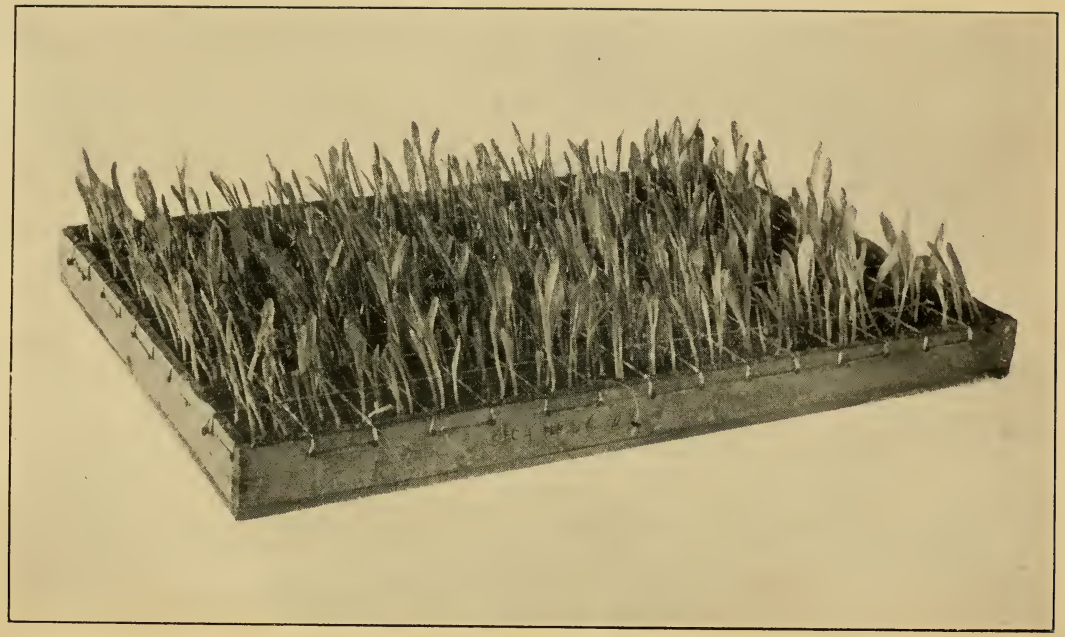

A SAND GERMINATOR

The Study of Corn

BY

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The rose may bloom for England,
The lily for France unfold;
Ireland may honor the shamrock,
Scotland her thistle bold;
But the shield of the great republic,
The glory of the West,
Shall bear a stalk of tasseled corn,
Of all our wealth the best.
The arbutus and the goldenrod
The heart of the North may cheer,
And the mountain laurel for Maryland
Its royal clusters may rear,
And the jasmine and magnolia
The crest of the South adorn,
But the wide republic's emblem
Is the bounteous golden corn.

—Edna Dean Proctor.

CONTENTS

PREFACE

THIS work is prepared as a laboratory guide in corn judging for use in agricultural colleges, high schools, and agricultural extension schools, and as a guide to the farmer in the study of corn.

During the past decade, which has meant so much for corn improvement, the score-card method of judging, in which definite standards are set, certain credits given to the several qualities considered and definite rules given for marking deficiencies, has been largely employed.

The score-card has been of great value and convenience in the study of corn at a time when little attention had been given to corn improvement; but our corn specialists are now beginning to realize, as our stockmen have realized for many years, that the score-card is too arbitrary and unpliable for the most careful comparison of individual or unit groups. The primary function of the score-card is an aid to the beginner, and, as such, will doubtless be found to be of considerable value in the hands of many instructors, but in the experience of the writer with undergraduate students of the agricultural college, it has required much supplementary instruction and has not proved to be the most convenient means of acquiring knowledge as to detail in the study of corn or the importance or relation between the characteristics considered. The chief objections to the general or ex-

clusive use of the score-card in the study of corn are:

(1) Most score-cards do not provide for sufficient detail in the study of corn. There are many qualities which have not and can not well be included in the score-card because of their relative unimportance or their infrequency of occurrence, which are of considerable importance in the judging of certain samples.

(2) The score-card does not show the relation between the several qualities, except in a limited way, and does not present the subject in an analytical manner which is conducive to original study on the part of the student.

(3) It is an unsatisfactory method of selecting and judging corn. It is based upon the assumption that there are always certain definite relations between each of the qualities on the score-card and that each quality may be assigned a certain number of credits. As a matter of fact, no such relation exists. For instance, in comparing two samples it may be found that they are very similar in all respects, with the exception of maturity and seed condition, in which they differ radically. Maturity and seed condition, then, are the deciding factors between these two samples and are worth practically 100 points. In comparing two other samples, the maturity and seed condition may be found to be identical, but the type or amount of corn represents the important difference. Any one of these qualities may be worth 0, 10, 20, 50, or any number of credits, and any score-card in which each quality is always given a definite number of credits is apt to fail to show the true relative value of the samples or ears.

The chief characteristics of the method of judging outlined in this book are the arrangement of the detailed characteristics of the ear in a manner to show their significance and their relation to each other, a comparison of ears in these various characteristics and the comparison of ears and groups of ears as units. The average relative importance of the several characteristics is stated only in a general way, but the student is taught the relative value of these characteristics in all possible combinations of strong and weak points by numerous comparisons. The score-card may be used to advantage in conjunction with the comparison method of judging, but its use should follow that of the comparison sheets A and B or of a similar study, and be used to point out some of the more important characteristics and to show in a general way the relative importance of the several characteristics, with the understanding that the relative importance is not a fixed quality.

While one may proceed much more rapidly in the study of corn under the direction of a competent instructor, this work is arranged, so far as possible, in such a manner as to enable the careful student to proceed without further instruction.

THE STUDY OF CORN

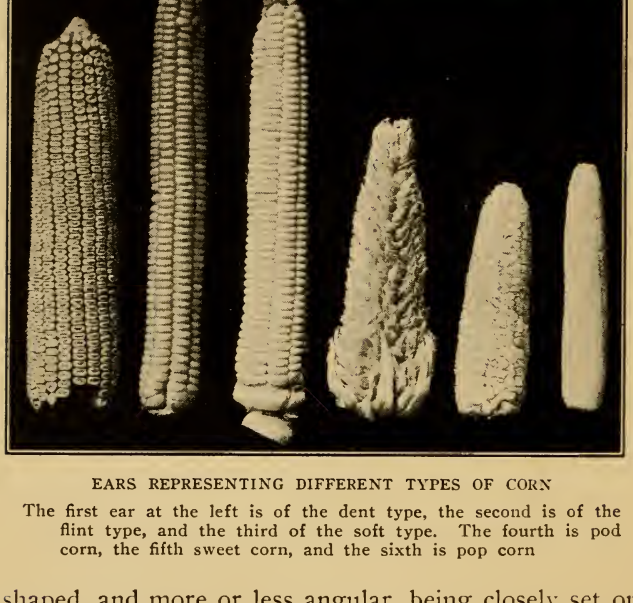
CHAPTER I

TYPES AND VARIETIES OF CORN

Corn, known botanically as *Zea maize*, and in other countries commonly as maize, belongs to the grass family, but differs widely from wheat, oats, our pasture and meadow grasses, and other common species of the family. Few if any of the wild types of corn are known, and doubtless the cultivated species would become extinct in a few years if not cared for by man. Dr. E. L. Sturtevant has classified corn in six sub-species or types, as follows:

Dent corn (*Zea indentata*) in which the horny endosperm is located mainly at the edges of the kernel, and the soft or white endosperm in the center and at the crown. In maturing, the soft endosperm shrinks more rapidly than the horny endosperm and causes an indentation and a more or less irregular wrinkling or folding of the seed coat at the crown of the kernel. This type, on account of the large number of varieties and varying conditions under which it has been grown for a great length of time, shows a wide variation, but is, on the whole, a medium to large type, requiring a medium to long season for maturity. Usually only one ear, which is of medium or large size, is produced on each stalk.

This type is further characterized by ears which usually have a large number of rows of grains and a large diameter, the circumference being about ¾ to 4/5 the length of the ear. The grains are long, wedge-



EARS REPRESENTING DIFFERENT TYPES OF CORN

The first ear at the left is of the dent type, the second is of the flint type, and the third of the soft type. The fourth is pod corn, the fifth sweet corn, and the sixth is pop corn

shaped, and more or less angular, being closely set on the cob.

Dent corn is by far the most common type of corn and is especially adapted to the corn belt and to all sections where the growing season is sufficiently long to mature it.

Flint corn (*Zea indurata*) differs from the dent type in having the soft endosperm in the center of the grain and surrounded by the horny endosperm. In ma-

turing, the grain shrinks uniformly, so that no indentation is produced.

The flint corns do not require as long a season as the dent varieties and do not attain as great a height or as large a stalk or as broad leaves. The tendency to sucker is much more marked and frequently two or more ears to a plant are produced. The ears are produced much nearer the ground and are of a quite different type from those of the dent corn. The ears usually measure from 4½ to 6 inches in circumference and 8 to 14 inches in length. The usual number of rows is 8 to 12. The grains are rather loosely set on the cob with wide furrows between the rows. The kernels are shallow, usually wider than deep, and rounded at the crown. The ear has a flinty, glossy appearance, the more common colors being some of the various shades of yellow or white.

This type is adapted to our most northern States and to Canada and to other sections where the dent varieties are not adapted on account of the shortness of the season.

Soft corn (*Zea amaylacea*). This type may be readily recognized by the absence of the horny endosperm, the entire interior of the grain, aside from the germ, being composed of a soft, starchy endosperm. Varieties of this type are commonly grown in several of the South and Central American countries, where a long growing season is provided; but none of them are of commercial importance in the United States, although the Brazilian flour corn, which is one of the varieties of soft corn, is occasionally grown as an ensilage variety.

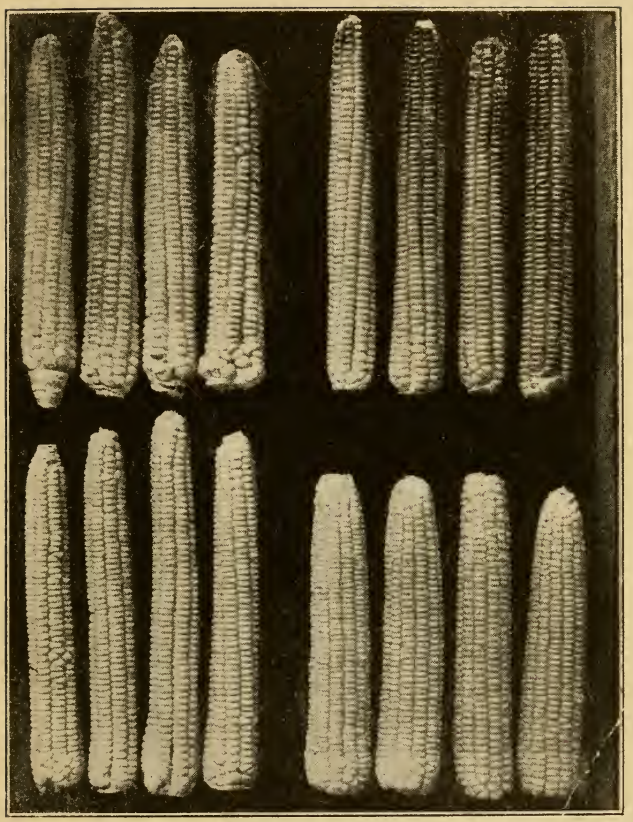
The shape of the ear is similar to the flint type, ex-

cept it is a little larger in circumference and somewhat shorter. The grain is of the broad, rounded type, similar to the flint kernel and in some varieties is very large. On account of the uniform shrinking of the grain in ripening, little if any indentation appears. The color varies widely, white, blue and black being the most common. The appearance of the ear is not as glossy as in the flint varieties.

Sweet corn (*Zea sacchrata*). This type is characterized by the translucent, horny appearance of the endosperm and the wrinkled appearance of the matured kernel. The starch is more or less reduced to sugar, which makes this type especially suited to table use. The ears are small to medium in size and usually have 8 to 16 rows, the grains being rather broad and rounded.

The length of season required for maturing varies widely in the different varieties, and selections may be had which are adapted to any section where corn is grown. Sweet corn usually shows a decided tendency to sucker and some of the larger varieties are heavy producers of forage and valuable for use as a soiling crop.

Pop corn (*Zea everta*). In this type all or nearly all of the endosperm is corneous or horny, and very hard, which gives it the property of popping or turning inside out into an enlarged white mass upon being heated. There are two groups of varieties, the rice and the pearl. In the former the ears are inclined to taper considerably and the grains are very sharp or pointed at the crown. In the latter the grains are smooth or rounded at the crown and more compact on the cob, and the ears are only slightly tapering.



FOUR VARIETIES OF FLINT CORN

In the upper row the four ears at the left are Smut Nosed Flint, and those at the right the Red Blazed Flint. In the bottom row the Longfellow Flint is shown at the left and the Yellow Flint at the right.

The ears of pop corn vary in length from about 3 inches in the Tom Thumb variety to 7 or 8 inches in some of the larger rice or pearl varieties. Pop corn suckers readily and usually produces several ears per plant. The length of season required and the adaptability to different conditions varies widely in different sections. It is little grown except for human consumption.

Pod corn (*Zea tunticata*). This corn is characterized by a small to medium sized ear which is not only enclosed in the husk about the ear, but has husks surrounding each kernel. Because of the tendency of dent corn to occasionally revert to this type and the tendency of pod corn to break up into several types, this corn is thought to be the primitive or original type of corn from which the other types have developed.

The plant suckers abundantly, is very leafy, and has a tendency to produce grains in the tassel. It is of no commercial importance, being grown only as a curiosity.

Varieties of corn. The fact that corn is a cross-fertilized plant and is with difficulty kept pure, and the fact that any type will change materially in a few years if placed under greatly different conditions, accounts for the existence of the thousand or more, more or less distinct varieties or strains that are grown to-day. These varieties show every possible variation in type of plant, ear, adaptability, etc.

The dent varieties are frequently classified as to the length of season, as follows: early, medium early, medium, medium late and late. And also as to color, as follows: yellow varieties, which represent the most

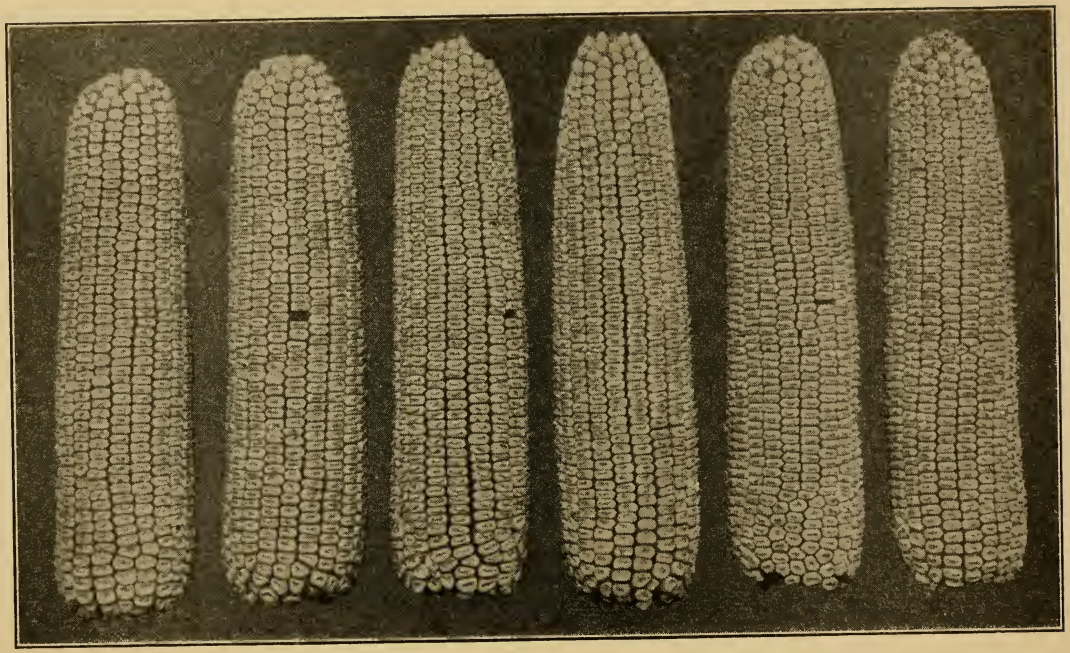
common type in at least the northern part of the corn belt and the Northern States; the white varieties, which are quite commonly grown throughout the corn belt and are the preferred type in the South, and the yellow, white-capped, blue, red, and calico corns, which are grown in a limited way in certain sections throughout the corn belt.

