

Experiment Station
of the
Kansas State Agricultural College
MANHATTAN.

Bulletin No. 139—June, 1906.
(Issued August, 1906.)

Agronomy Department.

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The Study of Corn.

INTRODUCTION.

This bulletin has been prepared for use by the young men in the Boys' Corn Contests which are being conducted under the direction of the Farmers' Institute Department of this College, and by others who are interested in the study and improvement of corn. No attempt has been made to present an exhaustive study of corn, but rather to furnish a guide in elementary corn judging to those who are not so situated that they may receive practice work in High Schools or Agricultural Colleges.

It is surprising how few people can pick out a good ear of corn before they are carefully instructed and trained in the vital points, both as to desirable qualities and defects. It is just as important to select and grow a pure and perfect type of corn as it is to select a well-formed hog or perfect type of dairy animal for breeding purposes. A higher per cent of protein, greater productiveness, and other valuable qualities, which may be bred into corn by careful and intelligent selection, should greatly increase the value of this crop to the farmer.

HISTORY, TYPES AND VARIETIES.

1. What is the origin and history of corn?

Indian corn or maize, known botanically as *Zea Mays L.*, is distinctly an American plant, not having been known in the Old World until it was introduced from America. In Europe and Asia, the word corn has been applied since Bible times, to wheat, barley, etc., hence the colonists called maize Indian corn to distinguish it from the other grains. Before the discovery of America, the Indians of this continent and the semi-civilized tribes of South

America raised this crop quite extensively, and although their methods of breeding appear to have been crude, they have probably improved the corn plant far more than it has since been improved by the white man. Little was done, however, in a systematic way in the improvement of corn until a few years ago, when several farmers and a few of the experiment stations realizing the importance of this work took it up. Among the farmers who were pioneer corn breeders were J. S. Leaming, Wilmington, Ohio; Jas. Riley, Thornton, Ind.; and James Reid, East Lynn, Ill., who were the originators of the Leaming, Boone County White, and the Reid Yellow Dent varieties, respectively.

2. To what conditions is corn best adapted?

Corn is best adapted to a moist, fertile, alluvial soil, which is supplied with a well-distributed rainfall of about 16 inches during May, June, July, and August, and where the average summer atmospheric temperature is between 70° and 80° Fahrenheit, and at a sufficiently low elevation that the nights are not more than 20 to 30 degrees colder than the days.

3. Which states are known as the Corn Belt, and what has been the average yield of corn in each of these states during the past 10 years—1896 to 1905?

State.	Bushels.
Iowa	281,023,876
Illinois.....	279,022,252
Nebraska.....	219,196,176
Missouri.....	173,537,549
Kansas.....	172,839,481
Indiana.....	139,969,560
Ohio.....	97,988,975

4. Name the types or general classes of corn.

Dent corn. — A large growing type with large ears and with the crowns of kernels dented.

Flint corn. — A smaller growing type than the dent, ears only 4 to 5 inches in circumference, though often 12 to 14 inches long. Kernels rounded at crown and hard and flinty.

Soft corn. — A large growing type with ears resembling the flint, except very soft and starchy.

Pop-corn. — A medium to late growing type. Small ears. Very hard and flinty.

Sweet corn. — An early to late growing type with small ears, kernels hard and translucent, and with a wrinkled appearance at crowns.

Pod corn. — A very leafy type with large tassels, ears small, and each kernel enclosed in a separate husk.

5. Where are these different types most commonly grown in this country?

The dent corn is most commonly grown in the Corn Belt and in those other states or localities which are fairly well adapted to corn

growing. Flint corn is grown in our most northern states, as in Minnesota, North Dakota, and in Canada, where the summers are not sufficiently long and hot to be well suited to the growing of the dent varieties. Soft corn, such as the Brazilian Flour corn, is a large, late-growing fodder type, and is grown mostly in the Southern States. Pop-corn and sweet corn are grown in all parts of our country, mostly for human food. The pod corn is not grown in this country except as a curiosity, but is grown in Mexico and other Central American countries.

6. Name several varieties of corn which are widely known in this country.

Boone County White and Silvermine among the white varieties and Reid Yellow Dent, Leaming, Golden Beauty and Pride of the North among the yellow varieties.

7. Name several varieties of corn which have given the most satisfactory results at the Kansas Experiment Station, Manhattan, Kan.

Among the white varieties are the McAuley, Hammett, Forsythe Favorite, Cocke Prolific, White Salamander, Sanders' Improved, U. S. P. B., Selection Number 77, and Boone County White. Among yellow varieties are the Hildreth, Bickers' Choice, Klondyke, Kansas Sunflower, Hogue Yellow Dent, Golden Row, Legal Tender, and Reid Yellow Dent.

8. Give a brief description of several of the varieties of corn used in the Boys' Contests.

WHITE VARIETIES.

McAuley.—rather late-maturing and large-growing variety, suited for planting on fairly low and fertile land. Experiments also show that it does fairly well on ordinary upland in counties that are not sufficiently supplied with moisture to make them well adapted to corn growing. The ears are of medium size, cream white in color, and with butts and tips only medium well rounded, and the indentation medium rough. The kernels are compact and of good length and shape. This corn shows good uniformity and type and is altogether an excellent corn.

Hammett.—A medium maturing corn, suited for growing on bottom-land or good upland. The ears are of medium size, and have a large circumference in proportion to their length. Butts and tips are well filled and kernels are deep, with a fairly small space between rows, giving a large per cent of shelled corn. The indentation is medium rough, the color is cream white, and the uniformity is fairly well marked.

Boone County White. — A medium late corn, suited to bottom-land and favorable conditions. The ear is well proportioned and is well rounded at butt and tip. The color is cream white, and the inden-

tation varies from medium rough to rough. The kernel is fairly deep and is more nearly square (as it appears in the ear) than most other corns.

Silvermine.—This corn is medium in its maturity and growth and may be grown successfully on either bottom-land or upland. The ear is somewhat smaller than most of the late corns, and is fairly well rounded at butt and tip. The rough indentation and rather broad flat kernel, with every second suture or furrow between the rows very distinctly serrated, gives this variety a characteristic appearance. The kernel is of medium depth and the color is cream white.

YELLOW VARIETIES.

Hildreth.--This corn is a very large-growing, late-maturing variety, suited for bottom-land and fertile soil. The ear is large and well rounded at butt and tip. The kernels are inclined to be small (as they appear in the ear) but are very deep. The indentation is medium rough, and the color is a deep golden yellow.

Kansas Sunflower.--This variety is fairly late in maturing and is better adapted for growing on bottom-land than on upland. The ear has a smaller circumference and a less number of rows and a broader kernel, with usually wider furrows between the rows, than the other varieties here described. The indentation is medium, and the color is a deep golden yellow.

Reid Yellow Dent.—This corn is medium in maturity, and may be grown on either bottom-land or upland, but is not as well adapted to the bottom-land as the larger growing varieties. The ear is of medium size and is well proportioned. The furrows between the rows are usually small, and the ear appears to be very compact, though the space between the kernels at the cob is often large. The kernels are apt to be "shoe-peg" shaped or square, or rounded in cross-section. The color should be a deep yellow, but is often a pale yellow. The indentation varies from medium to rough.

Hogue Yellow Dent.—This corn is of the same general type as the Reid Yellow Dent, the most noticeable difference being in the color (yellow, with light yellow caps).

CORN JUDGING.

9. How should an exhibit of corn be prepared for judging?

In preparing an exhibit of corn for judging, varieties should be chosen, if possible, which have a distinct type, and for which a "Standard of Perfection" has been prepared by some of the agricultural colleges or corn breeders' associations. Pick out several samples, of 10 ears each, which show as much uniformity and

breed type as possible. Place a small string tag on each ear, for numbering the samples and ears. Use numerals for distinguishing the samples and letters for the ears in the samples.

STUDY OF CHARACTERISTICS.

The following characteristics which are commonly found in corn are hereby presented with the hope that they may be of value in making a more careful study of the points which should be noticed in judging corn:

SHAPE OF EAR,

- Cylindrical.*—Uniform circumference from butt to tip.
- Partly Cylindrical.*—Uniform circumference for a portion of length.
- Slightly Tapering.*—Slight, taper toward tip.
- Distinctly Tapering.*—Taper very apparent.
- Very Tapering.*—Extremely tapering.
- Reverse Tapering.*—Slight taper toward butt.
- Too Short or too Long for Circumference.*—Proper proportion of circumference to length is as three to four.
- Circumference of Ear.*—Measure at one-third the distance from butt to tip.
- Length of Ear.*—Measure from extreme butt to tip.

ROWS OF KERNELS.

