C. W. Smith

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777

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EXPERIMENT STATION.

ILLUSTRATED

CHICAGO:

BREEDER'S GAZETTE PRINT.

1895.

PREFACE

In 1828 William Cobbett, a rather eccentric yet famous Englishman who for a time resided in America, published in London "A Treatise on Cobbett's Corn." Thirty-eight years later, in 1866, Edward Enfield published in New York a book on "Indian Corn; Its Value, Culture and Uses." These are the only volumes in the English language, within the knowledge of the writer, that have been written as handbooks on Indian corn for farmers. Since these books were issued much valuable information has accumulated concerning the corn plant, and it is due to this fact that this volume was written. In America this cereal is grown more extensively than is any other, and its great food value for man and beast is fully recognized.

For a large amount of the present knowledge we have of Indian corn we are indebted to the researches conducted at the agricultural experiment stations. This volume is rather in the nature of a compilation of such information as seems to the writer might be of service to American corn-growers. It is not a special account of the author's experience in growing this crop, but rather of the results of many cultivators. No attempt has been made to go into general details when it has seemed unnecessary, and some subjects have been lightly touched upon as unimportant. But if the volume as a whole shall be of material service to our corn-growers it will have served its purpose.

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CONTENTS.

CHAPTER I.

HISTORICAL.

Indian corn, the *Zea mays* of botanists, is unquestionably native to America. Before the discovery of this country by Columbus this cereal was unknown in Europe, Asia or Africa. Maize was undoubtedly grown by the inhabitants of North, Central and South America in prehistoric times. Mounds that were erected prior to the time of the American Indian, of which he has no tradition, that have been explored in recent years, have contained corncobs and charred kernels. In mounds excavated at Madisonville, O., in 1879, remains of maize were found in quantities. In the caves occupied by the early Cliff Dwellers in the southwestern United States, ears of corn have been frequently discovered. In South America Darwin found on the coast of Peru, "heads of maize, together with eighteen species of recent sea shells, embedded in a beach which had been upraised at least eighty-five feet above the level of the sea."*

* Animals and Plants under Domestication, New York, 1890, I, p. 338.

Ears of Indian corn are occasionally found in vessels placed in ancient Indian tombs or mounds in Chili, Peru and Central America. The Smithsonian Institute at Washington has numerous interesting specimens of corn, exhumed from mounds and tombs, that must be very ancient. One specimen was discovered deposited in an earthen vessel eleven feet under ground in a grave with a mummy, near Ariquipe, Peru.* Marcay refers to corn found in Aymara Indian tombs in South America, that, from the material accompanying it, must belong to a period long before the Spanish conquest.† Among the ruins of Peru are stone carvings of ears of corn, executed centuries ago, before the discovery by Europeans.

Original Home.—The original home of Indian corn is thought by some to be Central America or Mexico, south of the twenty-second degree of north latitude.‡ In 1888 Prof. Dugés collected at Moro Leon, north of Lake Cuitzco, Mexico, several corn plants which have been termed wild maize, and considered by some to be the original parent of Indian corn. Plants from this source were grown at the Cambridge,

* Report United States Department of Agriculture, 1870, p. 420.

† Travels in South America, I, p. 69.

‡ Maize: A botanical and economical study, by John W. Harshberger, 1893, p. 202.

Mass., botanical gardens, at Philadelphia and at Ithaca, N. Y.

The Indians of Mexico and the southwestern United States have for centuries grown corn very similar in general conformation to that found in the mounds of ancient times, which is quite unlike that grown in the northern corn belt. This corn is soft or starchy, of color ranging from white to pink, blue and other shades, has a large cob, and round, smooth topped kernels of fair size. Says Sturtevant:*

"Centeotl, in Mexico, was goddess of maize, and hence of agriculture, and was known, according to Clavigero, by the title, among others, of Tonacajohua, 'she who sustains us.' Sahagrun writes of the seventy-eight chapels of the great Temple of Mexico, that the forty-fifth edifice was called Cinteupan, and therein was a statue of the god of maize."

