiment stations began extensive inbreeding investigations with corn.

In 1905, at Cold Spring Harbor, on Long Island, New York, work was begun which eventually was to revolutionize corn production and to make old corn varieties nearly as extinct as the dodo. Dr. G. H. Shull found that when corn was inbred for two or more generations, there was a marked reduction in vigor. This loss in vigor was greatest after the first inbreeding and became progressively less in each succeeding generation. Although this loss in vigor was undesirable from a practical standpoint, it was accompanied by a marked increase in uniformity.

Dr. Shull's experiments didn't stop with inbreeding, however. He crossed some of these inbred strains and in some crosses obtained yields considerably better than the original parent variety. Dr. Shull possessed sufficient imagination to see that such hybrids could be used commercially. The inbred lines then available, though, were so low in yield that the use of such hybrids didn't appear feasible.

In the years that followed only a few people continued inbreeding and crossbreeding experiments with corn. D. F. Jones, at the Connecticut Station, suggested the use of double crosses (a hybrid between two single crosses) rather than the single crosses (hybrid between two inbred lines) used by Shull. This use of double-cross hybrids permitted the production of better size, shape, and quality of seed and materially reduced the cost of such seed.

About 1920 many of the Cornbelt stations started extensive programs looking toward the development of good inbred lines of corn, and eventually hybrids. The work at the Iowa Station was started in 1922. The work was co-operative between the Iowa Agricultural Experiment Station and the United States Department of Agriculture. Dr. Merle T. Jenkins had charge of the program and made several important contributions.

In the early stages of the work, little information was available on what constituted a good inbred line. Any line which could be maintained without too great difficulties was considered worth keeping. However, the value of a line is determined mainly by its performance in hybrid combinations, and the making and testing of such hybrids proved to be a very serious bottleneck. If a corn breeder had four hundred inbred lines, not a very large number as most programs go, it would require the making and testing of 79,800 single crosses to determine the merits of such a group of lines. The production and testing of this number of crosses is practically impossible. Dr. Jenkins and Dr. A. M. Brunson, then located at the Kansas Station, developed and proved the value of a scheme of testing, called the top-crossed test, which has since come into general use. With this scheme

each inbred line is crossed with a common parent, such as an open-pollinated variety, and the resulting top cross is used to evaluate the line. Thus only four hundred crosses were necessary to test the four hundred lines. This simplified very materially the testing of new lines and undoubtedly was an important factor in hastening the widespread commercial use of hybrid corn.

The next problem was of a somewhat similar nature. Suppose that through the use of the top-cross testing procedure the original four hundred lines had been whittled down to one hundred lines.

If these one hundred lines were combined in all possible single crosses, the number of such crosses is 4,950. The hybrid corn used by the farmer is a double cross rather than a single cross. Now when these single crosses are combined into double crosses the total number possible is 11,763,675. If all of these hybrids were made and Iowa's entire corn acreage planted to such combinations, there would be less than one acre planted to each possible hybrid. Assuming one had sufficient staff and funds to test ten thousand double crosses per year, it would require over one thousand years to make and test these 11,763,675 double cross combinations. Of course it is impossible to make and test this number of hybrids. Here again Dr. Jenkins developed a satisfactory and highly efficient short cut by devising a method whereby the performance (yield, lodging, etc.) of double crosses could be predicted from single cross yield records. With such a prediction method available it was necessary to make and test only a small percentage of the total possible combinations. This prediction method is widely used and materially shortens the period between the first inbreeding and the final tested product—the double cross grown by the farmer.

INTRODUCTION IN IOWA

The total process from the beginning of inbreeding through the period of testing until the proven hybrid is ready for the farmer's field requires a period of about ten years. The corn breeding program at Iowa State College was started in 1922. The first hybrids were ready for release in 1932 and 1933. At that time hybrid corn was still considered as some sort of new fangled magic—a passing fad. To help acquaint the farming public with hybrid corn, small samples were distributed to farmers over the state. This seed did not have the show corn kernel and type and many who received the seed refused to plant it, feeding it to the hogs or chickens. A few adventurous souls, however, planted it alongside their regular corn. At harvest time most of these reported a higher yield from the hybrid.