- Rows in Distinct Pairs.*—Alternate spaces between rows of kernels wider than the others. The two rows in a pair uniting in a serrated line and the adjoining rows in different pairs uniting in a straight line.
- Rows Indistinct.*—Kernels irregular and not arranged in distinct rows.
- Number of Rows.*—Counted one-third distance from butt to tip.
- Rows Lost.*—Larger number of rows at butt than at tip.
- Rows Straight.*—Parallel with cob.
- Rows Turned to Right or Left.*
- Narrow Space Between Rows.*—Rows pressed closely together.
- Medium Space Between Rows.*—Distinct furrows.
- Wide Space Between Rows.*—Wide furrows.
- Narrow, Medium or Wide Space Between Kernels at Cob.*—Notice space between kernels of the same row and also of different rows.

BUTT OF EAR.

- Open.*—Greater space between rows at butt.
- Kernels Diverging.*—Space between summits of kernels in same row.
- Shallow.*—Kernels at butt flat and short.
- Naked.*—Butt of cob not entirely covered on the sides.
- Exposed.*—Entire end of cob exposed.
- Slightly Swelled Around End of Cob.*—End of cob covered, but kernels only slightly swelled out beyond cob.
- Moderately Swelled.*—More marked than above.
- Extremely Swelled.*—Swelling over end of cob very marked and the depression deep.
- Enlarged.*—Large butt with no extra rows or kernels.
- Expanded.*—Large butt caused by extra rows of kernels.

TIP OF EAR.

- Kernels in Rows.*—Rows extending to tip.
- Flat.*—Cob flattened at tip.
- Exposed.*—Entire tip of cob not covered with kernels.
- Partly Filled.*—A portion of end of cob exposed.
- Filled.*—Entire end of cob covered with kernels.

MATURITY.

Very Moist, Moderately Moist, Thoroughly Dried.—These qualities may be judged approximately by the dampness and temperature of the ears as held in the hand.

Bright Color.—Indicates that the corn is well matured.

Dull-dead Color.—Shows lack of vitality and immaturity.

Firm.—Corn rigid on cob.

Loose.—Corn slightly moveable on cob.

Chaffy.—Corn very loose on cob, and small, poorly developed kernels.

KERNEL.

Upright.—At right angles with surface of cob,

Sloping.—Leaning toward tip.

Roof-shaped at One Edge.—Convex at one edge and flat at the other.

Straight Wedge-shaped.—Edges of kernels straight, tapering.

Rounded Wedge-shaped.—Edges rounded lengthwise, tapering.

Rectangular.—Short and broad, as broad at tip as at crown.

Shoe-peg Form.—Long, narrow kernels, with parallel edges.

Square at Crown.—Crowns not rounded.

Rounded Corners.—Corners rounded at tip and crown.

Slightly Rounded at Edges.—Rounded lengthwise of kernel.

Small, Sharp Point at Crown.—Pointed projection from chit side of kernel.

Round, Smooth Dented.—Round, smooth depression at crown of kernel.

Long, Smooth Dented.—Long, smooth depression.

Crease-dented.—Edges of kernels pressed toward each other, leaving small space between, and edges parallel.

Rough Projection Dented.—With any rough, ragged or beaked projection from crown of kernel.

Bridge-dented.—Crease-dented with fold across center.

Crumple-dented.—Seed coat wrinkled as in sweet corn.

Breadth, Depth, Thickness.—Exact measurement.

Color.—Note color and shade as an indication of mixed or impure breeding.

Horny Layer.—A large, horny layer indicates high protein content.

Starchy Portion.—A large amount of the white granular portion near the crown and through the center of the kernel shows a large proportion of starch.

Size of Germ.—A large germ shows that the kernel is strong in vitality and rich in oil and protein.

SHANK.

Large.—Nearly the diameter of cob.

Medium.—Half the diameter of cob.

Small.—One-third the diameter of cob, or less.

COB.

Large.—Larger than 4½ inches in circumference.

Medium.—From 3½ to 4 1/2 inches in circumference.

Small.—Not more than 3 1/2 inches in circumference.

Color.—Note shade.

Note.—Part of the above is copied from A. D. Shamel's publication on Corn judging.

STANDARD OF PERFECTION FOR CERTAIN VARIETIES OF CORN

VARIETY.	Ear.			Kernels.					Rows.		Butts.	Tips.	Shank.	Cob.		Per cent of shelled corn.
	Shape	Length inches.	Circumference inches.	Condition.	Color.	Indentation.	Shape.	Length	Number.	Space.	Filling out.	Filling out.	Size.	Size.	Color.	
Reid's Yellow Dent...	{ Slightly tapering, }	10-10.5	7-7.25	{ Very firm...	Light yellow...	Medium smooth.	Medium wedge..	Long.	18-24	Narrow.	{ Deeply rounded.	Well cover'd.	Small...	Medium.	{ Dp. red }	88
Leaming.....	Tapering...	10-10.5	7-7.25	Firm...	{ Deep yellow, }	Med...	{ Med. wedge,	Long.	16-22	Narrow.	Rounded.	Medium..	Medium.	Medium.	{ Dp. red }	88
Hildreth's Yellow Dent	{ Slightly tapering, }	10.5-11	7.75-8	Firm...	{ Deep yellow, }	Med...	{ Long wedge,	Long.	18-24	Narrow.	Rounded.	Medium..	Medium.	{ Med. large..	Lt. red. }	88
Legal Tender,....	Cylindrical.	10-10.5	7.25-7.5	{ Med. firm...	Medium yellow...	Medium rough...	Medium wedge..	Long.	16-22	Medium.	Rounded.	{ Well cov'r'd	Small...	Medium.	Red...	88
Kansas Sunflower.....	{ Slightly tapering, }	10-10.5	7-7.25	{ Med. firm...	Medium yellow...	Medium rough...	Medium wedge..	Long.	14-20	Narrow.	Rounded.	Medium..	Medium.	Medium.	Red...	88
Golden Beauty.....	{ Slightly tapering, }	10-10.5	7-7.25	Firm...	{ Deep yellow...	Med. sm'th.	Broad....	Med..	12-14	Medium.	Even.....	Medium..	Medium.	Medium.	Red...	84
Pride of the North.	{ Slightly tapering, }	8-8.5	6.5-6.75	Firm...	Medium yellow...	Medium smooth.	Medium wedge..	Long.	14-16	Medium.	Rounded.	Medium..	Small...	Small...	{ Dp. red }	88
Boone County White ..	Cylindrical.	10.5-11	7.5-7.75	Firm...	Pearl white...	Medium rough...	Medium wedge..	Long.	16-22	Narrow.	Rounded.	Medium..	Medium.	{ Med. large }	White	88
Silvermine.....	Cylindrical.	10-10.5	7.25-7.5	{ Med. firm...	Cream white...	Rough.	{ Med. wedge,	Long.	16-20	Narrow.	Rounded.	{ Well cov'e'd,	Small...	Medium.	White	90
Early Mastodon.....	{ Slightly tapering, }	10.5-11	7-7.5	{ Med. firm...	Light yellow..	Med...	{ Med. wedge,	Long.	18-22	Narrow.	Rounded.	Medium..	Medium.	{ Med. large..	Lt. red. }	88
Champion White Pearl.	{ Slightly tapering, }	9.5-10	7-7.25	Firm...	White...	Med...	{ Med. wedge,	Med..	16-20	Medium.	Even.....	Medium..	Medium.	Medium.	White	84
Hickory King.....	Cylindrical.	8-8.5	6.5-6.75	Firm...	White...	Smooth.	{ Very broad,	Short.	8-10	Medium.	Even.....	Medium..	Medium.	Small...	White	84
Calico.....	{ Slightly tapering, }	10-10.5	7.5-7.75	Firm...	Calico...	{ Med. rough.	Med. wedge..	Long.	16-22	Narrow.	Rounded.	Medium..	Medium.	{ Med. large }	Red...	88

STUDENT'S SCORE-CARD FOR CORN, AGRONOMY DEPARTMENT, KANSAS
STATE AGRICULTURAL COLLEGE.

Number of exhibit.....

Name of variety.....

POINTS.	Perfect Score.	Student's Score.	Corrected Score.
TRUENESS TO TYPE OR BREED CHARACTERISTICS:			
1. Shape of ears: Cylindrical, straight rows, proportional length to circumference.....	10		
2. Length of ears, conformity to standard.....	5		
3. Circumference of ears, conformity to standard.....	5		
4. Color:			
(a) Grain, no mixed kernels.....	5		
(b) Cob: White kernels, white cob; yellow kernels, red cob.....	5		
5. Uniformity of kernels: Uniform size, shape, indentation.....	10	40	
GENERAL QUALITY:			
<i>Proportion of Corn to Cob as Indicated by:</i>			
1. Butts of ears: Kernels swelled out about shank regularly.....	5		
2. Tips of ears: Filled out with regular-sized kernels.....	5		
3. Kernels:			
(a) Shape: Wedge-shape.....	5		
(b) Depth: Deep or long.....	10		
4. Space:			
(a) Furrow between rows.....	5		
(b) Space between kernels at cob.....	5	35	
<i>Composition:</i>			
Large germ and horny layer, and a relatively small amount of the white starchy portion.....	10	10	
<i>Market Conditions:</i>			
1. Vitality: Bright, well matured, firm on cob, large bright germ.....	10		
2. Soundness or freedom from injury: No cracked, rotten, worm-eaten, or otherwise injured kernels.....	5	15	
Total.....	100		

Per cent of shelled corn as determined.....