Indians as corn-growers.—The early American explorers discovered the Indians cultivating fields of maize. Delafield tells us† that "when Cartier visited Hochelaga, now called Montreal, in 1535, that town was situated in the midst of extensive cornfields." Champlain in 1603 found cornfields eastward from the Kennebec river. In 1621, Squanto, an Indian, showed the Puritans how to plant and care for maize, and some twenty acres were planted and successfully grown.‡ At the time of the Pequot

* *American Naturalist*, March, 1885, p. 226.

† Transactions New York State agricultural society, 1850, p. 386.

‡ Harshberger; Maize: A botanical study, etc., p. 131.

war in 1637 the English destroyed over two hundred acres of corn planted by the Indians. The Puritans in King Philip's war, in 1675, took "what he had worth, spoiled the rest, and also took possession of one thousand acres of corn, which was harvested by the English."* Wherever the early explorers or voyagers went they found either fields of Indian corn or the Indians using the grain for food. Capt. John Smith, in his "Indians of Virginia," tells of the methods of planting at that time (1608). Cabeca de Vaca found an abundance of maize near Tampa Bay, Florida, in 1528.† In 1679 La Salle, when on a trip through the Great Lakes and across Illinois, found large quantities of stored corn in a village of Illinois Indians and took about forty bushels of it.‡ Columbus in 1498 writes to Ferdinand and Isabella of the maize plant and of fields eighteen miles long. The early explorers also noted maize as an important article of food for man in Yucatan, Nicaragua, and Mexico.

Harshberger's conclusions.—In his important historical study of maize, Harshberger says: §

"The evidence of archæology, history, ethnology, and philology, which points to central and southern Mexico as

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* Harshberger; Maize: A botanical study, etc., p. 131.

† *Torrey Botanical Club Bulletin*, VI, p. 86.

‡ Harshberger; Maize: A botanical study, etc., p. 135.

§ *Ibid.*, p. 151.

the original home of maize, is supported by botany and meteorology. All of the plants closely related to maize are Mexican. It is an accepted evolutionary principle that several species of the same genus, or genera of the same tribe, though dispersed to the most distant quarters of the globe, must originally have proceeded from the same source, as they are descended from the same progenitors. It is also obvious that the individuals of the same species, though now in distant regions, must have proceeded from one spot, where their parents were first produced; for it is incredible that individuals, identically the same, should have been produced from parents specifically distinct. Applying these principles to maize, we reach the conclusion that maize was originally Mexican. * * * The evidence to the present date (1893) places the original home of our American cereal, maize, in central Mexico."

CHAPTER II.

BOTANICAL CHARACTERISTICS.

Indian corn is known by botanists as *Zea mays*. It belongs to the grass family and is an annual plant. It is classed as an endogenous plant for the reason that it increases in height and diameter of stem by internal growth.

The root is of two classes, primary and secondary. The former is fine and fibrous, and in the field the plant produces a large mass of these roots. No long tap root is developed; consequently, as with the grasses generally, the roots branch out in all directions rather near the surface. For this reason shallow cultivation of the growing crop is advocated, as breaking the roots is deemed an injury to the growing plant.

In interesting experiments conducted by Prof. F. H. King at the Wisconsin experiment station* upon the development of corn roots in natural soils under the conditions of field cultivation, he washed out plants at different stages

* Ninth annual report Wisconsin experiment station, 1892, p. 112.

of growth. Forty-two days after planting, when the plants were 18 inches high, the roots of two hills met and passed each other in the center between rows 42 inches apart, and had penetrated to a depth of 18 inches. The surface roots sloped gently downward toward the center, where those nearest to the surface were some eight inches deep. At the last cultivation, when the plants were nearly three feet high, the roots occupied the entire soil to a depth of two feet, with the surface roots six inches below the center between the rows. At tassel time the roots fully occupied the upper three feet of soil in the entire field, and in the center between the rows the surface roots were still higher, a few being scarcely five inches deep. At maturity the roots were found penetrating to a depth exceeding four feet and within four inches of the surface in the center between rows. In connection with this study Prof. King estimates that the plants on a well-tilled acre are required to pump from below during growth from 300 to 400 tons of water. The wonderful feeding power of the corn roots is shown in this striking development and activity.