During these early years hybrid corn came in for much criticism.

Corn showmen didn't like it because the ear type didn't conform to the score card ideal. Livestock men who didn't understand the principles involved were very skeptical of developing a superior corn through the use of runts (the inbred lines). Henry A. Wallace and

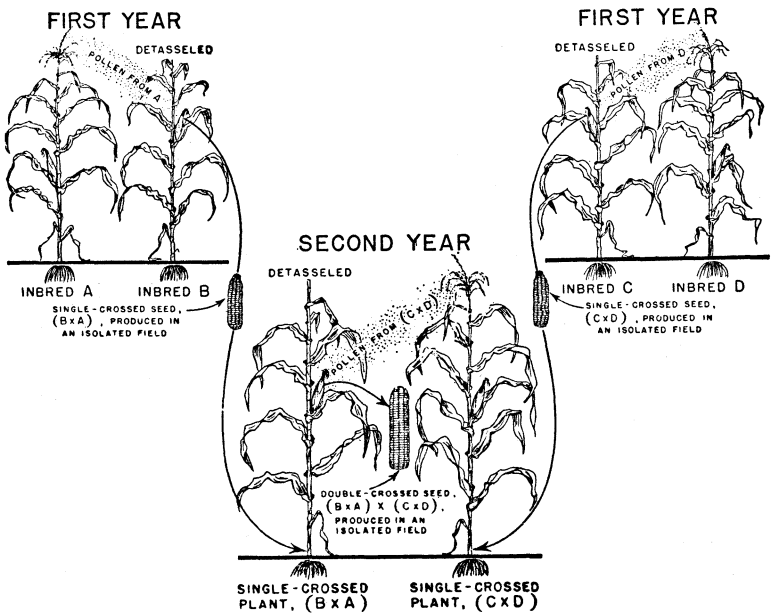

FIG. 3.—Hybrid seed corn, now used for almost every acre of corn planted in Iowa, is produced by means of these carefully-supervised methods. This is the method of producing seed of single and double crosses.

the Pioneer Hi-Bred Corn Company played a very important role during this period in publicizing hybrid corn and in demonstrating that large-scale commercial production was feasible.

The Iowa corn yield test demonstrated year after year that the best hybrid combinations regularly outyielded the best open-pollinated strains. This happened with such regularity that a special class was set up for hybrids. The various hybrid entries competed only with each other. In spite of this distinction the final yield reports continued to tell the same story; an average superiority of 20–25 per cent for the hybrids over the open-pollinated varieties. It was not mainly increased yielding ability alone that sold hybrid corn to the farming public, however. The ability of the various hybrids to stand up when mature probably was the biggest factor in their eventual adoption.

This may appear surprising, since we normally think of the farmer

as being interested in a maximum production per acre. The explanation is simple. Many farmers do not possess wagon scales and therefore cannot determine small variations in yield. Differences in yield must amount to at least 10 per cent to be visible to the eye. But differences in lodging (stalk breaking or root lodging) are readily discerned. During the harvest period these differences become more deeply engraved on the husker's consciousness with each additional ear that he has to stoop to gather.

The development of hybrid corn, its rapid acceptance, and the effect on production has been said to be the most important development in agricultural production of the past century. This is especially true in Iowa where adoption of hybrid corn was more rapid than in any of the other Cornbelt states. In 1933, less than 1 per cent of Iowa's corn acreage was planted to hybrid corn. Ten years later, in 1943, 99 per cent of Iowa's corn acreage was planted to hybrid corn. The effect of hybrid corn on the average yield per acre was striking.