Rank of three best ears.....1..... 2..... 3.....

Rank for protein and oil.....1..... 2..... 3.....

Student's name

Date

RULES FOR JUDGING CORN.

TRUENESS TO TYPE OR BREED CHARACTERISTICS.

Shape of Ears.—The ears of the exhibit should be true to variety-shape, or in general cylindrical, which will permit of an equal number of rows and a uniform size and shape of kernel from butt to tip of ear. For a poorly shaped ear, not true to type, cut 1 point. If rows run out or turn to right or left, cut as per judgment of judge.

Length of Ears.—Measure from extreme butt to extreme tip, add the deficiency and excess in length of the ears not conforming to the standard, and for each inch thus obtained cut 1/2 point.

Circumference of Ears.—Measure the circumference one-third the distance from butt to tip of ear, add deficiency and excess of all ears not conforming to the standard, and for every inch thus obtained cut 1/2 point.

Color.—(a) For every mixed kernel cut 1/8 point. Do not count more than four mixed kernels in any ear, as this number is sufficient to debar the ear from a score on color of grain. (b) For white cob in yellow corn, or red cob in white corn, cut 5 points (except in red cob varieties of white corn). For slight difference in color of cob, cut as per judgment of judge.

Uniformity of Kernels.—Note whether kernels in all parts of the ear are uniform as to size, shape (both when viewed from the end and side of kernel), color, indentation, etc., and whether the kernels in all the ears are similar to each other. For each ear with kernels not uniform cut 1 point.

GENERAL QUALITY.

PROPORTION OF CORN TO COB.

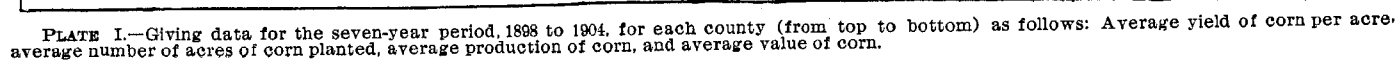
Butts of Ears.—The rows of kernels should extend in regular order over the butts and swell out about a medium-sized shank. For a poorly filled butt, in which kernels do not cover the end of the cob, cut 1/2 point. If kernels cover cob but are flat, shallow, and do not swell out beyond the cob, cut 1/4 point. For irregularity in kernels, cut 1/8 point.

Tips of Ears.—Should be filled out with straight, parallel rows of uniform kernels. For every exposed tip, full size of ear, cut 1/2 point; for less exposed tips and irregular kernels make smaller cuts.

Kernels.—(a) Shape: Kernels should be slightly wedge-shaped, with straight edges. A cross-section of the kernel should be a rectangle, with thickness not more than one-half the width. For each ear with poorly shaped kernels cut 1 point. (b) Depth: Kernels should be long and in proportion to the diameter of the cob. For each ear with very short kernels cut 1 point.

Space.—(a) Width of furrow between rows: For less than 1/32 inch, no cut; 1/32 to 1/16 cut 1/4 point; for more than 1/16 inch cut 1 point. (b) Space between kernels at cob: For space of 1/32 inch or more cut 1/2 point. For smaller space make proportional cuts.

From supply of ears of same variety select one or more ears which closely resemble the exhibit in the proportion of corn to cob; estimate this percentage, weigh ear, shell, and weigh corn. Divide weight of shelled corn by weight of ear, which will give the per cent of shelled corn. The student should continue this practice until he is fairly proficient in estimating the proportion of corn to cob.



COMPOSITION.

For each ear whose kernels have small germs or small horny parts and a relatively large amount of the white starchy portion, cut 1 point. For ears which show a better composition as indicated by the relative size of the different parts of the kernel, make proportionate cuts.

MARKET CONDITION.

Vitality.--Note brightness, maturity, freedom from moisture, firmness on cob, size of germ, etc. For each very loose-kerneled or immature ear cut 1 point.

Soundness.--For each injured kernel cut 1/16 point, but do not count more than 8 kernels in any ear, as this is sufficient to debar the ear from a score on soundness. Make germination and moisture tests as a check upon score on "Market Condition."

10. How should one proceed to score corn?

Arrange the 10 ears in the sample on a table, with the butts of the ears towards you. Remove two or more kernels from each ear and place them directly in front of the ears, for a study of depth, shape, uniformity, etc., of kernels. Write the number of exhibit and name of variety at the top of the score-card. The "Standard of Perfection," as given on page 229, should be carefully studied in connection with each point on the score-card. On page 231 are given rules for judging, which if carefully observed should furnish sufficient instruction for scoring. The entire sample should be judged, but it is necessary to score each ear separately and to add the credits given to the 10 ears for recording on the score-card before proceeding to the next point. In scoring those points which are given a grade of 10, each ear of the sample is worth one credit, and in scoring those points which are given a credit of 5, each ear of the sample is worth one-half a credit.

Starting with "Shape of ears," the first point of the score-card, pick up ear No. 1 of the sample, hold it at a convenient distance from you to get a good view of it and notice how nearly it approaches the ideal shape of ear for the particular variety. If the ratio between length and circumference is not correct, if the ear is too tapering or is in any way ill-shaped, or if the rows are not straight and parallel to the ear, it should not be given a full credit. A perfectly shaped ear is worth one credit; a very poorly shaped ear may be given a zero credit. This ear which you have examined may, in your judgment, be worth three-fourths of one credit. Keep this in mind and add to it the score of the next ear, etc. The sum of all the scores should be placed on the scorecard as your score on shape of ears.

In scoring the length of ears, turn again to the "Standard of

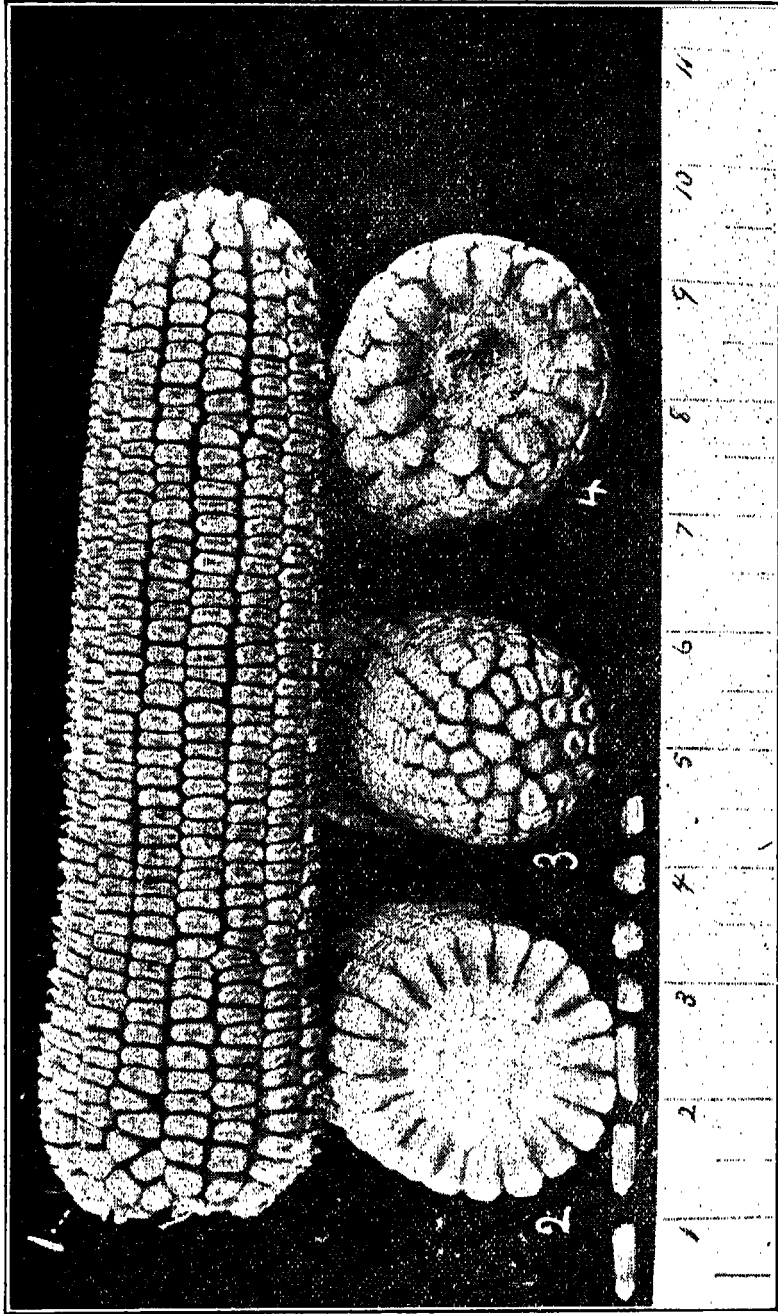


PLATE II.—Showing the McAuley variety of corn.