After the corn plant becomes well established and has nearly reached its full height the secondary roots come from the stem near the ground. They first appear as nodules from which develop the root tips, which proceed to make a downward growth into the soil. After penetrating slightly below the surface a mass of fibrous roots is produced from this buried portion. These roots assist in maintaining the erect position of the plant, as well as in securing nourishment and moisture. Generally the depth of the planting does not influence the depth of the rooth growth.

The stem (or culm) of Indian corn, varies in height from 18 inches to 18 feet, according to the variety and conditions of growth. Sturtevant even notes one variety in South America attaining a height of 24 feet. The stem consists of a number of smooth sections (internodes), joined together by short joints (nodes). The mature stem has a pithy interior with a thin covering of harder material.

In a study made by the writer on the rate of growth of the corn plant, at the New York experiment station it was noted that the increase ranged from three to 18½ inches per week in gain. The most rapid development occurred when the plants were about five weeks old. Under specially favorable conditions a growth of five inches has been recorded in one day.

The leaves grow from the joints, there being a leaf at each one. For a greater part of the stem, the lower part of the leaf (sheath) is wrapped about the stem from one joint almost to the next. In a study of the corn plant at the Iowa experiment station,* the number of leaves on a stalk varied with field corn from 12 to 18, with a width of blade from $3\frac{3}{4}$ to $5\frac{1}{8}$ inches. Microscopical examination of a number of varieties showed considerable difference in the thickness of the leaf structure and in the amount of green coloring matter present. At the Missouri station, Prof. Schweitzer measured the leaf surface of a vigorous plant of average development.† "The total surface of the twelve living leaves on one side was 1,633.73 square inches, which doubled for both sides, and adding the area of the outside of the sheaths, makes the total external leaf surface of this plant 3,480 square inches, or 24 square feet." Schweitzer considers the leaves the chief source of production of organic matter, and while 16 or 18 may be produced in our climate, the lower ones die off before maturity, and activity is confined to perhaps twelve.

The flower is of two kinds, male and female. The former is known as the tassel, and is situated at the tip of the stem in the form of a branching head (panicle), while the latter is located in between the sheaths of leaf and stem,

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* Iowa agricultural college experiment station. Bulletin No. 2, September, 1888.

† Missouri agricultural experiment station. Bulletin No. 5, February, 1889.

and consists of a mass of fine hairs called silk, enclosed in the husks of the ears to be. The tassel contains many small flowers (see Fig. 1), and each of these produces a large amount of pollen or dust for fertilizing the female flowers. This pollen is from the anthers of the flowers, and according to Harshberger* as many as 2,500 are formed in a single anther, and 18,000,000 are given as the number produced by each plant, there being 7,200 stamens to a panicle.

FIG. 1.—The stem at left is a branch of the male panicle, showing spikelets. The center figure is of a pair of these spikelets removed. The figure at the right is one of the male spikelets opened, showing two flowers inside. (After Harshberger.)

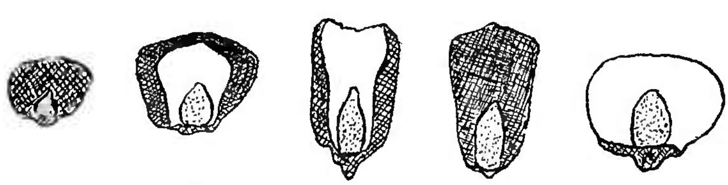
The female (pistillate) flowers being located below the male (staminate), the pollen of the male is blown about in the air and falls onto the silks which protrude from the enclosing husks, and fertilizes them. Each silk extends back into the husk and to the seat of what will become a kernel of corn if fully fertilized. The content of this husk is an embryo ear of corn. The portion of the silk exposed is somewhat hairy without, and is a hollow tube within.

*Maize: A botanical study, etc., p. 85.

(The awl shaped figure in Fig. 2, with ovule at base.) The pollen develops down into this tube and fertilizes this embryo seed (ovule) at its base on the little cob. The small, rough point seen on the round or flat head of a kernel of corn is the point where this silk was attached to it.