No attempt can be made here to classify and describe all the important varieties, but a brief description is given below of a few of the most popular ones.

DESCRIPTION AND ADAPTATION OF VARIETIES

Boone County White. The Boone County White was originated in Boone County, Indiana, but is probably more widely distributed to-day than any other variety of white corn. It is a rather large, nearly cylindrical ear, with 18 to 22 rows, measuring in the north central zone about 9 to 10 inches in length and 7 to 7½ inches in circumference and attaining a somewhat larger size as grown farther south. The grains are of medium width and fairly thick, and are usually of good length. The color is a cream white and the indentation varies from medium smooth to rough, the medium rough type being more common.

Although the ear characteristics are fairly well fixed, the Boone County White, on account of its wide distribution, has developed into several types of varying maturity and adaptability. It is, on the whole, a rather large, late-maturing variety, and is especially adapted to fertile soils in the southern part of the north central zone and throughout the south central and southern zones.



BOONE COUNTY WHITE

Clarage. The Clarage has been developed in Ohio, where it is quite commonly grown. It is a small-eared corn, measuring 8 to 9 inches in length and 6¾ to 7¼ inches in circumference, the number of rows varying from 14 to 18, and the color being a medium yellow. The kernels are fairly broad and of only medium depth. The indentation is medium smooth.

It is medium early in maturity, and is especially adapted to the clay soils of medium fertility in northern Ohio, to the uplands in southern Ohio, and to similar conditions in adjoining States. It varies considerably, both in type and adaptability in the hands of different breeders, these selections or strains usually lacking the uniformity of type found in the Reid's Yellow Dent and Leaming varieties.

Cocke Prolific. This variety, which has long been grown in the South, is representative of a large class of Southern corns known as prolific varieties. The ears are small, 8 to 9 inches in length and 6 to 6½ inches in circumference; but two or more ears are frequently produced on each stalk. The ear is slightly tapering to tapering, with 10 to 14 rows and a medium broad kernel with rather wide space between the rows. The indentation is medium smooth. The grain is of only medium depth and the per cent of grain is medium.

This and other prolific varieties are well adapted to the soil and climatic conditions of the South and are quite commonly grown. On account of the large amount of forage, they are promising varieties for silage; but it is questionable if varieties which produce a single ear per plant cannot be made to pro-

duce as large yields of grain and can be harvested more economically.

Collier's Excelsior. The Collier's Excelsior is a large-eared, white variety which has been developed in recent years in eastern Maryland, originating from a cross between the Farmer's Interest and White Elephant and closely resembling the Boone County White in type. The ears are cylindrical, well filled at the butt and tip, and measuring 10 to 11 inches in length and 7¼ to 7¾ inches in circumference and have 18 to 24 rows. The indentation is medium rough and the kernels deep.

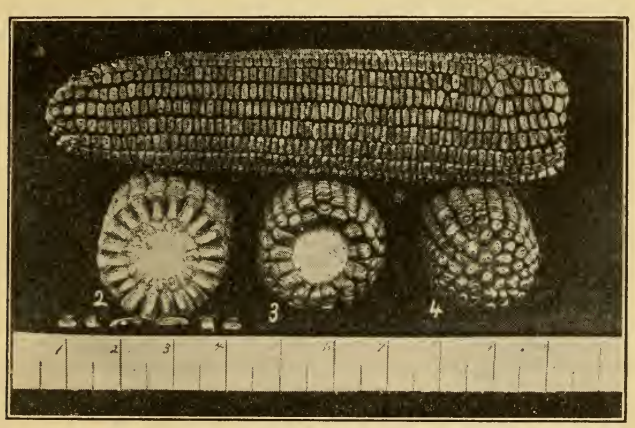
While this variety has not been widely distributed as yet, its apparent productiveness and adaptability to fertile soils or soils of medium fertility in the eastern ends of the south central and southern zones would indicate a wider distribution during the next few years.

Funk's Yellow Dent. The Funk's Yellow Dent is a medium large and medium late maturing variety, which has been developed during recent years in central Illinois. In general appearance the ears resemble the Reid's Yellow Dent, which entered largely into its early breeding. The ears are slightly tapering, 9 to 10 inches in length and about 7 inches in circumference. The indentation is medium rough and the color is a medium yellow, with a light or pale yellow cap. The grains are not as compactly placed upon the ear as in many strains of the Reid's Yellow Dent; the grains are deep and the butts usually well rounded, and the tips well filled.

Some strains of this variety have been bred for high content of protein and oil. While this variety does

not have the wide distribution of the Reid's Yellow Dent and Boone County White, it has a growing popularity throughout the corn belt. It is best adapted to conditions of the south central zone.

Hickory King. The Hickory King is a variety of corn which has long been grown in the South and to a limited extent in the south central zone. It is only



HILDRETH YELLOW DENT

A variety which is well adapted to the bottom lands, and more fertile soils of Kansas

a medium-sized ear, 8 to 9 inches in length, 6½ to 7 inches in circumference. It is characterized chiefly by its small number of rows and its very large, broad grains and its rather smooth, flinty appearance. It is medium late in maturity, and is especially adapted to the medium or poorer soils south of the Ohio River.

Hildreth. The Hildreth corn is a variety which has been developed during recent years in Kansas, where it is a promising variety for the river-bottom soils in

the eastern and central parts of the State. It is very late in maturing and is not well adapted to any part of the corn belt north of the northern border of Kansas nor the soils of poor fertility or unfavorable conditions south of this line. The ears are large in circumference and of fairly good length; the cobs are medium large, but the grains are very deep. The space between the rows while not wide is frequently deep, there being a large number of rows with a grain of narrow or medium width.

Hogue's Yellow Dent. This variety, which has been bred since 1885 in Saline County, Nebraska, and has since been distributed to other parts of Nebraska and adjoining States, has a medium-sized ear 9 to 10 inches in length and 6¾ to 7¼ inches in circumference. The ear is slightly tapering, has 16 to 20 rows, is medium compact, and is medium rough in indentation. It has a medium deep grain and a good per cent of shelled corn. It is medium late in maturity.

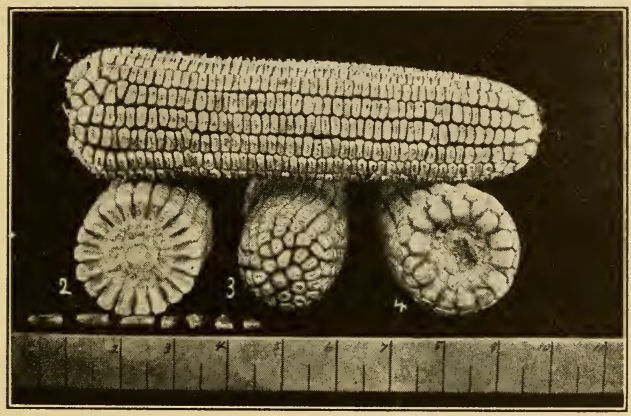
This variety has proved to be well adapted to eastern and central Nebraska and to northeastern Kansas and promises to be more widely distributed within the next few years.

Kansas Sunflower. This variety, which originated in central Kansas, has been carefully selected for many years, but did not have a wide distribution until tested and disseminated by the Kansas experiment station.

The ear is slightly tapering, or nearly cylindrical, 9 to 10 inches in length and about 7 inches in circumference; it has 14 to 18 rows, with a rather broad grain, the rows usually being carried out fairly well at butt and tip; the cob is medium small and the grain fairly deep for the size of the ear; the color is

a rich golden yellow. It is especially adapted to the drier sections and thinner soils of Kansas and adjoining states.

Leaming. The Leaming variety, which was originally bred in Clinton County, Ohio, consists of two distinct types. The old type of Leaming is a distinctly tapering ear with 18 to 24 rows and from 7 to



M'AULEY WHITE

A corn of wide adaptability in Kansas and adjoining states.

8 inches in length and from 7 to 7½ inches in circumference. The color is medium dark, often with a tinge of red. The grain is apt to be rather narrow and thick and is often quite irregular. The indentation is medium smooth. The butts and tips are usually well filled.

The Improved Leaming was bred in Illinois from the old Ohio type, from which it differs radically in appearance. The ears are slightly to medium tapering and have 18 to 22 rows. The length of ears is

9 to 10 inches and the circumference about 7 inches, the size varying somewhat according to the soil and climatic condition.

The color is a medium yellow with a tinge of golden yellow, and the indentation varies from medium to medium rough. The grains are usually somewhat wider and much more uniform than in the old type. The Leaming has a wide adaptation, being commonly grown in Iowa, Illinois, Indiana and Ohio, and to a less extent in several of the adjoining states, and also in several of the Eastern and Southern states.

Minnesota No. 13. This is a variety which has been developed by the Minnesota Experiment Station from a native Minnesota variety, and was first distributed by this station about 10 years ago. The ears are slightly tapering, 7 to 8 inches in length and 6 to 6½ inches in circumference, and 14 to 18 rows with a medium broad kernel. The indentation is medium smooth and the color is a medium yellow. While the uniformity is not as marked as in some varieties, the kernels are fairly deep and are compactly set on the cob. The butts are usually well rounded and the tips well filled. It is especially adapted for growing in Minnesota and the Dakotas, where it is commonly grown. It is also grown to a less extent in several other states.

Pickett's Yellow Dent. The selection and improvement of this variety may be traced back for a couple of decades or more, but its distribution throughout the lower peninsula of Michigan has taken place during the last few years. The ears are slightly tapering and are of medium small size,

measuring 7 to 8½ inches in length and 6½ to 7½ inches in circumference. The number of rows varies from 16 to 20. The kernels are medium long and are very compactly placed on the cob. The tips are well filled, the butts well rounded, and the shank small. The color is a medium bright yellow with light yellow caps. It is a medium small and rather early variety, reaching the height of about 8 feet and always maturing nicely unless planted late. It is well adapted to central and southern Michigan, and is growing in popularity. It is little grown in other states.

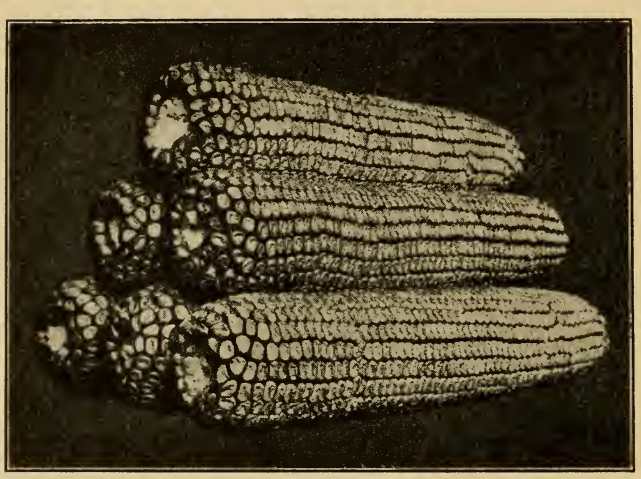
Pride of the North. The Pride of the North has been a more or less popular corn in the Northern States for several decades, but does not show the breeding and type found in some other varieties. The ears are small, the larger ones measuring only 7 to 8 inches in length and about 6 inches in circumference. The number of rows varies from 14 to 18, and the kernel is medium wide and rather shallow. The indentation is medium smooth; the color is a medium dark yellow. The ears are slightly tapering; the furrows between the rows are fairly wide and the kernels are only fairly uniform.

This variety is very early in maturing, and is well adapted to growing in the northern tier of States, where it is a good producer, or for late planting somewhat south of this belt.

Reid's Yellow Dent. In the north central zone, where the Reid's Yellow Dent variety is most commonly grown, it is of medium maturity and size, the ears measuring 9 to 10 inches in length and 6¾ to 7¼ inches in circumference. The typical number of

rows is 18 to 20, but ears are commonly found varying from 16 to 24 rows. The color is a medium dark yellow on the sides of the grain, often with a tinge of red appearing, the color of the caps or crowns being a light or pale yellow.

The Reid's Yellow Dent corn usually has a very



REID'S YELLOW DENT

compact appearance, there being little space between the grains. The kernels have a characteristic shape, being rather narrow and thick and appearing somewhat square, as seen in the ear. The butts and tips are usually well covered. The shank or attachment to stalk is usually small, frequently too small to support the ear.

This variety was originally bred in north central Illinois, but has for many years been widely distributed throughout the north central and south central zones

and to a less extent in the northern zone. It varies greatly in adaptability and maturity and somewhat in type, in the hands of different breeders and under different soil and climatic conditions, but the uniformity and type (with the exception of color) is usually well marked in the hands of any breeder.

It is well adapted to the rich soils or soils of medium fertility in the central zone, though in the south central zone larger growing corns frequently return larger yields upon the more fertile soils.

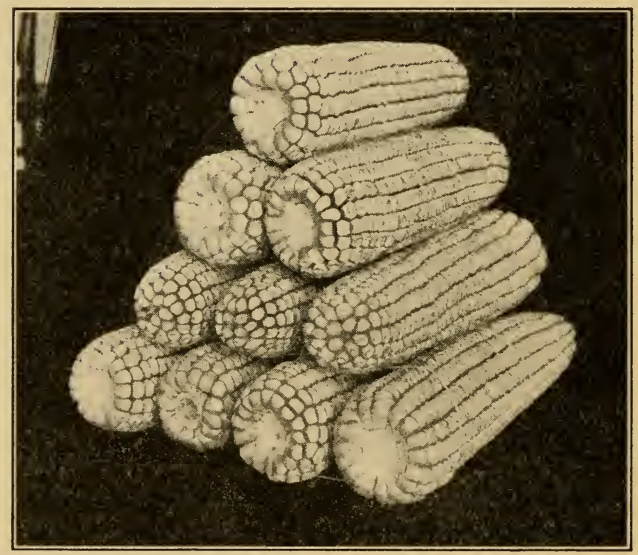
Silver King. The Silver King originated in northern Iowa, but has since been improved and widely disseminated throughout Wisconsin by the Wisconsin Experiment Station.

The ear is fairly large for the northern zone, measuring 8 to 10 inches in length and 6½ to 7½ inches in circumference. It has 14 to 18 rows, with a medium wide but deep grain and generally a good per cent of corn. The ear is nearly cylindrical, with the butts and tips well filled. The indentation is medium. It is an early maturing variety, and is especially adapted to Wisconsin, Minnesota, northern Iowa, and southern Michigan, where it is one of the leading varieties.

Silver Mine. The Silver Mine, which originated in Ford County, Illinois, about 1890, has a cylindrical or slightly tapering ear with a tapering tip, and measures 8½ to 9½ inches in length and 6¾ to 7¼ inches in circumference. While the rows are in distinct pairs, as in other varieties, the pairing is not as plainly visible, on account of the large space between the rows of each pair, which gives the ear a characteristic appearance. The usual number of rows is 18 to 20. The

kernels are rather broad and not very compact on the ear. The indentation is medium rough to rough. The color is a cream white. The cob is small and the per cent of grain fairly large.

This variety is medium early in maturing, and is best adapted to soils of medium fertility through the north central zone and the northern part of the south central zone. Its distribution is not as wide as the Reid's Yellow Dent, Leaming, or Boone County White, being grown chiefly in the section mentioned above.