Perfection" and see how long the ears of this variety should be; also read the rule for judging length of ears. With a tape measure or rule, measure from extreme butt to extreme tip, including the ends of the cob, if exposed. An excess or deficiency in length as compared with the standard are alike objectionable, and these should be added together and for each inch thus obtained one-half point should be taken from the score.

Proceed to score the sample in regard to other points on the score-card in a similar manner to that described above, observing carefully the rules for judging. In the "Rank of three best ears" place after the numbers 1, 2 and 3 the letters designating the ears which you consider the best for planting, considering both the trueness to breed type and the general quality of the ears. In placing the "Three best ears for protein and oil," base your judgment on size of germ and horny layer, paying special attention to the size of the germ, which is by far the richest part of the kernel.

DISCUSSION OF POINTS OF SCORE-CARD.

11. Why should corn be studied as to trueness to type or breed?

So that a better idea may be had as to the certainty with which the characters will be transmitted. Corn possessed of desirable characters but showing but little breed type is of little value, since these characters may be substituted the following season by latent or hidden characters of little value. Hardiness, productiveness and other invisible characters may be as distinctive breed characteristics as the color, shape of ears, etc., and these must be judged by the type as seen in the visible characters.

12. How may the trueness to type best be judged?

By studying the uniformity of the ears in shape, size, straightness of the rows, color, etc., and also by studying the uniformity of the kernels in size, shape, color, and indentation. The uniformity of ears is studied by comparing with the "Standard of Perfection," but as it is difficult to sufficiently define the standard of perfection for the kernels, a heading "Uniformity of kernels" is placed on the score-card.

13. Why should an ear of corn be cylindrical, or nearly so?

Because this is the only shape which will permit of the same number of rows throughout the length of the ear, and also the same size and shape of kernels in all parts of the ear. In a tapering ear there must be some short rows or the kernels must be larger or have more space between them at butt than at tip of ear. In such an ear, or one of irregular shape, some of the kernels

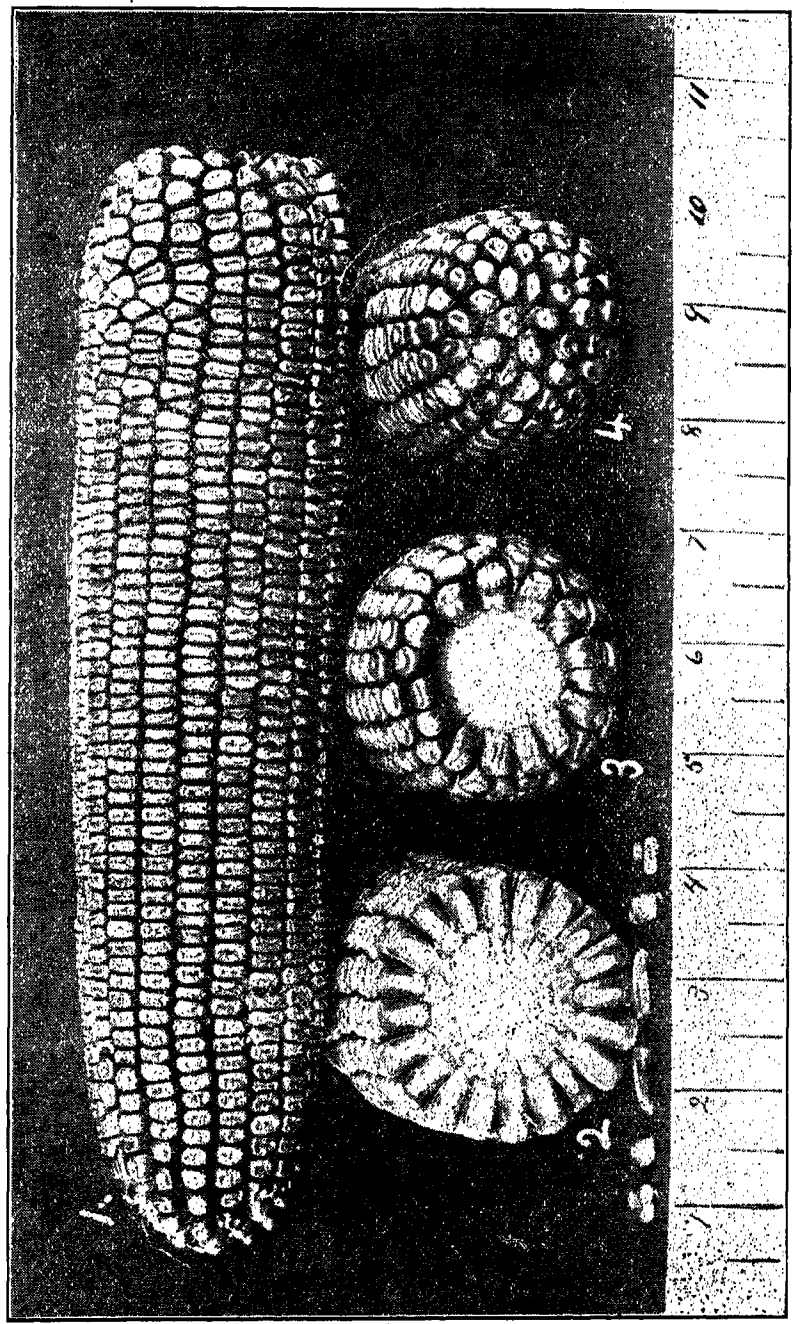


PLATE III.—Showing the Hildreth variety of corn.

must be of irregular size or shape, which will not permit of an even distribution by the planter.

14. What is the proper ratio between the length and the circumference of an ear of corn?

Although there is not much experimental data to show that an ear of corn should be of exact proportions, most corn breeders agree that the ratio between length and circumference should be about as 10 is to 7. It appears that ears which are long and slender are often associated with plants which are not possessed of the greatest vigor and hardiness, and also such ears have a relatively small percentage of grain; while ears which are large in circumference and short are usually late in maturing and also often have a small per cent of grain because of an extremely large cob.

15. How may mixture in corn be determined?

By the color of the grain and cob. The "Standard of Perfection" for each variety calls for a certain color. For instance, the Reid Yellow Dent should be a light yellow, the Leaming a deep yellow, and the Golden Eagle a bright golden yellow. Ears which are not of the proper color of grain or cob, or ears some of whose kernels are not of the proper color, show an ununiform type or the crossing of two or more varieties. The mixture of white in yellow varieties may easily be determined if the cross has occurred during the current year, but if the crossing occurred several seasons previous the yellow kernels may not have white caps, but only a slightly lighter shade of yellow. The crossing of the yellow upon the white varieties is much more difficult for the beginner to determine, as even in the first cross between distinct yellow and white varieties the caps or crowns are of the same color as the pure kernels of the white variety, the hybrid feature showing in the lower portion of the kernel. The cobs should be of nearly the same color, and white cobs in yellow corn and red cobs in white corn (except red-cob varieties of white corn) should bar the exhibit from a score on color. A proper color in corn can not be considered as a guarantee of purity in breeding, as varieties of the same color but otherwise differing widely in type may be crossed and not show any evidence of it in the color.

16. What per cent of an ear of corn should be grain, and upon what does this depend?

From 84 to 90 per cent in weight of an ear of corn should be grain. The percentage of grain depends upon the filling out of butts and tips, the depth and shape of kernel, the space between kernels, both at crown and tip of kernel, and the maturity and quality of the corn.