FIG. 2.—A longitudinal section of a portion of an ear with female spikelets in a hardened depression of cob, with ovary, glumes and palets. (After Harshberger.)

The kernel or seed.—While but one botanical species of corn is cultivated, this one may be divided into five groups or races. Each race is characterized by numerous varieties, and these freely cross-fertilize,



a *b* *c* *d* *e*

FIG. 3.

so that two or three types of seed may be found on the same ear. This race difference, so far as the writer knows, was first pointed out by Dr. E. L. Sturtevant.* These races may be described as follows, and the relative differences

* Maize: An attempt at classification. By E. Lewis Sturtevant, M. D., Rochester, N. Y., 1884, p. 10; illustrated.

between them clearly seen by splitting the kernels. In Fig. 3 the shaded parts of kernel above the base represent hard or corneous matter; the white parts starchy matter.

Pop corn.—The substance of the center kernel is hard and flinty (corneous) all through, excepting at the germ end, no white, soft starchy substance being present. See *a* in Fig. 3.

Flint corn.—The corneous matter surrounds the sides and tôp of the kernel, so that it is enclosed in a hard, flinty coat, with soft starchy substance in the central part. The kernel is usually about as broad as long, and rounding and smooth over the top. Flint corn is somewhat smaller than dent, and is best suited to New England and the northern line of corn growing. See *b* in Fig. 3.

Dent corn.—The sides of the kernels consist of corneous matter with the central part filled with soft material, even to the dented or contracted rough top. This contraction is due to shrinking of the softer part of the kernel in ripening. The kernel in many varieties is slender or wedge form. Nearly all the corn grown in the great corn belt of the Central West belongs to this race. See *c* in Fig. 3.

Sweet corn.—The kernels consist of translucent, horny material, which contain considerable sugar (glucose) instead of starch. The kernels in most varieties are quite wrinkled or twisted and are distinctly wedge shape. See *d* in Fig. 3.

Soft corn.—Excepting the germ the entire kernel is starchy and soft in character and has somewhat the form of the flints. This race is more commonly grown in the sub-tropical corn regions, as the far Southwest and in Mexico. This is the early form of corn as grown by the Indians. See *e* in Fig. 3.

Pod corn.—Additional to the above another form is found, which is rather uncommon. Pod or husk corn is a variety in which each kernel is enclosed in a small husk, while the aggregation of kernels, which may form a long or short ear, is enclosed in large external husks on a simple cob, as with common ears. Flint and dent corn may exist in this variety. Pod-corn seed when planted will usually give a crop of both podded and unpodded ears.

Classified by seed.—Each known variety of Indian corn may be easily classified with one of the so-called races, according to its seed. However, if two or more races are grown near by there will no doubt be ears composed of a mixture of each class, especially if the flowers develop at the same time.

CHAPTER III.

VARIETIES AND THEIR ADAPTATION.

Indian corn is easily cross-fertilized, accidentally or artificially, and as a result many so-called new varieties have been introduced in the past. As a rule but few have remained in general public favor for a long term of years, as it is difficult to find a variety that will adapt itself to a wide geographical range and climatic and soil variations.

Selecting a variety.—In selecting a variety two things necessarily should receive consideration: first, the capacity to mature a crop in a given locality, and secondly, productiveness in grain, or grain and forage. In this work it seems best to discuss this subject in two ways: first, to describe a number of standard varieties, and secondly, to give a list of varieties adapted to different States, covering a wide territory. The descriptions of varieties are gleaned from various sources, but unless otherwise indicated, are mainly on the basis of the published investigations of Dr. E. L. Sturtevant (our best authority on varieties) in the New York State experiment station reports, and the bulletins of the Illinois agricultural experiment station. The references of varieties to the several States is as a result of the tests made by the various agricultural experiment stations, unless otherwise specified.

Tested varieties.—The following varieties have been well-tested in this country, some of them for many years, and it is believed that from this list one can make a most satisfactory selection for almost any part of the United States or Canada. The reader is here reminded that some of the varieties, if grown in the West or South, may be larger than is here indicated in the descriptions.