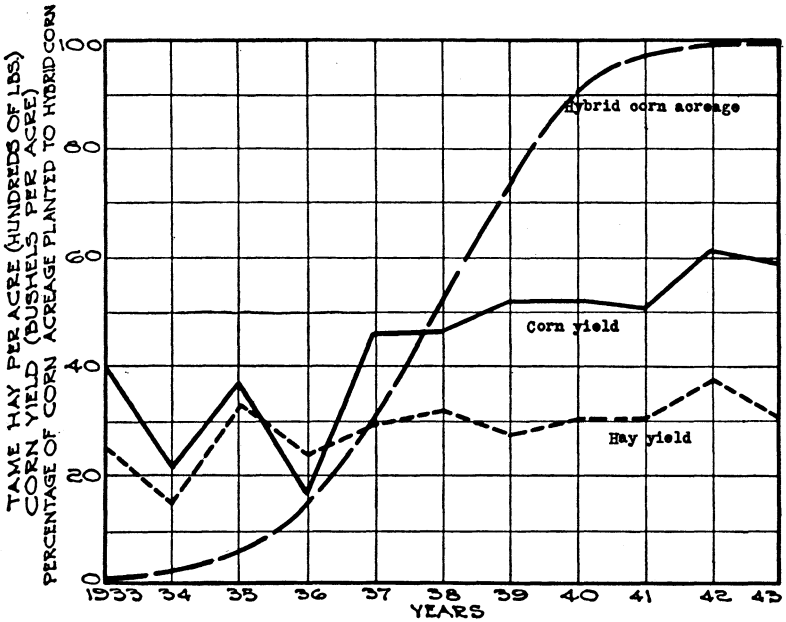

FIG. 4.—The effect of hybrid corn on acre yields.

Increased yields result from many factors: a series of favorable years, improved soil conditions, better practices, etc. However, tame hay should respond to such changes much as corn would. In addition

its growing season is virtually the same and acreage has been relatively constant. Where corn yields rose more than yields of tame hay, the difference may then be ascribed to the effect of hybrid corn.

YIELDS

The average yield of corn in bushels per acre was 53.8 for the five-year period, 1941–45. In four of these years the average yield was in excess of fifty bushels per acre. State average yields in excess of fifty bushels per acre have been recorded only twice before in the history of the state. These two years were 1939 and 1940, years in which hybrid corn comprised a considerable part of the state's acreage.

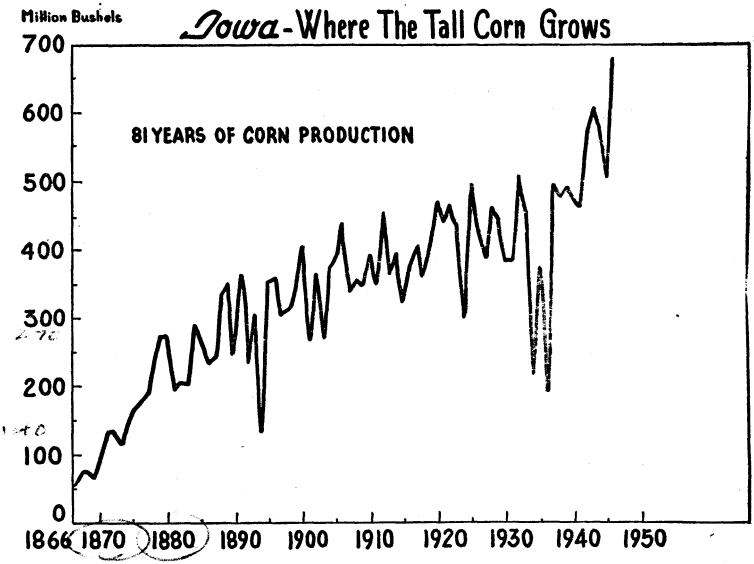

FIG. 5.—By its centennial year of statehood, Iowa's total annual corn production was nearing the 700-million bushel mark in its steadily climbing output.

These figures on acre yield are impressive, but it is difficult to conceive what can be done with 500 million bushels of corn. Table 6 expresses this production in terms of livestock products.

The "what and how" of hybrid corn has been told many times in both popular and scientific language. In spite of this many people think all hybrids are alike. When asked what kind of corn they planted they reply, "It was hybrid corn" or it was "Pioneer," "Funk," "DeKalb," "Station hybrid" or any one of a host of other names. They seldom remember the name of the hybrid, the only means by which they can be sure of getting the same thing the next season. They

assume that all hybrids sold by any one dealer are similar and equal in performance. This is far from true. Different hybrids differ as much in their characteristics as do different people.