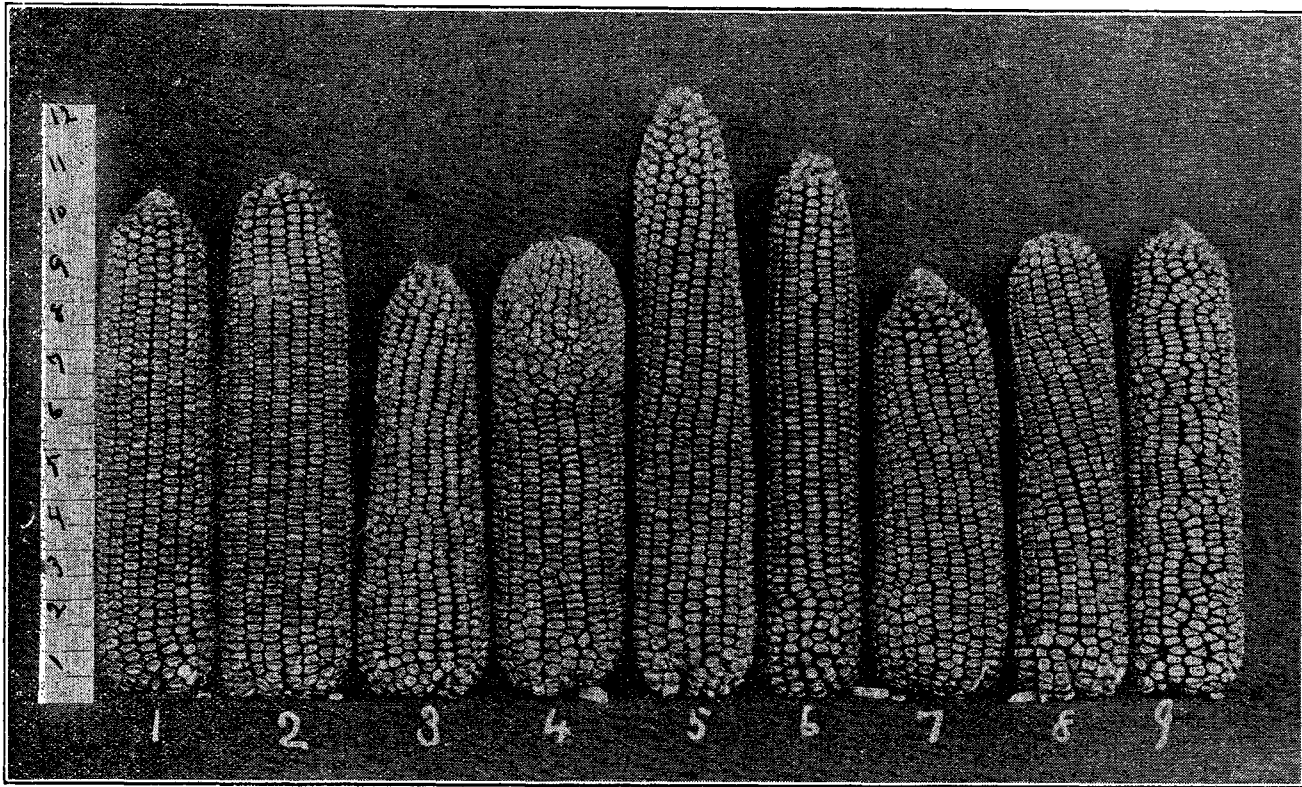


PLATE IV.—Showing different shapes of ears. Nos. 1 and 2 are good ears. No. 3 is too tapering. No. 4 is reverse tapering. No. 5 is too long. No. 6 is too small in circumference. No. 7 is too short and too large in circumference. No. 8 has its rows turned to the left. No. 9 has irregular kernels, making the rows indistinct.

17. How may the per cent of grain be determined?

Weigh the ear, and if there are any kernels missing add an equal number of the same size. Shell and weigh the corn. Divide the weight of shelled corn by the total weight of ear, which will give the per cent of grain on ear. The student should estimate the per cent of grain and then determine it by shelling and weighing until he is fairly proficient in making these estimates.

18. What is the proper shape for a kernel of corn?

A kernel of corn should be slightly wedge shaped with straight edges, so that adjoining kernels on the ear may fit together perfectly throughout their length. The length should be at least twice as great as the width, and a cross section should be a rectangle, with thickness not more than one-half the width.

19. How may the composition and feeding value of corn be judged by mechanical examination?

By studying the size of the germ and proportion of horny layer in the kernel. According to Holden the germ analyses show 19.25 per cent protein and 54.75 per cent oil, the horny layer or hard flinty portion 11.50 per cent protein and 1 per cent oil, and the white starchy part 7.50 per cent protein and 2.25 per cent oil. As the protein and oil are by far the most important feeding constituents of the kernel it will be seen that the germ is the most valuable portion and the horny layer second, while the starchy portion is of the least value. By noticing the size of the germ before cutting the kernel, and also the size of the germ and horny layer in cross-section, it will be noticed that the kernels on the different ears vary widely in the size of these two portions, and with practice the feeding value may be judged fairly accurately in this way.

20. How may vitality in corn be judged?

The germ is the embryonic plant, and is the chief means of judging the vitality in corn. After making a few examinations the student will recognize the appearance of the healthy, vigorous germ. Germs which are too light are generally of low vitality while germs that are very dark have usually been subjected to too cold a temperature while moist and their vitality destroyed. A kernel which is shriveled or colored at the tip or which retains the scales of the cob is apt to be of low vitality, as are also ears which are loose or chaffy or which show a large space between the kernels **next** to the cob. Although there may be many indications of low vitality it is not possible to judge it accurately, as sometimes corn which appears to be of low vitality will germinate fairly well, while corn which appears to be of good vitality may not grow at all.

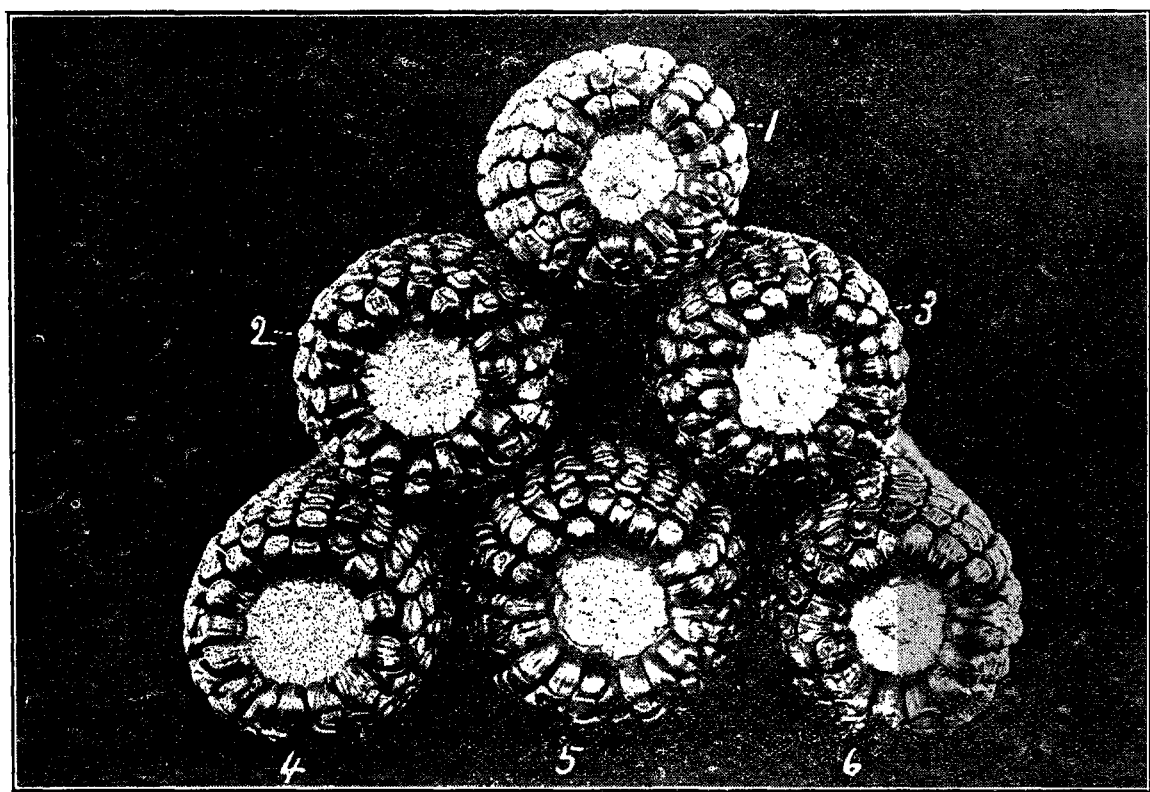


PLATE V.—Showing well-filled butts of ears.

The best way to determine the vitality of corn is to make a germination test.

21. How may the vitality of corn be tested?

Take a tight wooden box 18 inches square and 4 to 6 inches deep (or of some convenient dimensions), put in 2 or 3 inches of moist sand, and cover with a piece of white muslin which has been ruled into squares about two inches across. Have the seed-corn laid on a table or shelf where it will not be disturbed. From the first ear take kernels from near the butt, middle, and tip of ear, then turn the ear over and take three more kernels from the other side. Place these six kernels in the first check or square (**No. 1**); take six kernels from the second ear and place in the second square (**No. 2**) etc., until you have sampled all of the ears. Cover the grain carefully with another piece of cloth about the same size as the box, and also with a second piece of cloth enough larger to extend up on the sides to the top of the box. Put in one or two inches more of moist sand and keep the box in the ordinary living room temperature of the house. Add more water if the sand becomes too dry. The corn should germinate in from three to five days. Those ears whose kernels do not all germinate in five days should be discarded, as they are of such low vitality that they will injure the stand in the corn-field.