Dent varieties.—*Adams' Early:* Ears six to

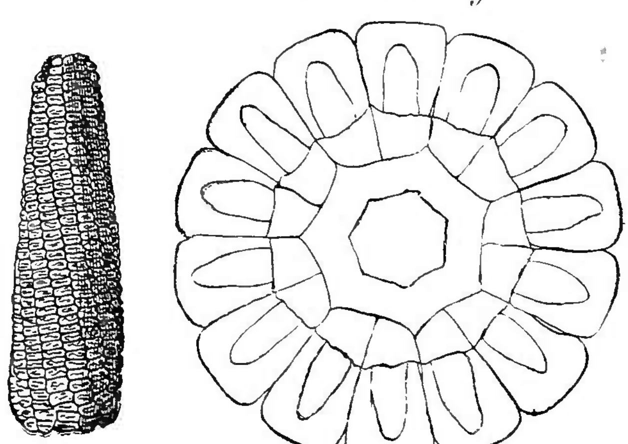


FIG. 4.—ADAMS' EARLY.

seven inches long, about $1\frac{3}{4}$ inches in diameter, slightly or strongly tapering, rounding at the butt; 12 to 16 rowed, the rows often slightly spirally or irregularly arranged. Kernels slightly deeper than broad; white above, horny white below, long dimple dented or creased. Cob large, white. Plant $5\frac{1}{2}$ to $6\frac{1}{2}$ feet tall. A favorite in the South for table use in place of sweet corn.

Blount's Prolific: Ears 6 to 8 inches long, and $1\frac{3}{8}$ to $1\frac{1}{2}$ inches in diameter. Ear stalk rather small. Mostly eight rowed. Kernels very angular in outline, rather deep, white at top, glossy white below, crease dented. Cob small and white. Plant 7 to 8 feet high, bearing its upper ears about 54 inches from the ground, often 4 to 8 on a stalk, the lower ears shorter and more pointed than the upper. A very popular and productive variety in some localities in the South and has been widely grown. Originated by Prof. A. E. Blount in Tennessee.

Boone Co White: Ears long and uniform from butt to tip. Kernels white, deep, thick; cob white. Stalks of medium height, thick, strong. Very productive. Medium late. Originated by James Riley, Boone Co., Ind., about 1880. Productive and popular as a bread corn. Well adapted to the central West.

Burrill & Whitman or *B. & W.:* Ears 8 to 9 inches long, 2 to 2.4 inches in diameter. Cobs white, small. Ears roughish, tapering; butt and tip evenly rounded and well filled; 14 to 16 rowed. Kernels white, broad, wedge shape.

Stalks grow about 10 to 11 feet high on rich soils. A favorite variety for silage, but is too late to mature seed properly in the North where early frosts occur.

Chester Co. Mammoth: Ears 7 to 11 inches long, $2\frac{1}{4}$ to $2\frac{3}{4}$ inches in diameter; smooth; slightly tapering, rounded evenly at butt and