SILVER KING (WISCONSIN NO. 7)

One of the most widely grown and highest yielding corns in Wisconsin

TABLE I.—DESCRIPTION OF VARIETIES, NORTHERN ZONE

Variety	Ear			Kernels				
	Shape	*Length inches*	*Circum. inches*	*Firmness on cob*	*Color*	*Indentation*	*Shape*	*Length*
Early Huron	sl. tap.	7–8	5¾–6¼	firm	light yellow	med. smooth	medium broad wedge	med. short
Longfellow Flint	sl. tap.	10–12	4½–5¼	firm	med. yellow	none	broad rounded	short
King of the Earliest	sl. tap.	7–8	6–6½	firm	light yellow	med. smooth	medium broad wedge	med. short
Minn. No. 13	sl. tap.	7–8	6–6½	firm	light yellow	med. smooth	medium broad wedge	med. short
Pickett's Yellow Dent	sl. tap.	7–8.5	6.5–7.5	firm	med. yellow	med. smooth	med. wedge	med.
Pride of the North	tap.	7–8	5¾–6¼	firm	med. yellow	med. smooth	med. wedge	med. short
Silver King	sl. tap.	8–10	6½–7½	firm	cream white	med. smooth	med. wedge	med. short

Variety	*Rows number*	*Space between rows*	*Butts filling out*	*Tips filling out*	*Shank size*	Cob		*Per cent of Shelled Corn*	*Uniformity*
						Size	*Color*		
Early Huron	14–18	med.	med. rounded	well filled	small	small	red	med.	med.
Longfellow Flint	8–12	large	even	med.	med.	small	white	small	med. good
King of the Earliest	14–18	med.	med. rounded	well filled	small	small	red	med.	med.
Minn. No. 13	14–18	med.	med. rounded	well filled	small	small	red	med.	med.
Pickett's Yellow Dent	16–20	small	well rounded	well filled	small	med.	red	med.	med.
Pride of the North	16–20	med.	med. rounded	well filled	small	small	red	med.	med.
Silver King	14–18	med.	med. rounded	med.	med.	med.	white	med.	med.

TABLE II.—DESCRIPTION OF VARIETIES, NORTH CENTRAL ZONE

Variety	Ear			Kernels				
	Shape	*Length inches*	*Circum. inches*	*Firmness on cob*	*Color*	*Indentation*	*Shape*	*Length*
Boone Co. White	cylin.	9–10	7–7.5	firm	cream white	med. rough	med. wedge	long
Clarage	sl. tap.	8–9	6.75–7.25	firm	med. yellow	med. smooth	med. broad	med.
Funk's Ninety Day	sl. tap.	8–9	6.50–7	firm	med. yellow	med.	med. wedge	med. long
Funk's Yel. Dent	sl. tap.	9–10	6.75–7.25	firm	med. yellow	med. rough	med. wedge	long
Golden Surprise	sl. tap.	9–10	6.75–7.25	med. firm	golden yellow	rough	med. wedge	long
Hogue's Yel. Dent	sl. tap.	9–10	6.75–7.25	firm	med. yellow	med. rough	med. wedge	long
Leaming	tap.	9–10	6.75–7.25	firm	med. yellow	med. rough	med. wedge	long
Reid's Yel. Dent	sl. tap.	9–10	6.75–7.25	firm	light yellow	med.	med. wedge	long
Riley's Favorite	sl. tap.	8–9	6.50–7	firm	med. yellow	med.	med. wedge	long
Silver Mine	sl. tap.	8.5–9.5	6.75–7.25	med.	cream white	rough	med. wedge	long

Variety	*Rows number*	*Space between rows*	Butts	Tips	Shank	Cob		*Per cent of Shelled corn*	*Uniformity*
			Filling out	*Filling out*	*Size*	*Size*	*Color*		
Boone Co. White	18–22	med. narrow	med. rounded	well covered	med.	med.	white	med. large	good
Clarage	14–18	med.	med. rounded	med. covered	med.	med.	red	med.	med.
Funk's Ninety Day	16–20	med. narrow	med. rounded	well covered	med. small	med. small	red	med.	med. good
Funk's Yel. Dent	18–24	med. narrow	well rounded	well covered	med.	med.	red	med. large	good
Golden Surprise	16–20	med.	med. rounded	med.	med.	med.	red	med. large	med.
Hogue's Yel. Dent	18–22	med. narrow	med. rounded	med.	med.	med.	red	med. large	med. good
Leaming	18–22	med. narrow	med. rounded	well covered	med.	med.	deep red	med. large	good
Reid's Yel. Dent	18–24	narrow	deep. rounded	well covered	med. small	med.	deep red	med. large	good
Riley's Favorite	16–20	med.	med. rounded	med.	med. small	small	deep red	med. large	med. good
Silver Mine	18–22	med. narrow	med. rounded	well covered	med.	med.	white	med. large	good

TABLE III.—DESCRIPTION OF VARIETIES, SOUTH CENTRAL ZONE

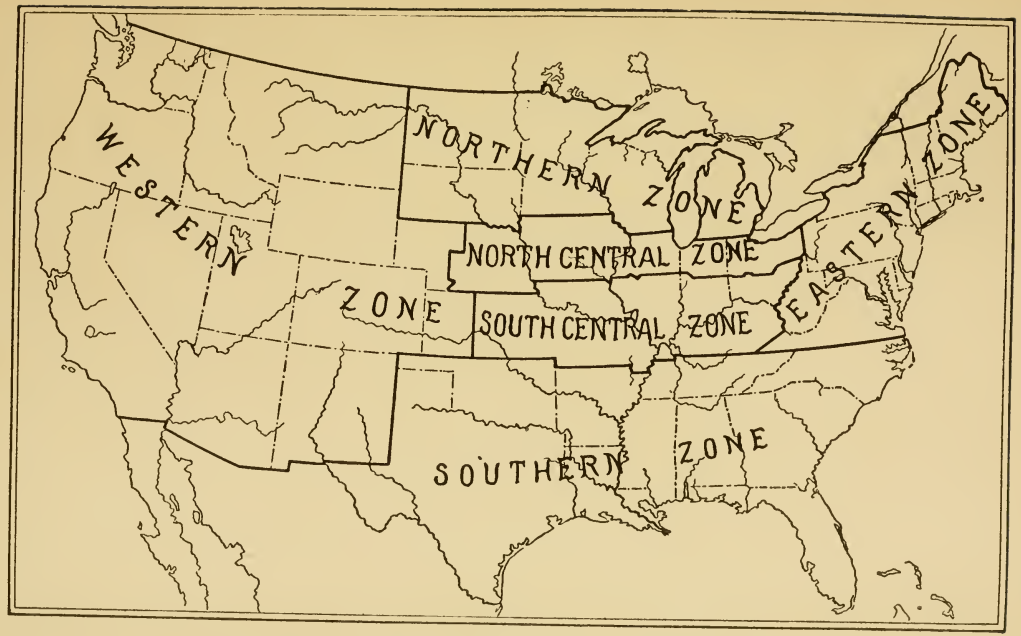
Variety	Ear			Kernels				
	Shape	*Length inches*	*Circum. inches*	*Firmness on cob*	*Color*	*Indentation*	*Shape*	*Length*
Boone Co. White	cylin.	10–11	7.25–7.75	firm	cream white	med. rough	med. wedge	long
Cocke's Prolific	sl. tap.	8–9	6.25–6.75	firm	pearl white	smooth	broad	short
Collier's Excelsior	cylin.	10–11	7.25–7.75	firm	cream white	med. rough	med. wedge	long
Funk's Yel. Dent	sl. tap.	9.5–10.5	7–7.5	firm	med. yellow	med. rough	med. wedge	long
Golden Beauty	sl. tap.	10–11	7–7.5	firm	deep yellow	smooth	broad	med.
Hickory King	cylin.	8–9	6.5–7	firm	pearl white	smooth	very broad	med.
Hildreth	sl. tap.	10–11	7.5–8	firm	deep yellow	med.	long wedge	long
Hogue's Yel. Dent	sl. tap.	9.5–10.5	7–7.5	firm	med. yellow	med.	med. wedge	long
Kansas Sunflower	sl. tap.	9.5–10.5	6.75–7.25	med. firm	med. yellow	med.	broad	long
Leaming	tap.	9.5–10.5	7–7.5	firm	med. yellow	med. rough	med. wedge	long
Mam. White Pearl	sl. tap.	10–11	7.25–7.75	firm	pearl white	med. smooth	broad	long
McAuley	sl. tap.	9.5–10.5	7–7.5	firm	cream white	med.	med. wedge	long
Reid's Yel. Dent	sl. tap.	9.5–10.5	7–7.5	very firm	light yellow	med.	wedge	long
Silver Mine	sl. tap.	9.5–10.5	7–7.5	med. firm	cream white	rough	med. wedge	long

Variety	*Rows number*	*Space between rows*	*Butts filling out*	*Tips filling out*	*Shank size*	Cob		*Per cent of Shelled corn*	*Uniformity*
						Size	*Color*		
Boone Co. White	18–22	med. narrow	med. rounded	well covered	med.	med.	white	med. large	good
Cocke's Prolific	8–10	med. wide	even	med.	med.	small	white	med.	med.
Collier's Excelsior	18–22	med. narrow	med. rounded	well covered	med.	med.	white	med. large	good
Funk's Yel. Dent	18–22	med. narrow	med. rounded	well covered	med.	med.	red	med. large	good
Golden Beauty	12–14	med. wide	even	med.	med.	med.	red	med.	med.
Hickory King	8–10	med. wide	even	med.	med.	small	white	med.	med.
Hildreth	18–24	med. narrow	med. rounded	med.	med. large	med. large	light red	large	med.
Hogue's Yel. Dent	18–22	med. narrow	med. rounded	med.	med.	med.	red	med. large	med. good
Kansas Sunflower	14–18	med.	even	med.	med.	med. small	red	med.	med.
Leaming	18–22	med. narrow	med. rounded	well covered	med.	med.	deep red	med. large	good
Mam. White Pearl	16–20	med.	med. rounded	med.	med. large	med.	white	med.	med.
McAuley	18–22	med. narrow	med. rounded	med.	med.	med.	white	med. large	med.
Reid's Yel. Dent	18–24	narrow	deep. rounded	well covered	med. small	med.	deep red	med. large	good
Silver Mine	18–22	med. narrow	med. rounded	well covered	med.	med.	white	med. large	good

TABLE IV.—DESCRIPTION OF VARIETIES, SOUTHERN ZONE

Variety	Ear			Kernels				
	Shape	*Length inches*	*Circum. inches*	*Firmness on cob*	*Color*	*Indentation*	*Shape*	*Length*
Boone Co. White.....	cylin.	10–11	7.5–8	firm	cream white	med. rough	med. wedge	med. long
Cocke's Prolific.....	sl. tap.	8–9	6–6.5	firm	pearl white	smooth	broad wedge	med.
Golden Beauty.....	sl. tap.	10–11	7–7.5	firm	med. yellow	med. smooth	broad wedge	med.
Hickory King.....	cylin.	8–9	6.5–7	firm	pearl white	smooth	very broad	med. long
McMackin Gourdseed.	cylin.	10–11	8–8.5	firm	cream white	med. rough	long wedge	long
Mosby Prolific.....	sl. tap.	8–9	6–6.5	firm	pearl white	med. smooth	broad wedge	med.
Sander's Improved...	sl. tap.	8–9	6–6.5	firm	cream white	med.	med. wedge	med.

Variety	*Rows number*	*Space between rows*	*Butts filling out*	*Tips filling out*	*Shank size*	Cob		*Per cent of Shelled Corn*	*Uniformity*
						Size	*Color*		
Boone Co. White.....	18–22	med.	med. rounded	well covered	med.	med.	white	med. large	good
Cocke's Prolific.....	10–14	med. large	even	med.	med. small	small	white	med.	med.
Golden Beauty.....	12–14	med. large	even	med.	med.	med.	red	med.	med.
Hickory King.....	8–10	med. large	even	med.	med.	small	white	med.	med.
McMackin Gourdseed.	20–24	med.	well rounded	well filled	med.	med. large	white	large	med.
Mosby Prolific.....	10–14	med. large	even	med.	med. small	small	white	med.	med.
Sander's Improved....	12–16	med.	med.	med.	small	small	white	med.	med.



MAP SHOWING OUTLINE OF CORN ZONES OF THE UNITED STATES

CHAPTER II

THE JUDGING AND SELECTION OF CORN

Among the things which are fundamental to the intelligent selection of corn are a familiarity with the detailed characteristics of the ear and grain and a knowledge as to the significance of each.

One should become so thoroughly familiar with every characteristic of the ear as to be able to recognize at a glance the strength or weakness of each. He must be able to see the shallow grain, the space between grains or the impurity of breeding as indicated by the color; he must see the uniformity in type or the lack of it and the conformity to the standard of the variety or type; he must know the significance of the tapering grain and know where to look further for the indications of the same weakness; he must have a standard in mind in utility points and have reasons for the same; and he must know in general what types are best suited to his soil and climatic conditions.

In comparison sheets A and B are given a list of the more important characteristics, arranged so as to show the significance of each. A careful perusal of this list and practice work in comparing ears by these sheets will be of value to the beginner as fundamental to the selection of ears or samples.

HOW TO STUDY THE CHARACTERISTICS OF CORN

Using Comparison Sheet "A." [1] Turn to pages 41 to 64 and read what is said in general in regard to study of characteristics, and pages 17 to 32 for description of the particular variety. Select two good ears of somewhat similar type and mark one of them "A" and the other "B." Use the terms slight, medium and marked, to express the differences in the several points; for instance, if ear "A" has a slightly better shape than ear "B," the term "slight" should be marked in the first column and the second column left blank opposite shape of ear, but if ear "B" is better, the descriptive word is placed in the second column and the first column is left blank. If the ear "A" is much better in size of ear, the term "marked" is written in the first column opposite size of ear; if the difference is only an average one, the term "medium" is used. The third column, under remarks, may be used for indicating any differences not expressed in the other two

[1] How to Prepare Exhibits for Judging.—The usual number of ears in a sample, either in class-room or a corn show, is 10. This is about as small a sample as will give a good idea of the type, and a much larger one would be cumbersome to handle and difficult to summarize and carry in mind. A sample of five ears is sufficiently large for class-room work in which the comparison is made between ears rather than samples. The first exercise, that of comparison sheet A, requires only two ears. Each ear should be identified by a small tag attached to the ear. The samples should be numbered and the ears lettered, the number and letters both appearing on each tag, so that any ear which becomes misplaced may be returned to its original sample.

CORN—Comparison Sheet A

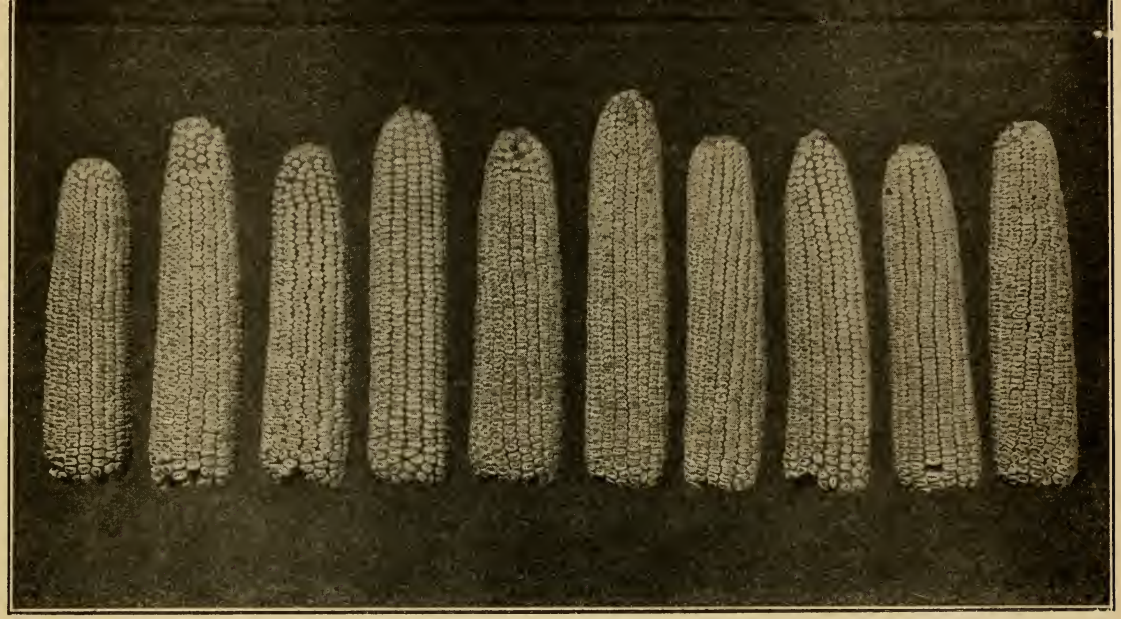
Date _____ Student's Name _____

Name of Variety _____ No. of Sample _____

Indicate the differences in the respective points of the two ears by the terms: slight, medium, marked.