22. What is the best way to handle seed-corn so as to insure good vitality?

Seeds which are fully mature and well dried should be of good vitality the following season after being grown. Seeds which are kept in a moist condition are usually of good vitality if the temperature is not allowed to fall too low, but the presence of moisture and a low temperature will injure or destroy the vitality. Seed-corn should be placed in open racks or hung up by the husks in a room where there is a free circulation of air. Sometimes artificial heat is necessary, especially **if** the corn is late in maturing.

CORN BREEDING.

23. What is meant by the "ear test" or the "ear-row" plan of breeding corn?

The planting of the seed-corn in adjacent rows, one ear to a row. Experiments have shown that the corn in the rows planted in this way will often differ greatly as to height, maturity, yield, and other characters, and the object of this plan of breeding is to pick the seed for planting the following season from the rows which produce the most corn of the best quality and which are pollinated by plants in some of the other best rows.

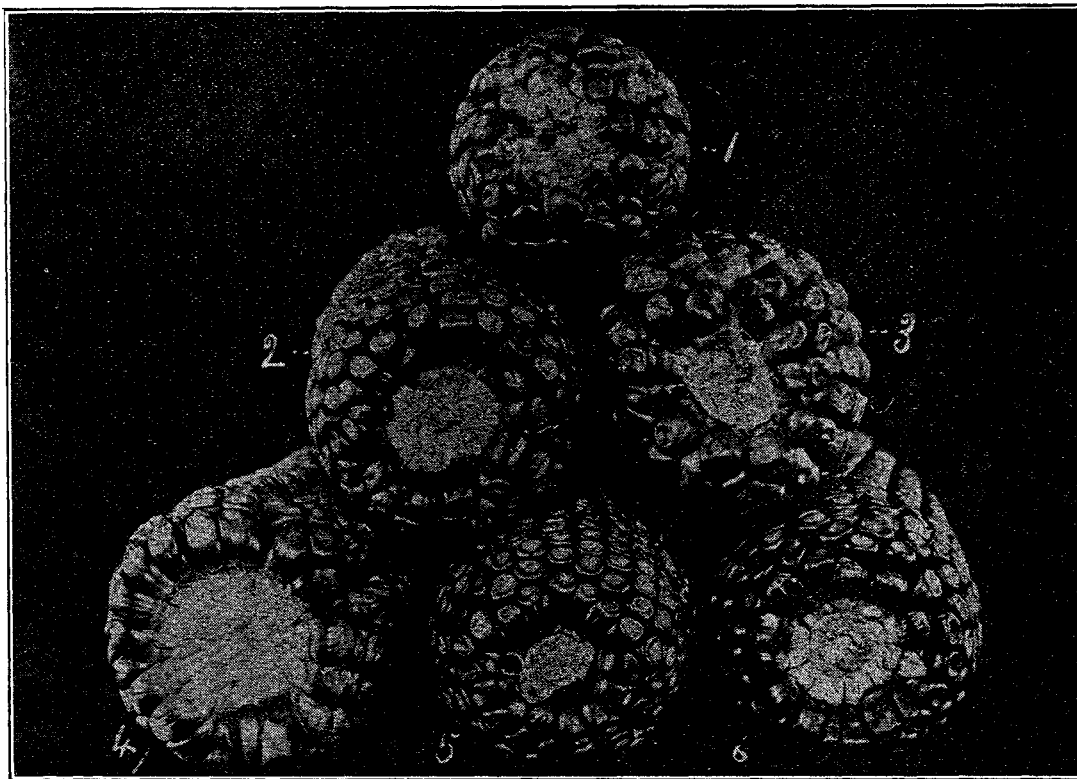


PLATE VI.—Showing irregular or poorly-filled butts (ears 1, 2, and 3), and ears which had large, small, and medium shanks (ears 4, 5, and 6).

24. What is the best plan of conducting the ear-test breeding plot as regards in-breeding and cross-breeding?

This is a somewhat disputed question, but it is generally conceded that corn should not be closely in-bred. It is usual, therefore, to detassel every other row and to save seed from the detasseled rows only so that all of the seed ears are pollinated by the plants in other rows. It is impossible to foresee the relative yields of the different rows, and it often happens that some of the best yielding rows are so situated that they are pollinated by plants in some of the most undesirable **rows** of the breeding plot. For this reason it is well to save a portion (about one-third) of each ear, so that if certain rows appear to be specially desirable but are not so situated as to be pollinated by desirable plants the original seed may be used the succeeding year for planting with other desirable strains.

25. Is the "ear-test" plan of breeding corn a practical system for farmers to use?

The ear-test breeding plot may be conducted on a very simple plan, and it is probable that the majority of the farmers of the State who grow corn as one of their main crops should undertake to pick out their seed-corn by the ear-test method.

26. When is the best time to pick seed-corn?

About the time the corn is mature. It is preferable to pick the ears from the standing stalks, so that the whole plant may be studied and only the best ears from the best plants selected.

27. Is it advisable to send very far away for seed-corn?

No. The seed should be grown in the same locality where it is desired to plant it, or in a near vicinity of similar conditions. Corn doubtless suffers more from being changed from one locality to another than any of our other crops, and as the soils and other conditions of our State differ widely in different localities, it may be necessary that the farmers in these various sections breed their own corn. There should be at least one capable corn breeder in every neighborhood, who will breed corn and sell to his neighbors. Varieties which have given the best results at the State Experiment Stations and desirable varieties from other sources should be secured, but in small quantities at first, unless grown under very similar conditions.

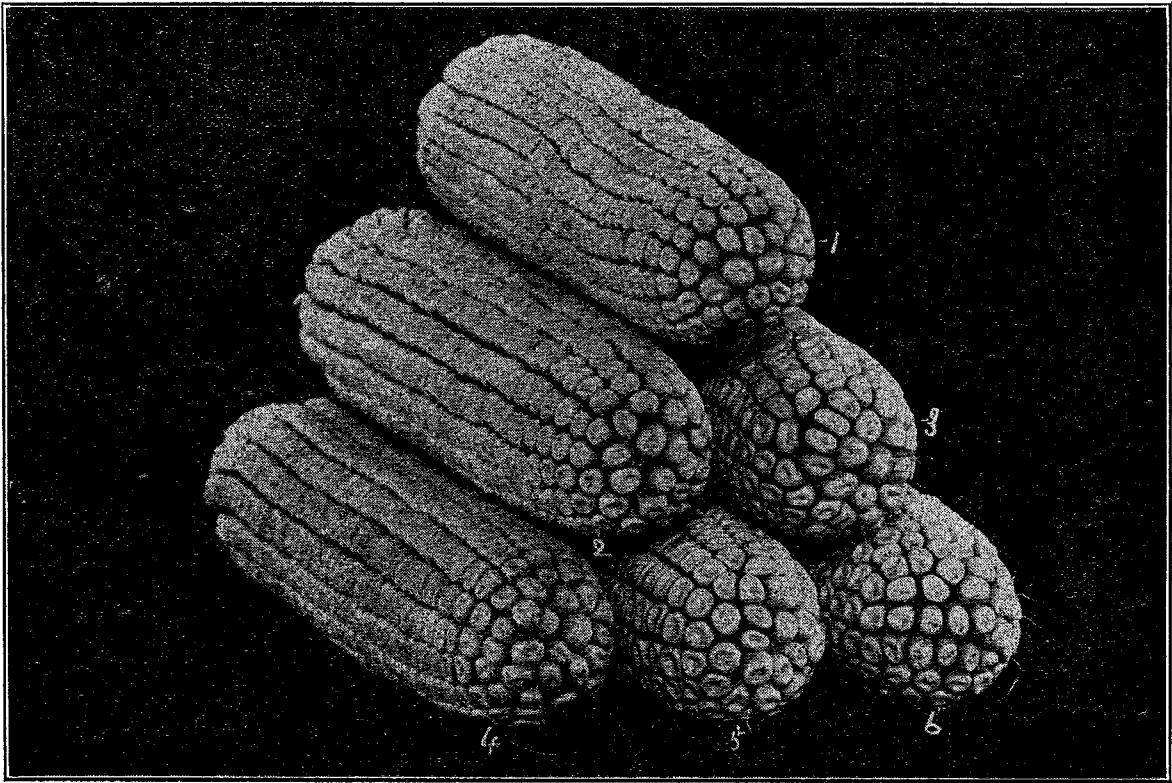


PLATE VII.—Showing fairly desirable tips of ears.