Any open-pollinated variety is a complex mixture of types. Some

TABLE 6
IOWA CORN PRODUCTION CONVERTED TO LIVESTOCK EQUIVALENTS

Year	Million Acres	Average Bushels Per Acre	Total Production (Million Bushels)	Pork Equivalent (Billion Pounds)	Beef Equivalent (Billion Pounds)
1941.....	9.1	51.0	465	6.5	3.7
1942.....	9.6	60.0	574	8.0	4.6
1943.....	10.9	59.0	641	9.0	5.1
1944.....	11.0	52.5	579	8.1	4.6
1945.....	10.9	46.5	508	7.1	4.0
Average....	10.3	53.8	553	7.7	4.4

plants are tall, others shorter, some have good ears, others have only nubbins or are completely barren, and so on for all the characteristics which could be listed. Inbreeding, to develop pure strains, is merely a convenient means of sorting this complex mixture out into its separate component parts. Selection practiced during this sorting process enables the breeder to save the desired types and discard the inferior ones. These true breeding strains then form the building blocks from which hybrids are produced. The characteristics of the hybrids vary, depending on the blocks used in its construction.

Hybrid corn's superiority in yield and its standing ability are important qualities, but possibly no more important than resistance to various diseases and insect pests or suitability for mechanical picking. Evaluation of hybrids from these standpoints is somewhat more difficult, however. Serious epidemics of the various corn diseases occur only sporadically, hence data are meager. The same is true for resistance to the various insect pests. But it is a common observation that the hybrids now being grown possess more resistance to disease and insect attack than the open-pollinated varieties previously grown. It also is the opinion of many that the mechanical corn picker would not have come into almost universal use except for hybrid corn.

USES OF CORN

This story thus far has dealt with the changes in corn varieties, production, and breeding methods. There have been comparable changes in the uses of corn. Corn yields more industrial products than

any other grain, but its main use has been and probably will continue to be for livestock feed. The bulk of Iowa's corn production is fed to livestock on the farm where it is raised, but industries use more than 500 million bushels yearly. From one-fourth to one-third of the corn processed by the wet and dry millers and the distillers is returned to the farmer in the form of by-product feeds.

The mixed feed manufacturers are the largest industrial users of shelled corn. This outlet for corn is relatively new and expanding rapidly. The next largest industrial outlet for corn is the dry milling industry. This industry is relatively old and mills for grinding corn were established shortly after the first settlers arrived in Iowa. Their chief products are corn meal, grits, breakfast cereals, and flour. Approximately 85–90 per cent of the dry milled corn products are used as food.

The main product of the wet milling industry is starch, with feed and oil as important by-products. The starch is used for food or for industrial purposes such as a core binder for use in making metal castings, and adhesives. It may be modified by heat, chemical, pressure, etc. into various types of products having adhesive properties. By conversion with acids, syrup or sugar may be obtained. These in turn may serve as raw material for further modification to fill special industrial requirements. When so modified they may be used in bakery products, beverages, chewing gum, lactic acid, jams, jellies, infant and invalid foods, mayonnaise, pharmaceuticals, vinegar, and vitamin C.

The corn oil which is recovered as a by-product is used largely as a cooking or salad oil. The gluten and oil cake by-products find their way back to the farm as livestock feed.

The use of corn by the distilling and fermenting industries is important, but the amounts of corn used are not large compared with other industrial outlets. The principal products are ethyl and butyl alcohols, acetone, and whiskey. Industrial alcohol is used by the manufacturers of such diverse products as medical supplies, synthetic rubber, shatter-proof glass, lacquers, and plastics.

The story of corn in Iowa during the past one hundred years is a story of progress. Superior open-pollinated varieties gradually replaced the immigrants' corn, to be replaced in turn by even better hybrids. Corn acreage increased with an increase in population, more efficient machinery, and better production methods. The livestock population increased with the expanding corn acreage. Corn in excess of livestock feed requirements has found an ever increasing industrial outlet to provide many articles now required by our complex civilization.