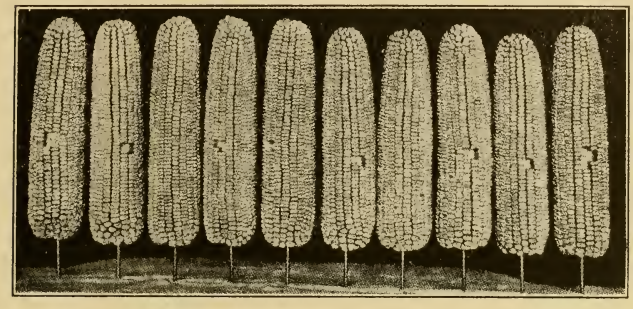
	EAR No. ____	EAR No. ____	REMARKS
A. Type or breed characteristics:			
a Shape of ear			
b Size of ear			
c Indentation			
d Natural color of ear			
1 Color of grain			
(1) Caps of grains			
(2) Sides of grains			
2 Color of cob			
~~Total color~~			
e No. of rows ~~and size of kernel~~			
f Shape of grain as viewed in ear			
~~Total type or breed characteristics~~			
~~**B. General qualities regardless of variety:**~~			
~~a Amount of grain and proportion of grain~~ to cob			
1 Weight of ear			
2 Depth of kernels in proportion to size of ear			
3 Space between grains			
(1) At tips			
(2) At crowns			
4 Filling out of butts and tips of ears			
~~Total amount and proportion of grain~~			

b Maturity and seed condition			
1 Hardness of grain and cob			
2 Dryness of grain and cob			
3 Weight of ear in proportion to size			
4 Color of ear and grains			
(1) Due to immaturity			
(2) Due to moisture and weather conditions			
5 Color of germs			
6 Blisters			
7 Cracking of grains			
8 Shape of grains at tip			
(1) Thickness			
(2) Width			
9 Size of grains			
10 Size of germs			
11 Freedom from mold and fungus diseases			
12 Freedom from breaking off of tip caps			
13 Freedom from attack of insects or other injury			
~~Total maturity~~ and seed condition			
c Uniformity of grains in			
1 Size			
2 Shape as viewed in ear			
~~Total uniformity of kernels~~			
d Composition			
1 Richness in protein			
2 Richness in oil			
e Shank			
~~Total of all qualities~~			



These ten ears show lack of uniformity in size, shape, indentation, kernel, etc. The man who exhibits such a sample at a corn show is growing a corn which has little breeding or type; and moreover he shows little knowledge of seed selection, as is evidenced by the almost entire lack of any standard in his selection

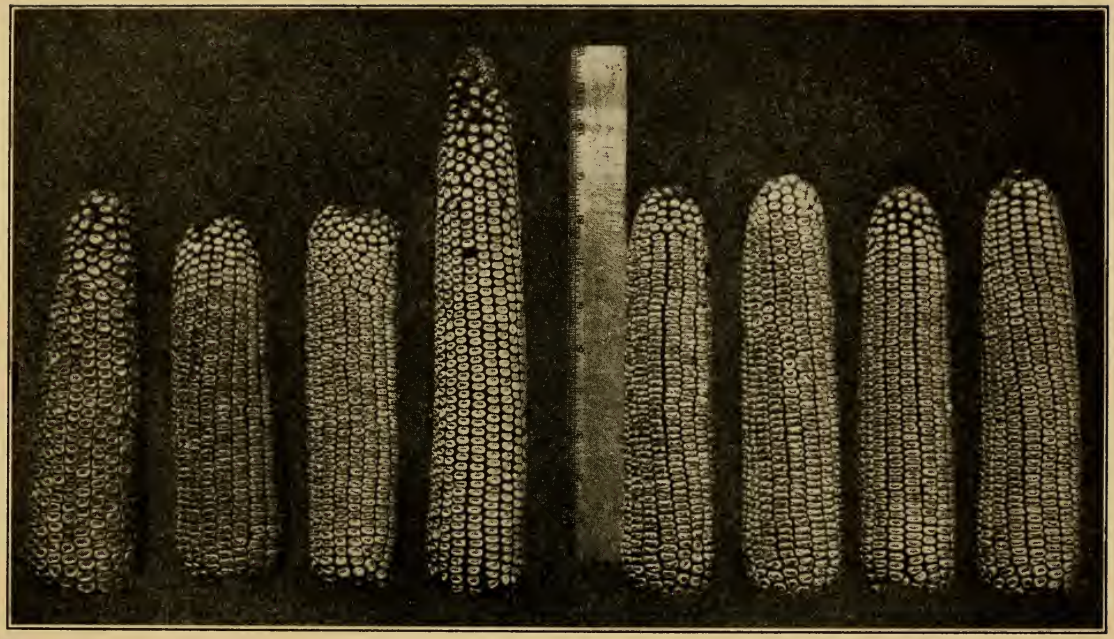
columns. It will be noticed that the characteristics are classified under the general heads, "type or breed characteristics" and "general quality regardless of variety or type," and that each of these are divided and sub-



These ten ears which were awarded first premium at the National Corn Exposition, 1908, show uniformity in size, shape, color, indentation, etc. The type is well fixed, and the characteristics will be transmitted to their offspring with considerable certainty.

divided into several qualities. The qualities mentioned in the general heads should not be studied until all the characteristics under these heads have been considered, when space will be found provided for making these summaries. The judging of the total qualities should always be done by comparing the ears rather than by summarizing the results on the sheet.

In this and the following exercises the student is encouraged to depend largely upon his own judgment. Some hints are given in the study of characteristics and description of varieties as to what an ideal type should be, and these should be studied carefully, but in order to get the most out of the course, the student must learn to ask and answer questions for himself.



The first ear at the left is too tapering, while the third is reverse tapering. Notice that these ears have irregular grains. The second ear is too short for its circumference, while the fourth is too long for its circumference. The four ears at the right are of desirable shape, being slightly tapering and having few irregular grains

CHARACTERISTICS AS TO TYPE OR BREED

The shape of the ear depends upon (1) the proportion of length to circumference. In normal-sized or large ears the circumference should be about ¾ to 4/5 the length, but in very small ears the circumference will be found to exceed 4/5 the length. These proportions are desirable because they are the normal ones and nothing can be gained, and perhaps much lost, by an attempt to change the standard; (2) the lines of the ear—which should be straight and curve out nicely at butt and tip of ear; ears whose lines are not straight usually have more or less irregular kernels; (3) the uniformity in size from butt to tip. While experimental data on this point is inconclusive, the greater uniformity of grains in the cylindrical or slightly tapering ear is sufficient to justify its preference over the very tapering ear. Ears with reversed taper are abnormal and not to be desired.

The size of ear is determined by (1) the length—which should be measured from butt to extreme tip of cob, as this indicates the true tendency of the strain toward length better than the length of ear to which the grain extends; (2) the circumference—which is usually measured at one-third the distance from butt to tip.

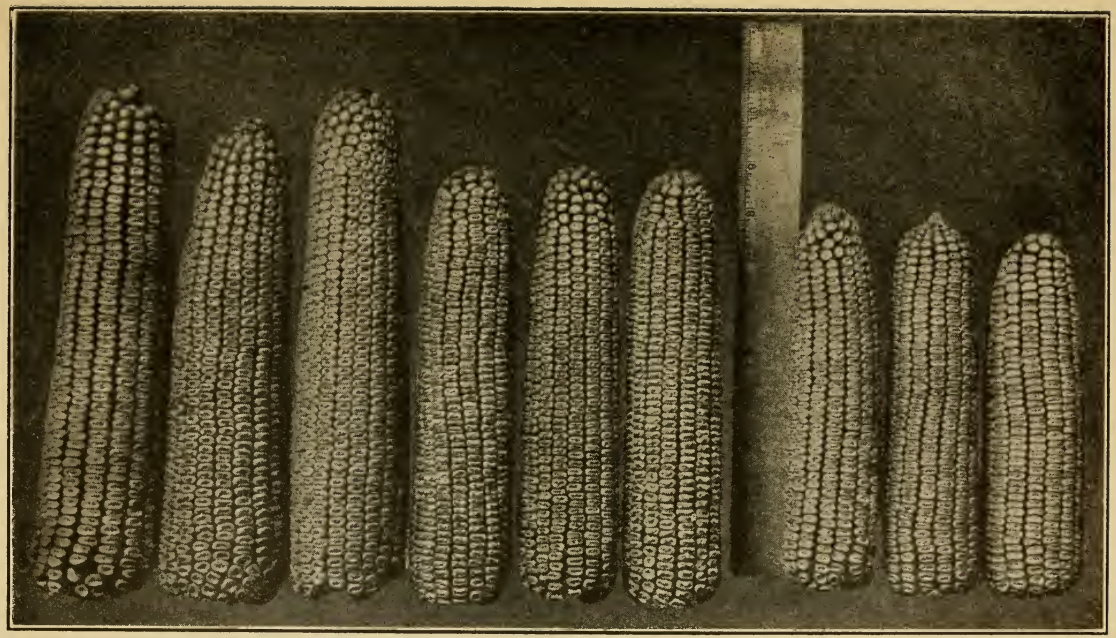
The size of ear is of importance as an indication as to its adaptability to soil and climatic conditions. Large-eared varieties will produce the maximum yield in the southern part of the corn belt, while small-eared varieties must be grown in the north. Larger-eared varieties may be grown on fertile soil under favorable conditions than on soils of medium or poor fertility, or with too light a rainfall, or other unfavorable

conditions. It is impossible to set a definite standard for length and circumference for all the conditions over any large section, but the size of ear will depend upon local conditions and can only be determined by one familiar with those conditions and with the particular variety of corn. The measurements given in the tabular description of varieties—pages 29 to 32—are of value mainly as showing the average dimensions of the respective varieties for the several zones.

The indentation in dent corn is of value chiefly (1) as an indication as to its adaptability and length of season. Usually the rough or deeply indented types require a long season and favorable conditions, while the smooth types will mature in a shorter season and will grow under less favorable conditions; (2) because of its corelation to other qualities. Ears that are fairly rough usually have a large circumference in proportion to their length, a large number of rows and narrow kernel, and small space between rows, and a deep grain. Smooth ears are apt to be long and slender, with a small number of rows and broad kernel with wide spaces between the rows, and shallow grains. A medium type, or a type approaching the former, is to be preferred over the latter in the central and southern zones, though a somewhat smoother type is best adapted to the northern zone.

The natural color of ear. By natural color of ear is meant the color of the variety when properly matured and not bleached or discolored by exposure to the weather.

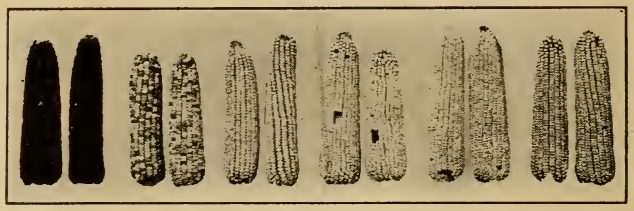
The most common colors in dent and flint corn are white and yellow, of which there are many shades. In these the color is located in the horny endosperm



The three ears at the left are of a large late-maturing type not well adapted to Ohio conditions. They will not produce the maximum yield of dry shelled corn, and the quality of grain will be inferior. The three ears at the right are of a small early-maturing sort, which does not utilize the entire growing season, hence produces only a small or medium yield. The proper size of ear will depend upon the soil and climatic conditions, and in the Central Zone will be a mean between the above-mentioned types as represented by the three ears in the middle.

and possibly the aleurone layer. In the blue corn of the squaw type and in the blue, purple and black corns of the soft and sweet types the color is in the aleurone layer. In the red and calico corns the color is located in the hull.

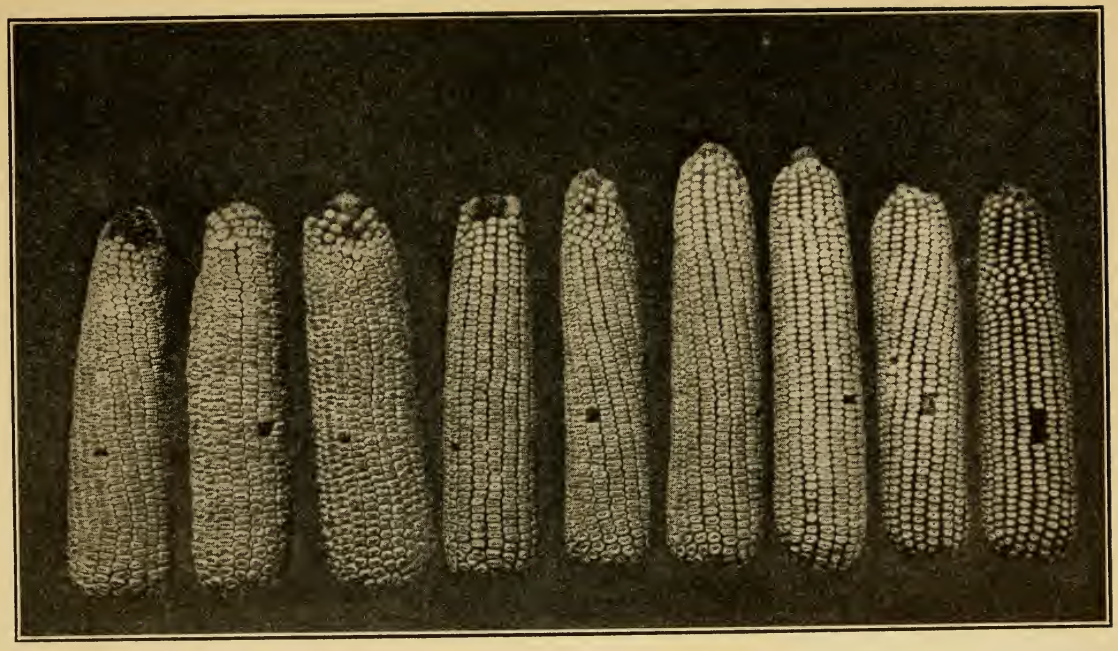
If the natural color of the sample is not characteristic of the variety or if the grains vary in color, it is



The two ears at the extreme left are of the bloody butcher type; the next two are mixed squaw corn; the next a couple of yellow ears with a decided tinge of red on the sides of the grains; and the fourth pair is a type of yellow white cap corn. None of these corns should be grown, as they have no advantages over the pure white and yellow corns as shown at the right, and have the disadvantages of grading as mixed corn on the market, and of mixing corns of pure color if grown on the farm.

an indication of impurity of breeding. When yellow varieties are fertilized by pollen from white corn, the mixture is shown by the white or light colored caps, but when white varieties are fertilized by yellow corn, the mixture is shown on the sides of the grains. The mixture of blue corn with corn of other colors is shown both at the caps and on the sides of the grains.

In the breeding of corn, red appears to be a dominant characteristic. When red corn is crossed with white, shades between the red and white are not produced and the mixture can only be identified by the white grains which may be found in the red or the red in the white, since the endosperm in both types is white. When red and yellow corns are crossed,



The three ears at the left are very chaffy and immature, and the feeding value and seed condition are poor. The three ears at the right are too smooth and flinty, which usually means a shallow grain and a low percentage, and small amount of grain. The three ears in the middle are of about the proper indentation or roughness.

the hybrids may be identified as above, and, further, by cutting open the grains and observing the color of the horny endosperm.

Number of rows and size of kernel. This is chiefly a type or breed characteristic. Ears that have too small a number of rows or too wide a kernel, or those with too many rows and too narrow a grain, show lack of type and purity of breeding.