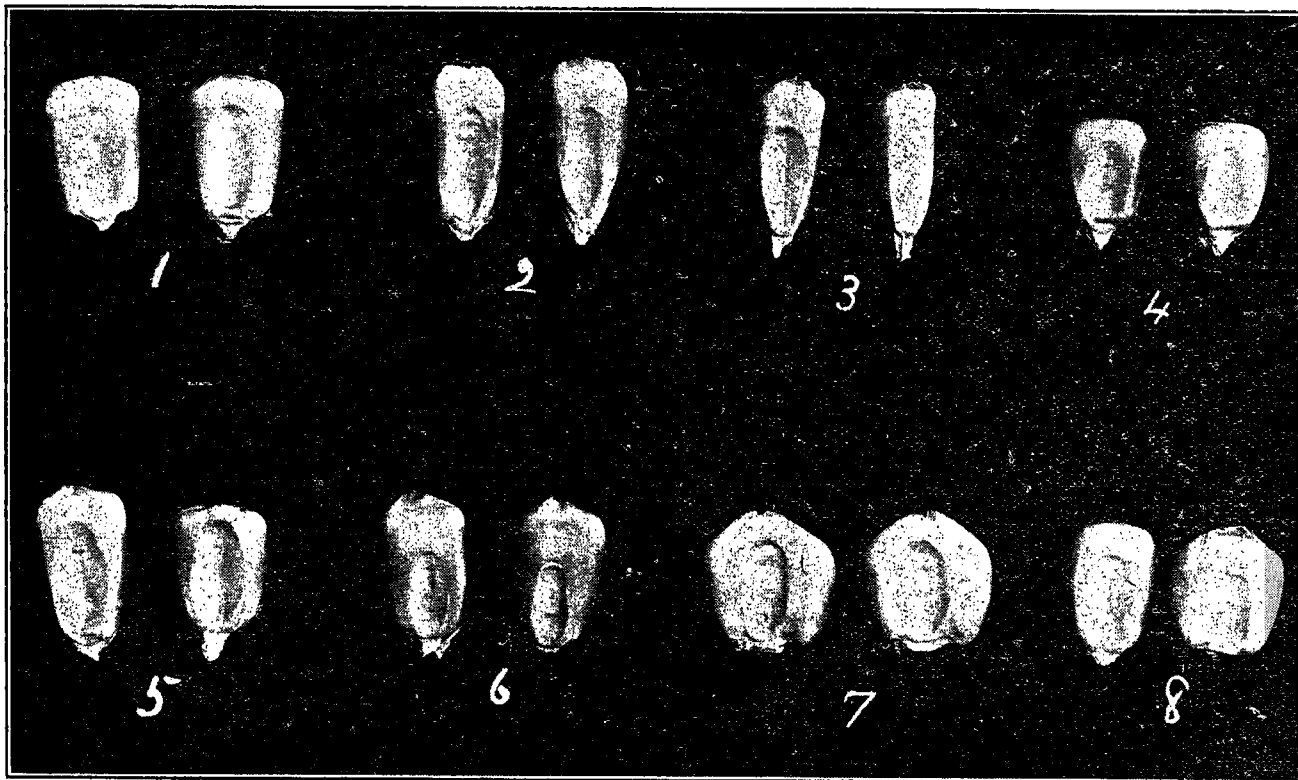


PLATE VIII.—Showing shapes of kernels. No. 1, kernels of desirable shape. No. 2, kernels which are too tapering at tip and not square enough at crown of kernel. No. 3, kernels which are too narrow or "shoe-peg shaped." No. 4, kernels which are too shallow, sides too much rounded and forming too large an angle. No. 5, kernels having large germs. No. 6, kernels having small germs. No. 7, kernels of the Hickory King type—too broad and sides too much rounded. No. 8, kernels of somewhat similar type to No. 7; often found in other types of corn.

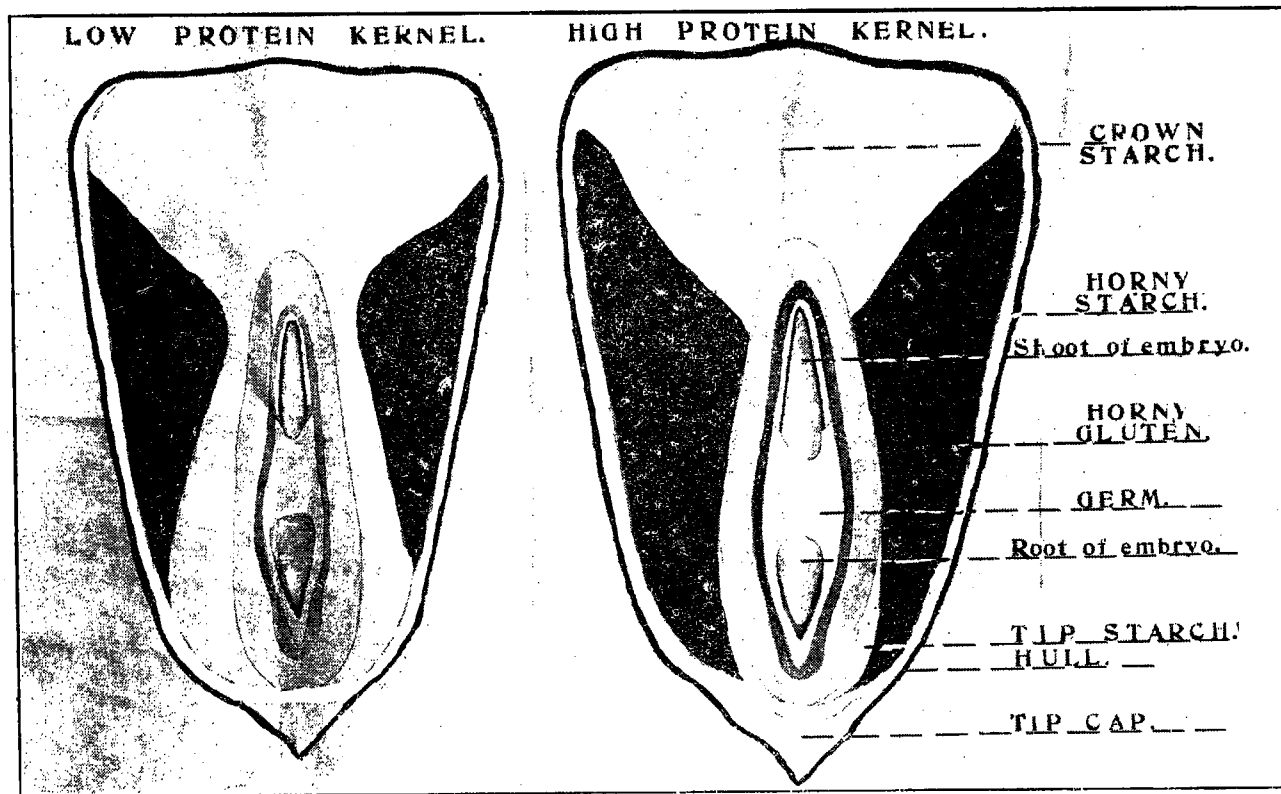


PLATE IX.—Showing the different parts of the corn-kernel. The high protein kernel has the larger germ, and larger amount of horny protein.