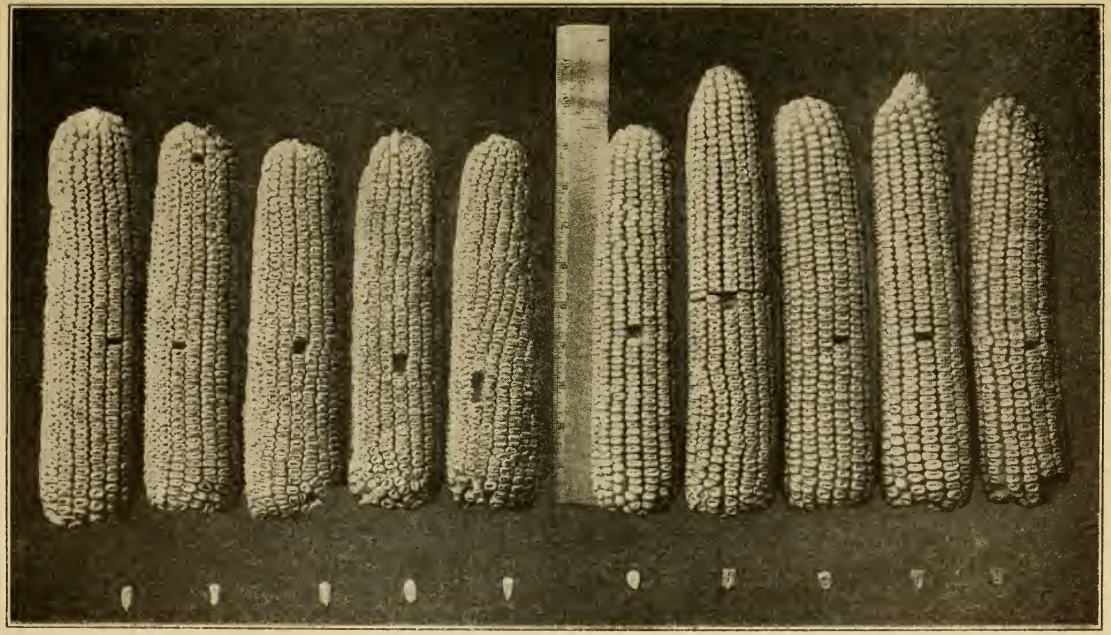
Shape of grain as viewed in ear. This refers to the size of grain in cross section, or the shape of the caps as viewed in ear. Each variety has a characteristic shape of grain; for instance, the grain of the Reid's corn is nearly square, and any non-conformity to this shape indicates lack of type.

GENERAL QUALITIES REGARDLESS OF VARIETY OR TYPE

(A) Amount of grain and proportion of grain to cob depends upon the following characteristics:

(1) The weight of ear. As three-fourths or more of the weight of an ear is in the grain, an ear which is light in weight cannot produce much grain. This is one of the best means of selecting high-yielding corn; and the ears of light weight should not simply be discarded, but those of very heavy, dry weight for their size should be selected.

(2) Depth of kernels in proportion to size of ear. Shallow-grained ears produce little corn, and are considered an undesirable type for planting. Recent experiments conducted in several states indicate, though they probably do not prove, that ears of extremely high per cent of grain are no better, if they are as



These ears illustrate association of characters in corn. The five ears on the left are fairly large for their length, have a large number of rows, are fairly rough, have a narrow kernel with small space between the rows, and a deep grain. The five ears at the right are long and slender, have a small number of rows, are rather smooth, and have a fairly broad kernel, with wide spaces between the rows, and shallow grains.

good, as ears with medium deep grain and with a medium high per cent of corn.

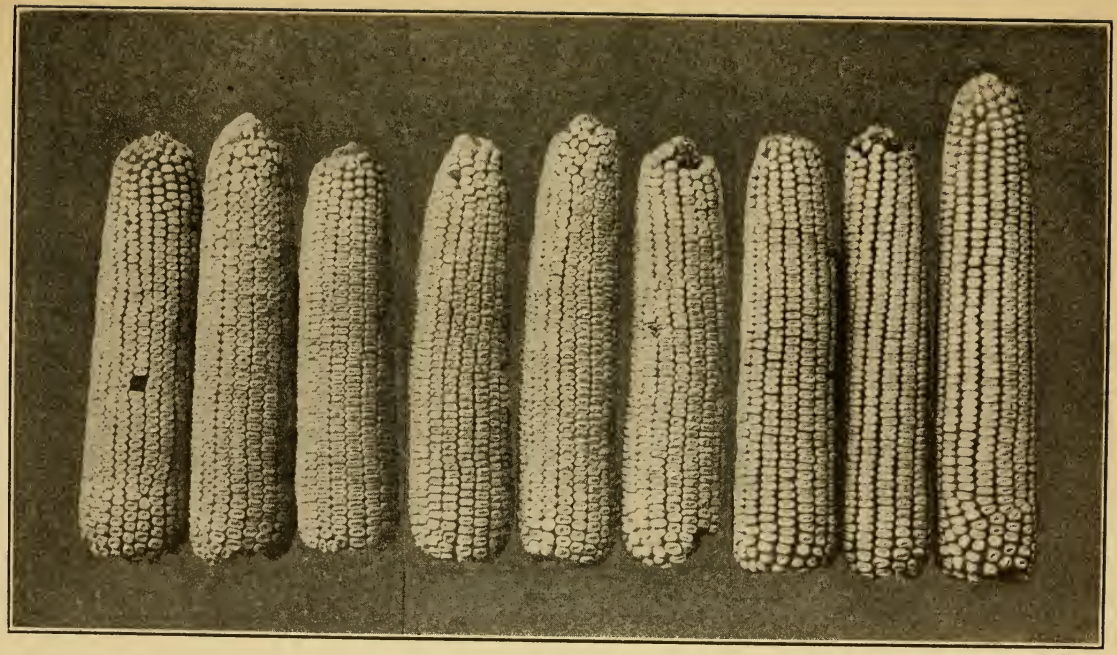
(3) Space between grains. (1) At tips, should be small, indicating well-developed kernels. Where the space at tips is large, the grains are not well matured, are light in weight and poor in composition; (2) at crowns, should be medium narrow and may be fairly deep. Some of the early standards in corn judging called for an extremely narrow space between crowns, but it has been observed in recent years that these ears do not dry out well and are apt to be associated with wide space at the cob, light weight and poor maturity.

(4) Filling out of butts and tips of ears. The butts and tips should be fairly well filled out, as otherwise an unnecessary amount of cob is produced. The complete capping over of tips is of little importance. The size of ear and its adaptability are of much more importance than the capping over of tip, and ears that are too small should not be selected simply because they are completely filled out at the tip. Ears that are too large and too long, with the cob projecting some distance, are likewise undesirable.

(B) Maturity and seed conditions are of first importance in the study of corn, and may be judged by the following characteristics:

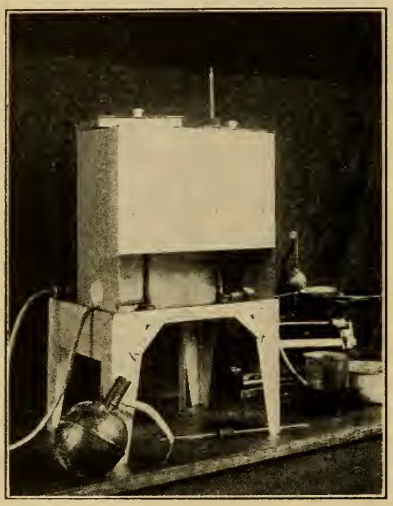
(1) Hardness and solidness of grain and cob. Take the ear in both hands and twist it gently, press on the grains to see if they can be pressed in. Notice if the cob is hard and solid. If the grain is soft and loose on the cob, it is an indication that it is not fully and normally developed.

(2) Dryness of grain and cob. Ears that are wet



The three ears at the left are very compact at the surface, but have too much space at the cob, with a pointed, poorly-developed kernel. The three ears at the right have too much space between the rows, resulting in a small percentage and small amount of grain. The three ears in the middle have a narrow, but fairly deep space between the rows. The grains are deep and well filled at the tip. The amount and quality of the grain is good. This type is to be preferred over either of the extremes mentioned above.

and sappy are generally immature. This type of ear, when dried out later in the season, has a peculiar sticky feeling to the hand, which may best be understood by a comparison of this type of ear with those that are hard and well matured.

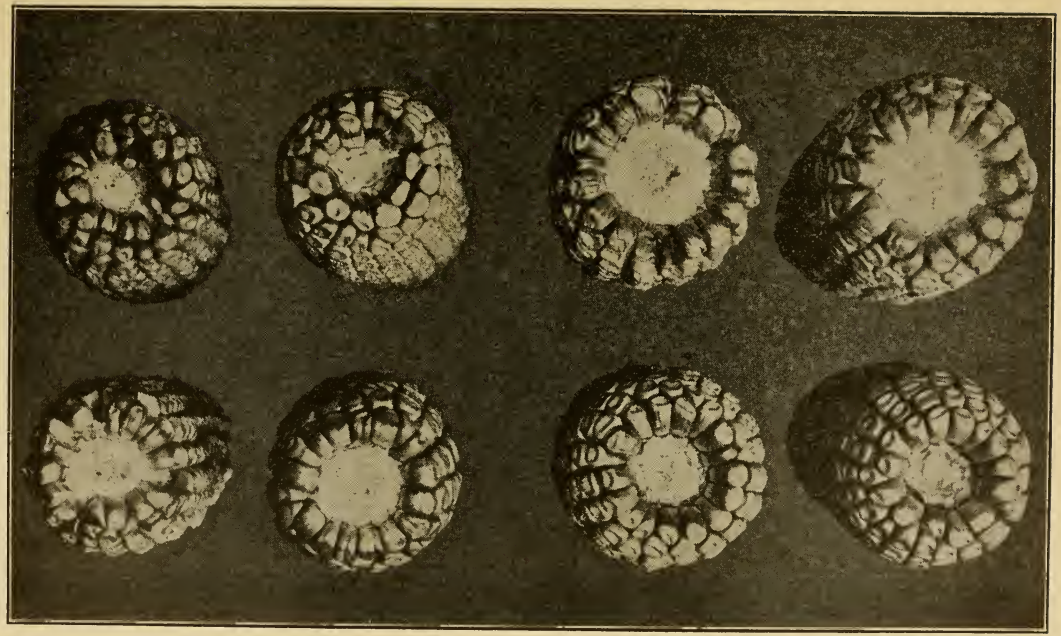


BROWN-DUVAL TESTER

For determining moisture content of grain, 100 grams of grain are heated in oil to a temperature of 190° C. This drives off the moisture in the grain, and it is condensed in passing through the condenser in the rear part of the apparatus and collected in the graduates below.

(3) Weight of ear in proportion to size. The ear which is light in weight in proportion to its size is not normally matured, and its vitality is apt not to be of the best.

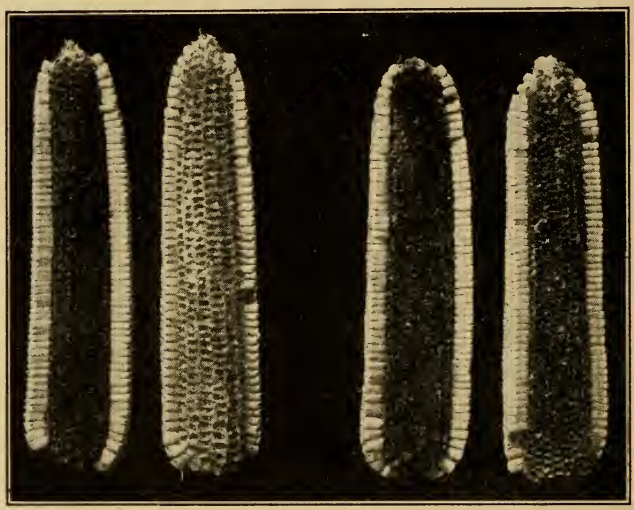
(4) Color of ear and grains. (1) Due to immaturity. A dull, pale, golden yellow, often with a fleck of white on the grain in the yellow corn, and a dull



BUTTS OF EARS

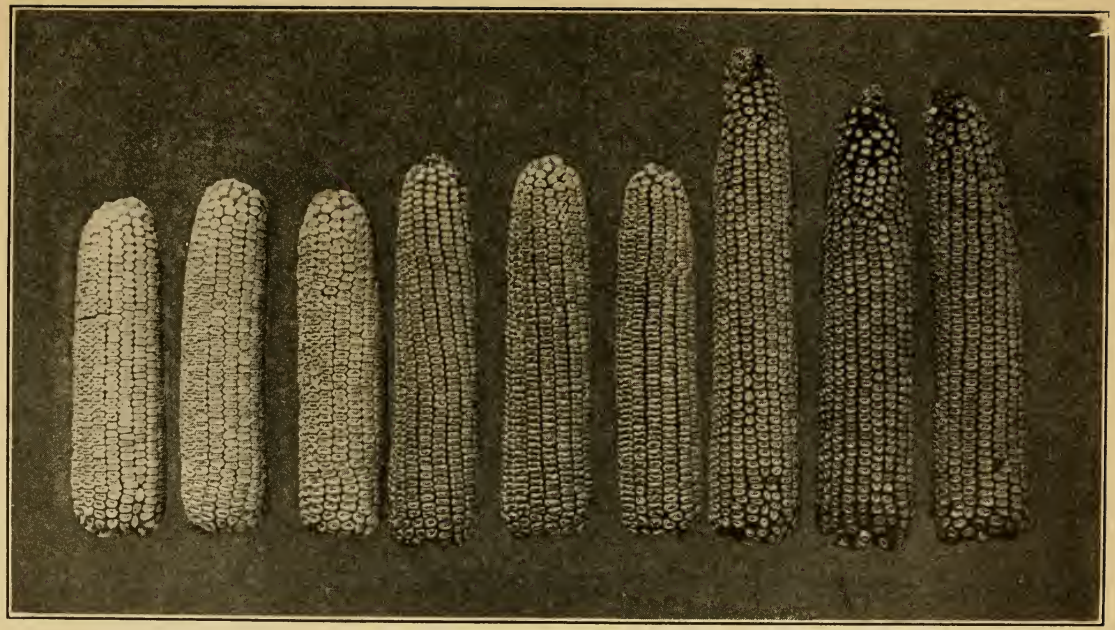
The first pair at the left in the upper row are desirable butts, being well rounded out, with regular grains; the second pair are flat and poorly filled. The first pair in the lower row had too large shanks, and the second pair too small shanks

white in the white corn, are indicative of immaturity. Well-matured corn should be bright and have a luster; (2) due to moisture or weather conditions. Ears that have laid upon the ground and become wet or have been exposed to the weather, have a dull color or bleached appearance. The color of the cob should be bright.



The first ear at the left is a deep grained type, although the grains at the butt and tip are not as deep as those in the middle of the ear, indicating the necessity of studying grains in different parts of the ear. The second ear has a very shallow grain and small per cent of grain to cob. The third ear has a compact grain, while in the fourth the kernels are pointed and there is a large space between them next to the cob.

(5) Color of germs. The color of the germ should be a greenish-yellow or the color of a healthy growing shoot before its appearance above ground. Pale or light-colored germs commonly found in immatured



The three ears at the left have well-filled tips, which is objectionable in such short ears; or rather the size of ear and its adaptability is of great importance, while the capping over of tips of ears is of little importance. The three ears at the right have exposed tips, which are objectionable in such long ears. The three ears in the middle are of medium size, and have fairly good tips.

ears and dark-colored germs are apt to be of low vitality and produce plants of little vigor. Black or dark-brown germs have been frosted when they contained too much water, or have rotted and will fail to germinate. Germs that sparkle when cut in two contain a large per cent of moisture and the vitality is apt to be destroyed if they are subjected to freezing weather when in this condition.

(6) **Blisters,** or the wrinkling of the seed coat, are caused by excessive moisture, and are indicative of the unfavorable conditions under which the corn has matured or been stored.

(7) **Cracking of grains.** The appearance of cracks in the sides of grains is thought to be the result of excessive moisture, perhaps accompanied by freezing weather. Such grains will usually fail to germinate and should never be planted.

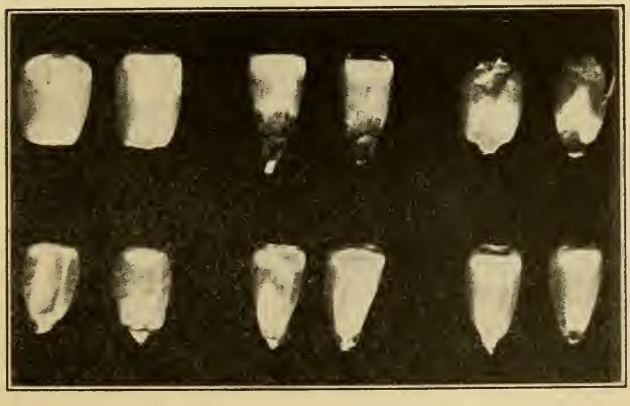
(8) **Shape of grains at tip.** Grains that are pointed at the tip have small germs and are apt to be of low vitality. Notice both the thickness and width. In this type of grain the scales of the cob often adhere to the grain, which is also an indication of immaturity.

(9) **Size of grains.** Normal-sized or large grains should have good germs with plenty of food stored in the endosperm surrounding the germ, but very small, thin or papery grains have small germs and a small endosperm and are apt to have little vitality.

(10) **Size of germs.** The germ is the embryonic plant, and if abnormally small is apt to produce a plant of little vigor. The size of germ may be estimated by observing the length and width in the entire kernel and the thickness in the lengthwise and cross sections.

DIFFERENT TYPES OF KERNELS

The first pair of kernels at the left in the upper row and the last pair in the second row are desirable grains. The second pair in the upper row are somewhat pointed and have small germs; the third pair are too narrow at the crown, and the fourth pair too pointed at the tip. The first pair in the second row are too broad and rounded; the second pair narrow and thin, and the third pair are of irregular shape.



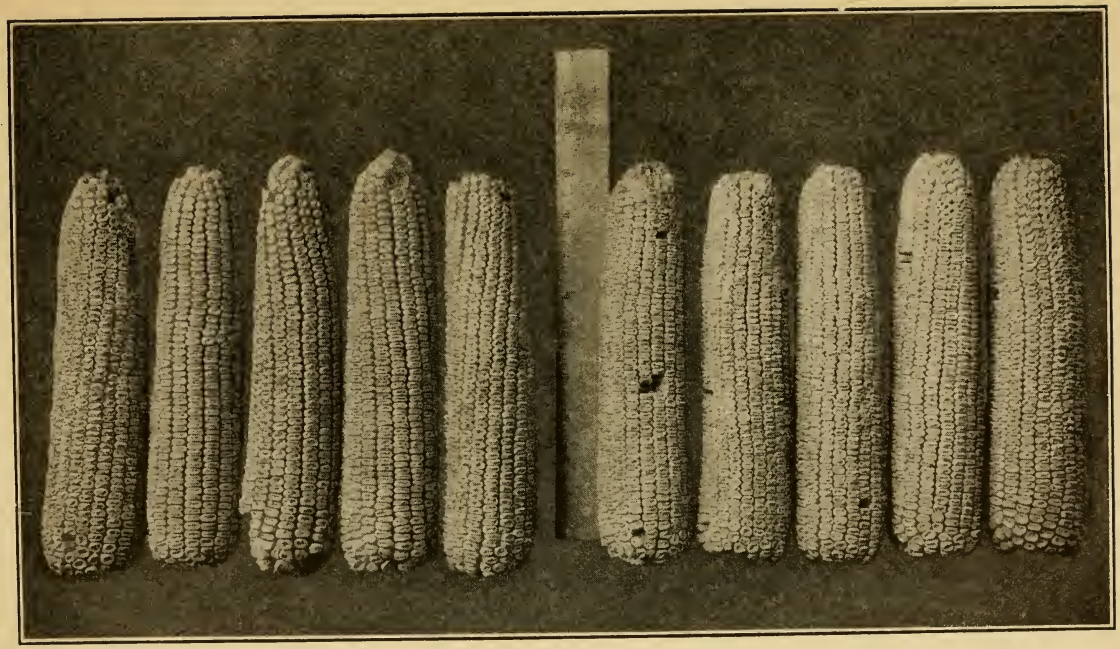
TYPES OF KERNELS INDICATING IMMATURITY AND POOR SEED CONDITION

In the upper row the first pair are broken off at the tip; in the second pair the cob chaff adheres and the third pair are rotten. In the bottom row the first pair have wrinkled or blistered seed coats, and the second and third pairs are very pointed at the tip.

(11) Freedom from mold and fungus diseases. The presence of these diseases is most frequently observed about the cob and between the grains, and indicates that the ear has been stored under unfavorable conditions such as are liable to rot or otherwise destroy the life of the germ.

(12) Freedom from breaking off of tip caps. This is an abnormal condition which, it is claimed, more or less exposes the germ, making it more liable to rot if the weather or drainage conditions are unfavorable. In the germination-box these grains frequently grow and produce vigorous stalks. If the grain breaks off above the tip cap so as to break the germ in two, its germinating qualities are destroyed.

(13) Freedom from attack of insects and other injury. Among the most common of the insects which attack corn in the ear are the ear worm, which feeds on the ear beneath the husks, and the angoumois grain moth, which attacks the stored grain. While the ear worm does considerable damage to corn, the injury is plainly visible on the ear and the injured grains may be discarded, when the remaining grains will be as valuable for planting as though the ear had not been injured. Little importance should therefore be given to slight attacks of this insect. The angoumois grain moth is a dusty-winged moth about three-eighths of an inch in length, which lays its eggs in the spaces between the rows; when the larvæ or worm is hatched it starts at the tip of the grain and eats its way toward the crown, and when almost to the surface it pupates. A few days later the adult moth pushes the covering cap off and emerges. The work of these insects may be recognized by the holes, about as big as a pin, which



The five ears at the left show lack of uniformity in size and shape of grain, while the five ears at the right have grains that are fairly uniform. The uniformity of grain is of great importance in getting an even distribution of seed and a good stand

they leave on the crown or sides of the kernel. Corn which has been attacked by these insects should be scored heavily, as the germinating qualities of the defective kernels have been destroyed or seriously affected, and there is little certainty as to the per cent of grains affected. The presence of these insects indicates, though it does not prove, that the corn is not of the current season's growth.

Other injuries, such as broken grains, if they do not affect the value of the grain for planting purposes, or if they affect only a small per cent of the grain, should not be considered of much importance.

Of the above qualities, the first four and the eighth may be considered as fairly sure indications as to the maturity. Aside from the black germs and the serious cracking of grains or the destruction of the germ, these qualities must not be considered as positive evidence as to whether corn will germinate, but rather as an indication as to the life history of the plant and the probability as to whether its seeds will grow or produce vigorous plants. The best means of determining the germinating qualities is the germination test, which is discussed on page 82.

(C) Uniformity of grains. The grains should be uniform in size and shape, so that an even distribution may be had from the planter. Observe whether the grains are uniform in size from butt to tip, whether the rows are straight, and whether there are any grains of irregular shape. Also notice whether the grains in the several ears of an exhibit are uniform in size and shape.

(D) Composition. Dr. C. G. Hopkins and his assistants at the Illinois experiment station, who have

THIS ILLUSTRATION SHOWS SOME OF THE PARTS OF THE KERNEL

The top row of grains are from a dent ear whose kernels have large germs and large horny parts, and are relatively rich in protein and oil; the second row of kernels has small germs and are starchy and low in protein and oil content; the third row shows the structure of a kernel of Flint Corn; the fourth that of the Brazilian Flour Corn, which is of the soft corn type; while the bottom row shows the structure of Sweet Corn. (For discussion of these types see pages 11 to 16.)

made a careful study of the composition of the corn kernel, divide the grain into six parts, namely, tip cap, hull, horny gluten, horny starch, white starch and germ, the definition and composition of which are given below.

The tip cap is a small cap covering the tip of the kernel and acting as a protection to the germ. It occasionally remains attached to the cob and leaves the end of the germ exposed. It may be readily removed by lifting it with a knife. Its composition resembles that of the cob.

The hull is the thin outer covering of the kernel, which is made up of several coats or layers of cells which are closely united in the matured grain. It may readily be removed with a knife after the grain has been soaked in water a few minutes. It consists largely of carbohydrates in the form of crude fiber, which is of little feeding value.

The horny gluten or the aleurone layer is an inner covering of the grain, somewhat thicker than the hull. This part may be seen as the thin yellow covering over the crown of yellow kernels after the hull has been removed; that is, it lies between the white starch and the hull. On the sides of the grain where it adjoins the horny starch, it is difficult to distinguish it from the latter part. It is the richest in protein of any part of the grain, as shown in the accompanying tables.

The horny starch is located mainly at the edges of the grain and on the side opposite the germ. With the horny gluten it makes up the hard horny part of the grain. It is composed largely of carbohydrates, but is richer in protein than the white starchy part.

The white starch occupies the crown end of the kernel and lies back of the germ and at the tip end of the kernel, the crown and tip starch usually being connected by a thin layer of white starch through the middle of the kernel. The white starch analyzes the highest in carbohydrates and the lowest in protein and oil of any of the four main parts of the grain, and is therefore the poorest in feeding value.

The germ is the embryonic plant and lies on the side of the grain toward the tip of the ear, usually extending from the tip of grain ½ to 2/3 the length of the kernel. By carefully making a lengthwise section with a knife, the embryonic stem pointing toward the crown and the embryonic root pointing toward the tip may be distinguished from the remaining portion.

The composition of these parts is given in the table below:

*** TABLE V—Showing Analysis of the Parts of Kernels —(Medium Protein Ear)**

Names of Parts	Per cent of whole	Composition of Parts			
		Protein Per cent	Oil Per cent	Ash Per cent	Carbohydrates Per cent
Tip caps.....	1.46	8.83	2.30	1.11	87.76
Hulls	5.93	3.96	.89	.79	94.36
Horny gluten.....	5.12	22.50	6.99	1.72	69.09
Horny starch.....	32.80	10.20	.24	.24	89.32
Crown starch.....	11.85	7.92	.17	.24	91.67
Tip starch.....	5.91	7.68	.39	.31	91.62
Germs	11.53	19.80	34.84	9.90	35.46
Mixed waste.....	25.40	11.10	1.23	.57	87.10
Whole corn.....	.....	10.95	4.33	1.55	83.17

* From Bulletin No. 87, Illinois Experiment Station.

*** TABLE VI—Showing Distribution of Material in 100 lbs. of Corn—(Medium Protein Ear)**

Names of Parts	*No. of lbs. in 100 lbs. Corn*	*No. of lbs. Protein in 100 lbs. Corn*	*No. of lbs. Oil in 100 lbs. Corn*	*No. of lbs. Ash in 100 lbs. Corn (by parts)*	*No. of lbs. Carbohydrates in 100 lbs. Corn*
Tip caps.....	1.46	.13	.03	.02	1.28
Hulls	5.93	.23	.05	.05	5.60
Horny gluten.....	8.51	1.89	.59	.15	5.88
Horny starch.....	47.08	4.80	.11	.11	42.05
Crown starch.....	17.01	1.35	.03	.04	15.59
Tip starch.....	8.48	.65	.03	.03	7.77
Germs	11.53	2.28	4.02	1.14	4.09
Total	100.00	11.33	4.86	1.54	82.26
Whole corn.....	.....	10.95	4.33	1.55	83.17

*** TABLE VII—Showing Analysis of Parts of Kernels Medium Protein Ear**—(Compiled from Table V)

Names of Parts	*Per cent of whole*	Composition of Parts			
		Protein Per cent	*Oil Per cent*	*Ash Per cent*	*Carbohydrates Per cent*
Tip caps.....	1.46	8.83	2.30	1.10	87.76
Hulls	5.93	3.96	.89	.79	94.36
Horny part.....	37.92	11.86	1.15	.44	89.22
White part.....	17.76	7.84	.24	.26	91.65
Germ	11.53	19.80	34.84	9.90	35.46
Whole corn.....	.....	10.95	4.33	1.55	83.17

It will be seen from a study of Table VII that the germ contains 19.80 per cent protein and 34.84 per cent oil, the horny or hard part of the kernel 11.86 per cent protein and 1.15 per cent oil, while the

* From Bulletin No. 87, Illinois Experiment Station.

white, soft portion contains only 7.84 per cent protein and .24 per cent oil. Those grains, therefore, which have a large horny portion and a large germ are relatively rich in protein, while those having large germs are relatively rich in oil.

The relative size of the several parts and therefore the approximate composition of the grain may be determined by mechanical examination. Notice the length and width of germ before cutting the kernel, and then cut through the grain lengthwise and crosswise to determine the thickness of germ and the amount of horny endosperm. The relative size of these parts will be found to vary somewhat in the grains of the same ear, and several grains as representative of each ear should be examined and compared with those from other ears.

(E) The shank should be large enough to support the ear, the small shank being responsible for a large per cent of the poorly developed ears in certain varieties of corn. On the other hand, the shank should not be unnecessarily large so as to make the corn difficult to husk. For normal-sized ears a shank 5-8 inch in diameter appears to be about right.

Comparison of Characteristics of Ears, Using Comparison Sheet "B," select five good ears of somewhat similar type and designate by letters. Rank the ears in each of the qualities mentioned in the list and mark the order in the columns to the right. For instance, starting with shape of ear, pick out the ear which has the best shape and mark the letter which is used to designate it in the first column, the second best in the second column, etc., paying no attention whatever to the other characteristics. After

completing the study of shape of ear, take up the next point—size of ear, and so on. Do not consider those qualities that are subdivided, that is the general headings in the comparison sheet, but the separate divisions, and afterward the summaries of these under the totals.

RELATIVE VALUE OF THE CHARACTERISTICS OF CORN[1]

Adaptability. The adaptability of any variety or selection to the soil and climatic conditions under which it is to be grown is of prime importance. Corns which are introduced from a distant locality where the conditions are radically different cannot be expected as a usual thing to do well the first few years after introduction and should not be planted in a field way until after they have been tested for two or more years in small plots. Even varieties that have been grown in the locality for years are frequently not adapted to the local conditions, in being too late or too early a type, or unsuited to the soil.

At the present status of corn production in most of the corn-growing sections of the United States, the adaptability should take first rank as to the importance

[1] After the student has become familiar with the several characteristics of corn and their corelation and the significance of each, he must know something as to the relative importance of these several qualities before he can intelligently judge between individual ears as units. In the laboratory this information may best be gained through lectures and private instruction, but to the student who is working without a competent instructor, the score-cards and the descriptive matter on the relative value of characteristics of corn will be a valuable aid.

of the several qualities, although, as already intimated, frequent exception will be found in the comparison of certain samples.

The best means of judging the adaptability between varieties or selections is by comparative field tests. The adaptability may best be judged in the ear by the size of ear in relation to length of season and by dryness and hardness of ear; weight of ear; brightness of color and other qualities indicative of its maturity.

Seed Condition. The seed condition, which includes the germination of the seed and the vigor of the resulting plant, which depends largely upon the maturity of the seed, is probably second in importance

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The student is frequently inclined to ask which is the more important of two minor characteristics, when he could answer the question for himself by considering the significance of the deficiencies at hand and looking for other qualities, which, together, would show one ear the better in more important characteristics, such as adaptability, seed condition, type, etc.

For instance, instead of attempting to decide whether a slight deficiency in shape of kernel is more objectionable than a slight mixture in color, the student should look for other indications of maturity and poor seed condition and of impurity of breeding. Perhaps in the one ear, besides the deficiency in shape of grain, we may find a slight deficiency in weight, softness of grain on the cob and the dull color of the immature ear, while in the second ear we may find the mixture of color confined to a few grains at the tip, which were fertilized by a late maturing plant, the color of the remainder of the grains and the color of the cob, and, in fact, all other qualities are characteristic of the variety. Little difficulty would be experienced in making a choice between the two ears after this study had been made.

CORN—Comparison Sheet B

Date_____ Student's Name_____

Name of Variety_____ No. of Sample_____

Rank the ears of the sample according to the qualities mentioned below.