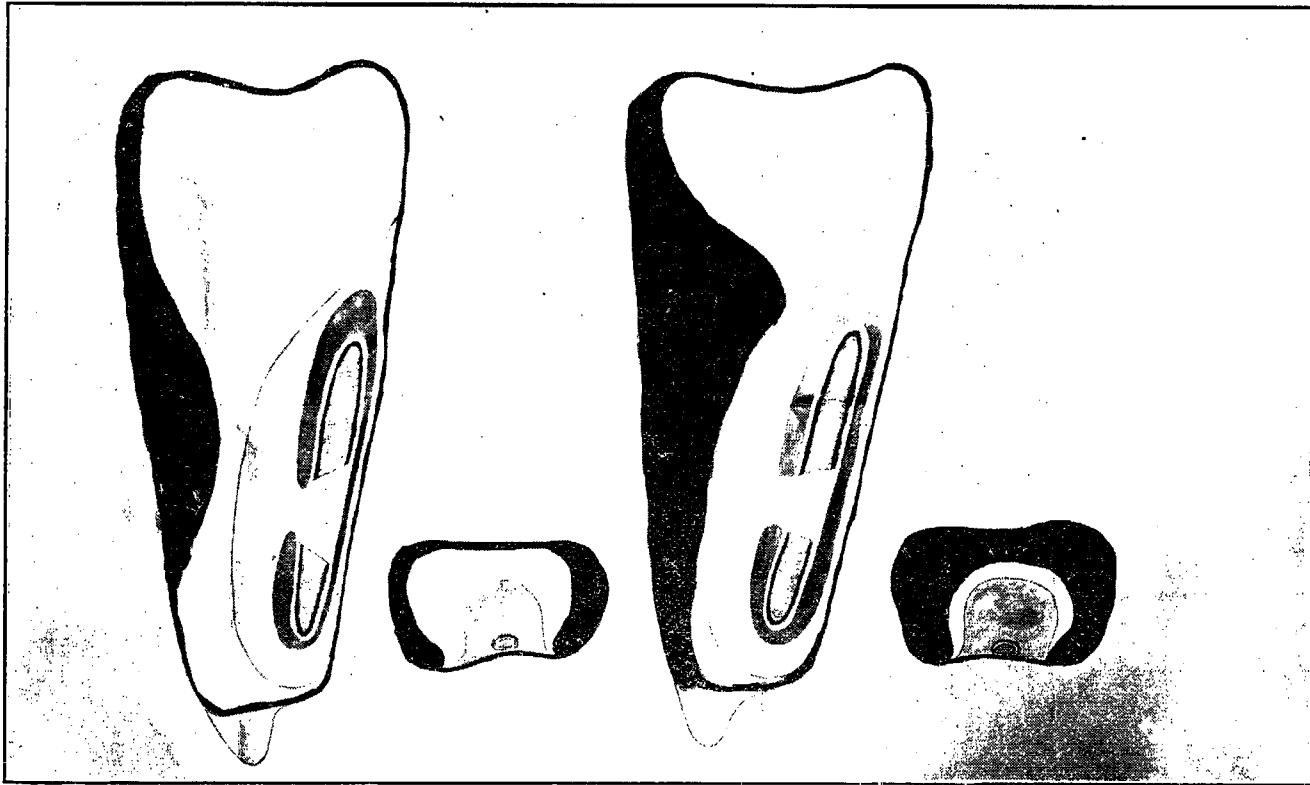


PLATE X.—Showing the different parts of the corn kernel. Notice the large germ and the large amount of the horny portion in the high protein kernel at the right as compared with the size of these parts in the low protein kernel at the left.

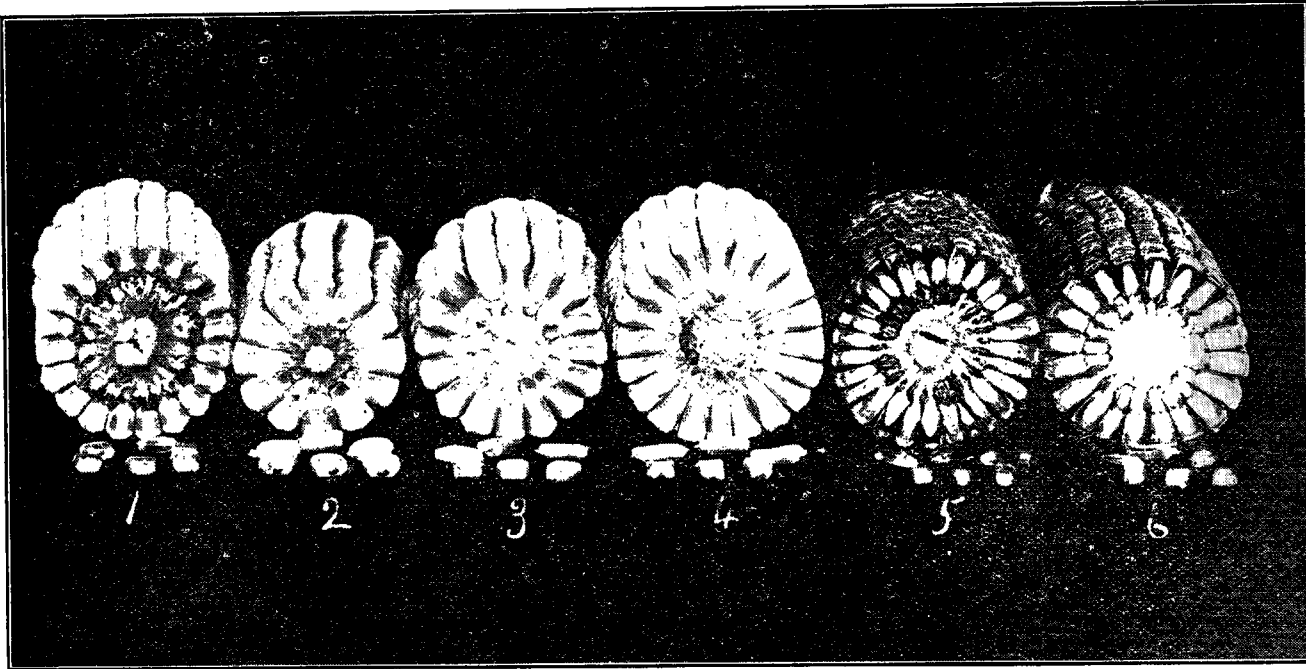


PLATE XI.—Showing different depths of kernels and different percentages of grain. No. 1, ear with very shallow kernels. No. 2, ear having a small cob in proportion to size of ear but with large furrows between the rows, making a small percentage of grain. Nos. 3 and 6 are fairly good ears. No. 4, ear with deep kernels in proportion to size of cob and with very little space between kernels either at crown or tip of kernels, making a large percentage of grain. No. 5, ear with fairly deep but narrow kernels, which causes a large amount of space between the rows and reduces the percentage of grain.

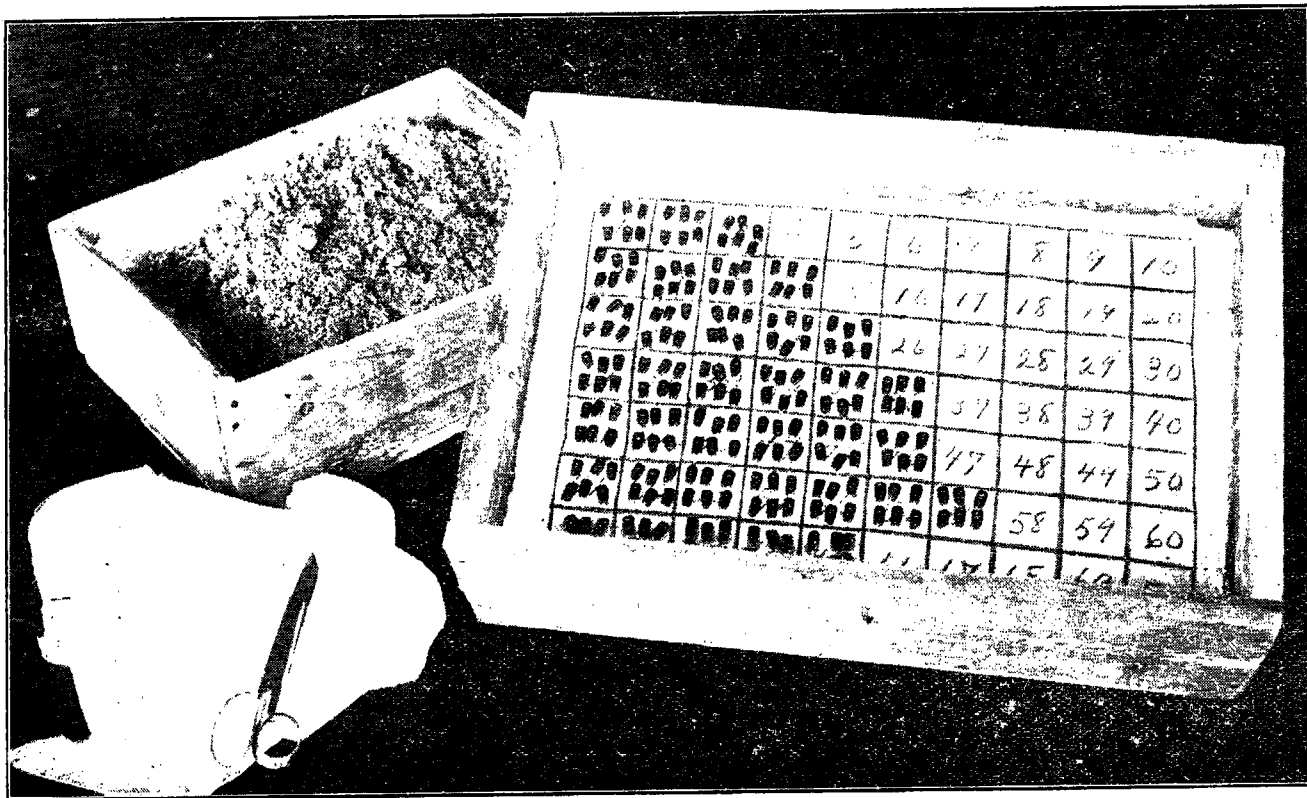


PLATE XII.—Showing a sand germinator. See answer to Question 20, page 211.