	1st	2nd	3rd	4th	5th
A. Type or breed characteristics:					
a Shape of ear					
b Size of ear					
c Indentation					
d Natural color of ear					
1 Color of grain					
(1) Caps of grains					
(2) Sides of grains					
2 Color of cob					
Total color					
e No. of rows and size of kernel					
f Shape of grain as viewed in ear					
Total type or breed characteristics					
B. General qualities regardless of variety or type:					
a Amount of grain and proportion of grain to cob					
1 Weight of ear					
2 Depth of kernels in proportion to size of ear					
3 Space between grains					
(1) At tips					
(2) At crowns					
4 Filling out of butts and tips of ears					
Total amount and proportion of grain					

b Maturity and seed condition					
1 Hardness of grain and cob					
2 Dryness of grain and cob					
3 Weight of ear in proportion to size					
4 Color of ear and grains					
(1) Due to immaturity					
(2) Due to moisture and weather conditions					
5 Color of germs					
6 Blisters					
7 Cracking of grains					
8 Shape of grains at tip					
(1) Thickness					
(2) Width					
9 Size of grains					
10 Size of germs					
11 Freedom from mold and fungus diseases					
12 Freedom from breaking off of tip caps					
13 Freedom from attack of insects or other injury					
Total maturity and seed condition					
c Uniformity of grains in					
1 Size					
2 Shape as viewed in ear					
Total uniformity of kernels					
d Composition					
1 Richness in protein					
2 Richness in oil					
e Shank					
Total of all qualities					

to adaptability. Although the last few years have seen a marked improvement in this respect, a large per cent of the corn acreage in the United States is still planted with seed of poor germinating qualities, which largely accounts for the poor stand and the large per cent of unproductive plants.

In studying samples of very low germinating qualities, the seed condition may frequently be of first importance; but in comparing well-matured and well-preserved samples, it may be found of very little importance.

In the average sample the best indications of maturity are hardness and dryness of ear, weight of ear, color of ear, shape of grains at tip and size of germs.

Among the best indications as to the seed condition due to storage conditions are color of germs, color of ear, blisters, cracking of grains and freedom from mold.

Amount of Grain and Proportion of Grain to Cob as Indicative of the Yield. This quality should probably be given third importance in the average sample, but it may take a much higher or occasionally a lower rank in the study of certain samples.

Many corn growers fail to realize that the large-cobbed, shallow-grained varieties which they are growing and which perhaps fill up the crib rapidly, are small producers of grain. Perhaps the best means of judging this quality is the dry weight of the ear. Other valuable points to be considered are the depth of grains; spaces between rows and grains; and the filling of butts and tips.

Uniformity and Trueness to Type. Of value in showing the purity of type and the selection and breed-

ing which the strains have had. While mistakes have doubtless been made in the past in the selection of corn, the strain or variety which has been selected to a definite type will almost invariably be found better if adapted to the conditions under which it is grown than the strain which has had no breeding and is lacking in type. Its importance among the different characteristics is seldom lower than fourth, and frequently higher.

Uniformity of Grains. While the uniformity of grains in size and shape was of comparatively little importance in early days when corn was planted by hand and thinned to the required stand, it is of much importance under modern methods of planting. A missing hill or a missing plant here or there may account for a loss of several bushels per acre in the yield. In order to get an even stand and the proper thickness of stand, it is necessary to have a grade of corn which is fairly even in size and shape of grain, and it is important not only to make as even a grade as possible, by the use of the grader, but to seek permanent improvement in this respect by selection and breeding.

Composition. While serious objection should be made to corns whose kernels are very starchy and contain small germs and little horny endosperm, the composition in the average sample of corn is of minor importance compared to the qualities mentioned above. It may be that special demands will in the future justify the breeding of corns high in protein, oil or starch content, but, under the present conditions, it is thought that breeding or selection to change the composition has little practical importance, especially

if this should be accompanied with the lowering of the yield per acre.

Shank. In the average sample of corn the shank is of little importance as compared to any of the above qualities. However, in a few varieties the very small, long shank or the very large shank is responsible for a material loss in the yield and quality of product or in the cost of harvesting.

The following comparison sheet (pages 72 and 73), which is used in the agricultural extension work of the Ohio State University, gives a concise statement of the more important points to be considered in seed-corn selection, and will be found to be of value to the farmer or student who can devote but little time to the study of corn.

For explanation of the several qualities mentioned see discussion of the same points elsewhere in this text.

The following score-card (pages 74 and 75), which is the score-card adopted by the Ohio State University and the Ohio Experiment Station, is submitted here chiefly for the purpose of showing approximately the average relative value of the more important points to be considered in the judging of corn. A little practise in scoring with this card will be of value in gaining familiarity with these points and with the score-card system of judging. The score-card may be used for scoring ten ears or ten samples of corn.

Comparison judging of ears in samples. After studying several samples of corn by use of comparison sheets A and B, the student should be familiar with the detailed structure of an ear of corn and be able to recognize each of these points, their importance and

their strength or deficiencies almost unconsciously and without following through any systematic arrangement of points. The next step and the most important of all is to train the judgment in the selection of ears as units, basing this selection upon an analytical and detailed study when necessary. Comparison sheet D has been prepared for recording the rank of ears in the samples.[1]

The method of procedure in this exercise is important. The student as he begins to examine a sample is able to see each ear as a unit and make a general summary of its qualities, which is usually approximately correct. After a careful examination has been made of several of the characteristics, it is fre-

[1] This exercise will be found to be one of the best means of training the judgment in the practical selection of corn, and much time should be devoted to it. The work should be varied by the provision of samples of different varieties, of strains representing the standard of different breeders, and samples showing the types adapted to different soil and climatic conditions.

The samples should be judged by the instructor before the laboratory period begins and built up in such a way as to leave no doubt as to the correct order of placing. A part of the laboratory period may be devoted to a placing of the ears in the samples, when the correct placings are given the students and the remainder of the period devoted to a review of the work already done. Or the instructor may devote a part of the time to a general discussion of the placing of certain samples and the reasons for the same.

In placing the ears in the samples it will avoid much confusion and add interest to the work to allow a definite period for the placing of each sample, requiring the students to pass around the table in regular order. The grading of papers may be facilitated by the use of grade sheet found on page 85.

CORN—Comparison Sheet C

Date_____ Student's Name_____

Name of Variety_____ No. of Sample_____

Rank the ears of the sample or the several exhibits according to the qualities mentioned below.

	1st	2nd	3rd	4th	5th	
1 Is It Adapted?						
Is the ear of the proper size to grow under your soil and climatic condition?.....						
Will it ripen as judged by the hardness and dryness of the ear, weight of ear, brightness of color, etc.?						
2 Will It Yield?						
Weight of ear.....						
Length and proportion.....						
Depth of kernels.....						
Space between kernels.....						
Filling out of butts and tips.....						

3 Will It Grow?						
Firmness and dryness						
Weight of ear in proportion to size						
Brightness of color						
Plumpness of kernel at tip						
Adherence of cob chaff to kernel						
Color of germs						
Blisters						
Freedom from mold and rotten kernels						
Freedom from breaking off of tip caps						
4 Does It Show Improvement? (Has it a distinct type? Is it the right type? Does it show selection and breeding?) Is it uniform in Size of ear?						
Shape of ear						
Indentation						
Color of grain and cob						
Number of rows and size of kernel						
RANK OF EARS						

EXPLANATION OF SCORE-CARD

1. Adaptability

Indicated by the size and maturity of ear. The size of ear should depend largely upon location (latitude), soil, rainfall and climatic conditions. Corn should be large and late enough in maturing to utilize practically all of the growing season, but it should not be so large and late a type as to fail of maturity during the average season. The maturity may be judged by the hardness and solidity of ear, the weight of ear in proportion to size, the brightness of color, the plumpness of grain at tip, and the size and color of germ.

2. Seed Condition

Determined largely by the maturity as indicated above, and also by the storage conditions. Corn which has been exposed to the weather often has a bleached appearance, or it may show evidence of mold or fungus diseases, or the seed coat may be wrinkled, causing blisters. Germs which have been frozen while containing a large per cent of water are usually black.

3. Shape of Kernel

Kernels should be full and plump at the tip, and broaden gradually from tip to crown, with the edges straight, so that they touch the full length. Thin, shrunken, sharp-pointed kernels are especially objectionable.

4. Uniformity and Trueness of Type

The ears should be uniform in size, shape, indentation and size of kernel. Uniformity or trueness to the type determined upon is essential to progress in corn improvement. Uniformity of kernels is essential to machine planting.

5. Weight of Ear

The weight of ear, and the weight of ear in proportion to size, are valuable means of judging corn that is thoroughly air dry, or in comparing ears of like moisture content. When the stand and other conditions of growth are equal, weight of ear is one of the best indications of productiveness.

6. Length and Proportion

Length will vary according to environment. No standard can be set by the score card save that set by maturity and proportion. Circumference is measured at one-third the distance from butt to tip. In normal-sized ears it should not exceed four-fifths, nor fall below three-fourths the length.

7. Color of Grain and Cob

Color of grain and cob is of importance, mainly as an indication of the purity of breeding. Grains which are off color, and tints in the grain or cob which vary from the standard, indicate mixture and lack of breeding and type.

8. Butts and Tips

Kernels should extend in regular rows over the butt and against the shank. The shank, however, should have sufficient size to support the ear. Swelled, open or badly compressed butts, as well as those having kernels of irregular size are objectionable. The tips should have kernels of even size, well dented and preferably in regular rows. An undersized ear is more objectionable with a completely capped tip than with a little bare cob. A sharply tapering tip is not desirable.

SCORE CARD FOR DENT CORN

Place _____ Date _____ 19___

Variety _____ Scored by _____

	Standard	SCORE — Nos. of Exhibits										
		1	2	3	4	5	6	7	8	9	10	
1 Adaptability	25											
2 Seed condition	15											
3 Shape of kernel	15											
4 Uniformity	15											
5 Weight of ear	10											
6 Length and proportion	10											
7 Color of grain and cob	5											
8 Butts and tips	5											
Total	100											

quently impossible to get a fair idea of the ear as a whole, the mind seeming to be preoccupied by those characteristics that have been examined in detail. The following rules for judging will be found to be helpful:

Pick up one of the ears and without looking for anything in particular you should get an idea of its appearance, type, weight, firmness, maturity, etc. You may not stop to think what, in particular, is good or bad about the ear, except in a very general way, but it impresses you as a good ear or as a poor ear or as a fair or medium ear. If a good ear as compared with the others lay it over to the right, if a poor one to the left, and if a medium one give it an intermediate position. Pick up the next ear and examine it in a similar way and so on through the sample. You have a better idea now as to how good the sample

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One of the most common and most serious mistakes made by the student, especially the beginner, is in judging almost entirely by means of the eye and in not training the hand. The hand, if properly trained, will be found to be as good and frequently the better means of selection of the two.

In order to train the hand in the selection of seed corn, it is well to practise for a while the ranking of ears entirely by the hand, then carefully studying the sample with the eye. Some of the things to be observed in the hand selection are the weight of ear, hardness and solidness of ear, sound of ear as caught in the hand, and the feel of the ear to the sense of touch.

These points are indicative of the adaptability, maturity, seed condition and the amount of corn—some of the most important points to be considered in seed-corn selection, and points that are frequently overlooked when the hands are not trained to judge them.

is. Go over it again in a similar manner and see if your first arrangement is satisfactory.

If your first impression does not indicate much difference between certain ears, do not be particular about the placing, but get the ranking approximately correct, according to the first impression. These two or three examinations should not require more than one-half to one minute for a five-ear sample. In judging most samples, there are some decisions that can be readily made, some ears perhaps that will easily take first rank and some that can as readily be put at the bottom of the list.

The decisions that can be made most easily should always be made first, and then plenty of time devoted to the more difficult decisions. After this preliminary arrangement of sample, take out some of the grains and examine the ears carefully, first comparing the first and second, then the second and third, and so on, rearranging them if necessary. Never attempt to compare more than two ears at the same time. If a choice between certain ears is found to be difficult, write down all the points in which one ear excels the other and whether these differences are slight, medium or large. Then write down the points in which the second ear excels the first; then if these points are grouped under type, amount and proportion of grain, seed condition, etc., and are balanced with each other, little difficulty will generally be found in coming to a satisfactory decision.

Comparison judging of samples in groups. The judging of samples in groups or classes, as in a corn show, should be done by practically the same method as the selection of ears in samples. The

CORN—Comparison Sheet D

Date _____ Student's Name _____

No. of Sample	First	Second	Third	Fourth	Fifth	Instructor's Grade

value of the first impression should not be overlooked. The judge should pass around the exhibit several times and get an idea as to the quality of the class and get some of the better samples in mind before making a careful examination of any of the samples.

In this preliminary examination several more samples should be selected than required to be placed, and these should be moved to another table, placing them in about the order of choice. Go over these samples once or twice more before taking out many grains or making a detailed examination, rearranging them if necessary. Then remove a couple of grains from each ear and make a careful examination of each sample, first comparing the first and second, then the second and third, etc., moving the samples if the first arrangement is not found satisfactory, so that the two samples being compared are always adjacent to each other.

If, after this examination, there is the least doubt as to whether all the best samples have been removed to the judging table, bring out several more samples and make a careful examination.

Importance of uniformity and type in judging samples. Aside from the qualities already considered in the study of individual ears, the comparison of samples containing several ears affords an opportunity to study uniformity and type, as an indication of purity of breeding.

A sample lacking in type not only shows little or no breeding, but indicates that the exhibitor has made little or no study of corn and has made no definite conclusions as to what type he prefers. Uniformity

should include uniformity in size and shape of ear, color, indentation, number of rows, size and shape of grain, and in fact, all characteristics of the ear.

WINTER SELECTION OF SEED CORN

The progressive farmer will pick his seed corn in the fall, either from the standing stalk or from the ear corn as husked, and put it in a dry, well-ventilated room, where it will dry out before freezing weather. More than sufficient corn for the next season's crop should be saved so as to afford an opportunity for further selection. This selection should be made in late winter, after the corn has dried out and has passed through the most severe of the winter weather and before the rush of the spring's work begins.

On most farms the month of February is found to be a convenient and satisfactory time for this work. The corn should be taken from the racks upon which it has been stored and placed upon tables or benches in a warm, light room. Never attempt to select seed corn in the barn on a winter's day, but take it to the house, where you will be comfortable, and where you can devote your entire attention to the study of the corn. Be sure that the room is well lighted, with natural light, choosing a bright day and working only in the middle of the day if necessary.

GERMINATION OF CORN

Many ways of making a germinator and conducting the test have been suggested, the choice of which will depend largely upon the convenience of the operator. The essential features are that the corn be kept in a moist condition, that the temperature be kept above

freezing and that the grains from each ear be placed in a separate check or pocket so that its identity with the ear shall not be lost.

A hand-made sand germinator which has proven very satisfactory may be made as follows: Make a flat box 3x20x30 inches, inside measure, and fill nearly full with moist sand, and then mark into squares two inches across by a cord which is passed around nails driven in the sides of the box, the checks in the first row beginning in one end are numbered 1 to 10, second 11 to 20, etc. After placing six grains from each ear in their respective checks another half-inch of moist sand is used to cover the corn. If, in any check, all of the grains do not grow, or if the sprouts do not show sufficient vigor, the corresponding ear should be discarded. A week to ten days' time is usually required to make a germination test with a sand germinator.

If it is desired to make several tests in the same germinator in a short time, the sawdust germinator will be found more efficient. This germinator may be made and operated as follows: Make a box 3x20x30 inches, inside measure, fill one-half full with old sawdust which has been thoroughly moistened (preferably sterilized by boiling), then cover with a piece of white cloth marked into two-inch squares and numbered as above. After placing the grain from the several ears in their respective checks, cover with another piece of cloth and tack at the corners, then lay on a third piece of cloth which is large enough to extend up over the edges of the box and fill the remainder of the box with moist sawdust, taking care to see that it is well firmed, especially about the corners.

After three to six days, depending upon the tem-

perature of the room, the corn should show vigorous sprouts, when the upper layer of sawdust should be removed by lifting the upper cloth, after which the second cloth should be carefully pulled back so as not to disturb the grains. If, in any check, one or more grains fail to germinate,. or if the sprouts do not show a vigorous growth, the corresponding ear should be discarded, but these ears should not be thrown out at once, but simply pulled out a little so that the order of the ears may be preserved until the remainder of the test is studied and checked over the second time if necessary.

After the corn has been placed on the tables and all the ears of low germinating quality discarded, the process of selecting the best ears should be much the same as that already described for the selection of ears and samples. It is best to make the preliminary selection by the "first impression," going back and forth over the corn several times to place the ears in their approximate rank before taking out many grains or making a detailed study. Then take several grains from each ear and make a careful comparison of all the best ears, considering the adaptability, maturity, seed condition, type and other points. Pick out enough ears to furnish the required amount of seed and discard the remainder or lay it aside for emergency.

HOW TO SHELL AND GRADE CORN FOR PLANTING

Shell off from butt and tip of ear all grains which are irregular in shape or larger or smaller than the type determined upon. Pick out from the remainder all the irregular or undesirable grains. If the size of grain varies somewhat on the different ears, grade ac-

cording to size of grain and shell and plant each grade separately, shelling by hand so as to avoid cracking of grains.

Shell each ear in a dish by itself and discard all ears which have very pointed, badly discolored, cracked, mixed or otherwise undesirable grains. Use a corn grader to make a still more uniform grade of grains. In order to test the grading and also the adjustment of the planter to your corn, make a calibration test of your planter.

To do this, block up one end of the axle and turn the wheel slowly, pulling back the trip that the chain passes through at regular intervals, but not more than twice for each revolution of the wheel. Count the number of times the required number of grains are dropped. If the proper number of grains are not dropped 85 times out of 100, the corn should be more carefully graded or different plates substituted in the planter.

All the possible placings of five ears are given in the table on opposite page. In order to use the grade sheet compare the student's placing with the correct placing and transpose the placing to numerals based upon 1, 2, 3, 4, 5 as correct placing. Example: if A, D, E, C, B should be the correct placing for a sample and a student should place it D, E, C, A, B, the student has placed D, which should have been second, first; therefore, put down 2 for the first rank; the student has placed E, which should have been third, second; therefore, put down 3 for the second rank; C, which should have been fourth, is placed third, so 4 is put down for third rank, and so on, when the student's placing transposed will be 2, 3, 4, 1, 5, the grade for which may be read directly from the grade sheet.

GRADE SHEET

1	2	3	4	5—100	2	1	3	4	5— 90	3	1	2	4	5— 80	4	1	2	3	5— 70	5	1	2	3	4— 60
1	2	3	5	4— 90	2	1	3	5	4— 80	3	1	2	5	4— 70	4	1	2	5	3— 60	5	1	2	4	3— 50
1	2	4	3	5— 90	2	1	4	3	5— 80	3	1	4	2	5— 70	4	1	3	2	5— 60	5	1	3	2	4— 50
1	2	4	5	3— 80	2	1	4	5	3— 70	3	1	4	5	2— 60	4	1	3	5	2— 50	5	1	3	4	2— 40
1	2	5	3	4— 80	2	1	5	3	4— 70	3	1	5	2	4— 60	4	1	5	2	3— 50	5	1	4	2	3— 40
1	2	5	4	3— 70	2	1	5	4	3— 60	3	1	5	4	2— 50	4	1	5	3	2— 40	5	1	4	3	2— 30
1	3	2	4	5— 90	2	3	1	4	5— 80	3	2	1	4	5— 70	4	2	1	3	5— 60	5	2	1	3	4— 50
1	3	2	5	4— 80	2	3	1	5	4— 70	3	2	1	5	4— 60	4	2	1	5	3— 50	5	2	1	4	3— 40
1	3	4	2	5— 80	2	3	4	1	5— 70	3	2	4	1	5— 60	4	2	3	1	5— 50	5	2	3	1	4— 40
1	3	4	5	2— 70	2	3	4	5	1— 60	3	2	4	5	1— 50	4	2	3	5	1— 40	5	2	3	4	1— 30
1	3	5	2	4— 70	2	3	5	1	4— 60	3	2	5	1	4— 50	4	2	5	1	3— 40	5	2	4	1	3— 30
1	3	5	4	2— 60	2	3	5	4	1— 50	3	2	5	4	1— 40	4	2	5	3	1— 30	5	2	4	3	1— 20
1	4	2	3	5— 80	2	4	1	3	5— 70	3	4	1	2	5— 60	4	3	1	2	5— 50	5	3	1	2	4— 40
1	4	2	5	3— 70	2	4	1	5	3— 60	3	4	1	5	2— 50	4	3	1	5	2— 40	5	3	1	4	2— 30
1	4	3	2	5— 70	2	4	3	1	5— 60	3	4	2	1	5— 50	4	3	2	1	5— 40	5	3	2	1	4— 30
1	4	3	5	2— 60	2	4	3	5	1— 50	3	4	2	5	1— 40	4	3	2	5	1— 30	5	3	2	4	1— 20
1	4	5	2	3— 60	2	4	5	1	3— 50	3	4	5	1	2— 40	4	3	5	1	2— 30	5	3	4	1	2— 20
1	4	5	3	2— 50	2	4	5	3	1— 40	3	4	5	2	1— 30	4	3	5	2	1— 20	5	3	4	2	1— 10
1	5	2	3	4— 70	2	5	1	3	4— 60	3	5	1	2	4— 50	4	5	1	2	3— 40	5	4	1	2	3— 30
1	5	2	4	3— 60	2	5	1	4	3— 50	3	5	1	4	2— 40	4	5	1	3	2— 30	5	4	1	3	2— 20
1	5	3	2	4— 60	2	5	3	1	4— 50	3	5	2	1	4— 40	4	5	2	1	3— 30	5	4	2	1	3— 20
1	5	3	4	2— 50	2	5	3	4	1— 40	3	5	2	4	1— 30	4	5	2	3	1— 20	5	4	2	3	1— 10
1	5	4	2	3— 50	2	5	4	1	3— 40	3	5	4	1	2— 30	4	5	3	1	2— 20	5	4	3	1	2— 10
1	5	4	3	2— 40	2	5	4	3	1— 30	3	5	4	2	1— 20	4	5	3	2	1— 10	5	4	3	2	1— 0

CHAPTER III

FIELD SELECTION OF CORN

Environment. Plants develop largely according to their environment, such as fertility of soil, moisture, climatic conditions and thickness of stand, etc. The soil is always more or less uneven, due to differences in slope, elevation, texture, sub-soil, previous cropping, treatment, etc. But most serious of all as regards the field selection of corn is the unevenness of stand, which gives certain plants two to six times as much plant food, moisture, and sunlight as those in a normal stand.

The large production of these plants is not inherited by the progeny unless grown under equally favorable conditions. The desirable type of plant is the one which will produce a good ear under crowded or unfavorable conditions, whose high-yielding qualities are inherent and will be transmitted to the progeny. After an ear has been separated from the stalk and its environmental conditions, it can no longer be told to what extent its size, weight and other desirable conditions are inherited, and to what extent due to environment.

No doubt the great majority of the ears selected after husking owe their appearance, in part at least, to the fact that the mother plants have had more favorable conditions than the average. That the ear which is carefully selected in the field is more valuable than the ear selected after husking has been

demonstrated by Mr. C. G. Williams, of the Ohio Experiment Station, as shown in the table below. The ears selected in the field were taken only from hills with three plants, that were surrounded by full hills on every side, while the ordinary selection was made from the wagon at the time of husking.

TABLE VIII

Plant Selection vs. Ordinary Selection

	Bushels
Av. yield per acre of 4 plant selection plots 1906....	72.49
Av. yield per acre of 4 ordinary selection plots 1906	69.26
Av. gain for plant selection.....	3.23
Av. yield per acre of 10 plant selection plots 1907...	89.04
Av. yield per acre of 10 ordinary selection plots 1907	84.64
Av. gain for plant selection.....	4.40
Av. yield per acre of plant selection plots '06-'07....	80.76
Av. yield per acre of plant selection plots '06-'07....	76.95
Av. gain for plant selection '06-'07.....	3.81

TIME TO SELECT SEED CORN FROM FIELD

When to select. The best time to select the seed corn from the field is as the corn is nearing maturity and some of the plants are nearly or quite mature and others somewhat immature, as shown by the development of the grain and the greenness of the leaves.

If the variety is found to be too late in maturing for the average season, select some of the more advanced ears; or if too early to utilize the entire growing season, select some of the later maturing ears.

Opportunity is offered at this particular time to study not only the maturity and adaptability of the plant, but the character of stalk and foliage, the height

EXPLANATION OF SCORE-CARD

Adaptability

Plants must be adapted to the average soil and seasonal conditions prevailing in the locality. Corn that is too late or too early in maturing, or that shows lack of adaptability to conditions, should be cut accordingly.

Vigor

Evidences of vigor are shown by uprightness of stalk, by the development of stalk, leaf and ear, and by freedom from disease. In marking for vigor note carefully the conditions of growth.

Height of Plant and Height and Angle of Ear

Cut for extremes in the case of both plant and ear. The ear should turn down at maturity.

Uniformity

Uniformity of plant and ear, and manner of growth, height of plant, ear, etc., and conformity to type determined upon.

Weight of Ear

While the weight of ear can only be estimated at the time selections are made, it is a point to take into consideration in selecting for high yield, if the conditions of growth are noted.

FIELD SCORE-CARD FOR CORN

Place _____ Date _____ 19____

Variety _____ Scored by _____

	Standard	SCORE										
		Nos. of Exhibits										
		1	2	3	4	5	6	7	8	9	10	
1 Adaptability	35											
2 Vigor	25											
3 Height of plant and height and angle of ear	15											
4 Uniformity and trueness to type	10											
5 Weight of ear (estimated)	15											
Total	100											

and angle of ear and other characteristics which should be considered in the field selection of corn.

The following score-card (page 89), which has been adopted by the Ohio State University, the Ohio Experiment Station, and the Ohio Corn Improvement Association, is suggestive of some of the more important characteristics to be considered in the field selection of corn:

RULES FOR FIELD SELECTION OF CORN

(1) Choose only those plants which have a normal amount of soil and sunlight, no matter how vigorous they may appear or how large and well-formed ears they produce. The plant which is able to produce the normal ear under crowded conditions is to be preferred over the one with a large ear, whose size and development are due to the fact that there are vacant spaces next to the plant allowing it more plant food and sunlight.

(2) Choose plants that are well adapted to the soil and climatic conditions, as judged by the vigor of growth and the earliness or lateness of maturity. Corn which does not utilize practically the entire growing season, or corn which is not well matured in a season of average length, is not adapted to the climatic conditions.

Corn which has been changed from poor land to rich land is apt to show its lack of adaptability by the smallness of stalks and plants, by its early maturity and by the appearance of the ears. Corn which has been changed from fertile soil to thin land is apt to attempt to make too large a growth and to fail of the proper development of the ear.

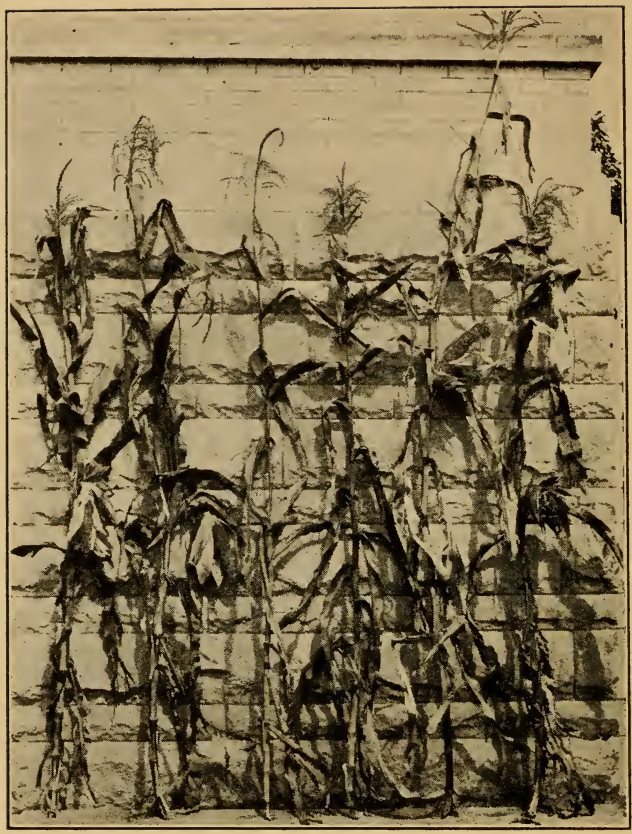
(3) Select plants which are of vigorous, healthy growth, as evidenced by the size of stalk, width of leaf, color of leaf and freedom from disease.

(4) Do not select ears from stalks which show a marked tendency to produce suckers. The suckering of the corn plant is doubtless of considerable economic value in thickening the stand when too thin, but the plant which produces several suckers in a good stand and normal season is not to be desired, as the suckers rob the plant of food and moisture the same as weeds, and seldom produce an ear of any value.

(5) Select ears only from standing stalks. In some varieties, practically every season, and in most varieties in certain seasons, large losses occur from the weakness of the stalk. The ability of the stalk to stand upright has been shown to be an hereditary character. By the selection of ears from those stalks which stand upright, the variety may be improved in this regard.

(6) Select ears which appear at the proper height on the stalk and which are heavy enough to turn down at maturity. The Illinois station, in six generations of breeding, produced from the same variety high and low ear strains which differed from each other nearly 3 feet in the average height of ear, showing that this characteristic is hereditary and that it is possible to breed to any desired height or ear.

(7) Select plants which have one good ear each rather than those that have two or more inferior ears. The maximum production of grain per acre can doubtless be as easily reached with one ear per stalk as with more, and the cost of harvesting is materially increased in the selection for the latter type.



THIS ILLUSTRATION SHOWS SEVERAL TYPES OF CORN PLANTS

The first at the left shows a vigorous growth and good ear attached to a normal shank. The second plant has too long a shank, which is apt to be broken off or twisted so as to prevent the sap of the plant going to the ear, to complete its development. The third plant represents the type which has a tall, slender stalk with narrow yellowish-green leaves, and a very small, poorly developed ear. The fourth plant shows a vigorous growth of stalk and leaf, but has produced no ear. The fifth plant is undesirable because of its abnormal height of stalk and ear. The last plant to the right has been attacked by smut and has failed in the production of an ear.

In the breeding of a strain of corn to be used exclusively for silage or for feeding on the stalk the size of ear is of little importance, so long as the production of grain and forage is satisfactory, some preferring the prolific or many-eared type.

(8) Select ears that are heavy. While weight of ear can only be estimated at the time selections are made, and while the moisture content of ears will vary considerably, the weight of ear is a valuable point to take into consideration as an indication of high yield, if the uniformity of the stand is considered, as suggested above, and only those plants selected which have no vacant spaces adjacent to them.

(9) Select ears of normal size and fairly short shanks. In some varieties the shanks are extremely small and rather long, so that the ears are blown about by the wind and broken off in harvesting. Most of these ears drop to the ground and rot, or at least fail of perfect maturity and seed condition. For normal-sized ears the shank should be about ⅝ inch in diameter. Smaller shanks are too small to properly support the ear, and larger ones make it difficult to husk the corn.

(10) Partially pull the husk from one side of ear and consider the general character of ear, as discussed in Chapter II, so as to avoid the selection of many ears which would have to be discarded later.

(11) Uniformity in type. By considering the ear in connection with the rest of the plant, there is no better place to select for uniform type of plant and ear than in the field. Select plants of a uniform height, maturity, ear, etc.

As field selection of corn should be made at about

the time of maturity or the time the leaves become dry and the grain passes from the dough to the mature stage, it is not best to pick the ear from the stalk, as the sap of the stalk is of much value in the proper development of the ear.

The ears may be selected and marked by a piece of cloth or otherwise, so that these ears may be noticed at the time of husking. Or, what is perhaps a more satisfactory way, is to cut the stalk at the time the selection is made and carry all such stalks to the edge of the field and place in separate shocks. This corn may then be husked as soon as it is dry enough and properly stored without waiting for the husking of the remainder of the field.

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