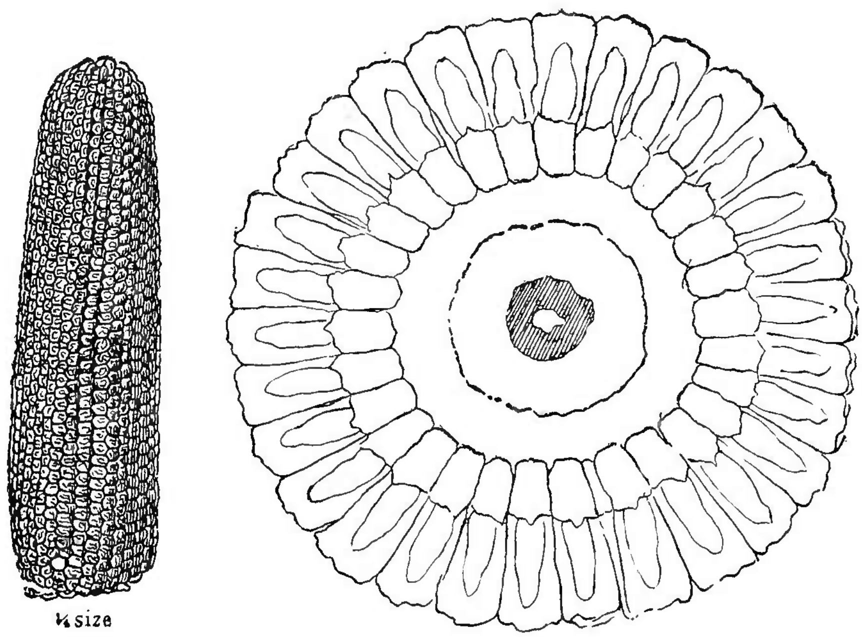


FIG. 5.—CHESTER CO. MAMMOTH.

tip; 18 to 30 rowed; cob red, large. Kernels yellow, deep, narrow, thick, crease dented. Plants tall. Matures late. Mr. E. S. Carman says:* "We have never raised larger ears of Chester County Mammoth corn than during the past season. We have lots of ears 11 inches

Rural New Yorker, Dec. 13, 1884, p. 832.

long, with 18 rows bearing 900 large kernels." Originated in Chester Co., Pa.

Dungan's White Prolific: Originated by S. W Dungan of Johnson Co., Ind. An ear sent the writer by Mr. Dungan, as his "ideal," was 10½ inches long, 2¼ inches in diameter, cylindrical, smooth, compact, 16 rowed. Kernels white, crease dented, deep, broad, thick. Cob white, medium size. The plant as grown at Lafayette, Ind., is large and vigorous, being a very desirable variety for silage. This is an excellent bread corn, is very productive, but too late for the northern line of the great corn belt. Well adapted to Southern Ohio, Indiana, Illinois, Kentucky, etc.

Farmer's Favorite: Ears 8 to 11 inches long, 2 to 2¼ inches in diameter, slightly tapering, 14 to 18 rowed, smooth. Cob red, of medium size. Kernels wedge shaped, deeper than broad, yellow. Plants of medium height. Also known as Golden Dent.

Golden Beauty: Ears 9 to 10 inches long, about 2½ inches in diameter; smooth, nearly cylindrical, cob white, large, does not cover well at tip. Kernels yellow, wedge shaped. Rows 16 to 20. Plant of medium height. Medium late.

Leaming: Ears 7 to 10 inches long, 2 to 2½ inches in diameter; smooth, slightly tapering, often pointed at tip; cob red, large, 18 to 22 rowed. Kernels yellow to orange above, orange below, dented, corners often rounded, deep, thick. Plant grows 8 to 10 feet high. Matures

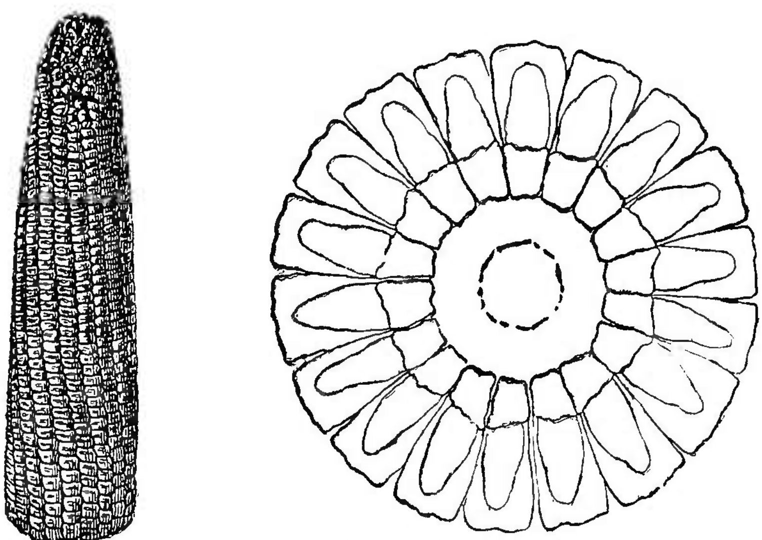


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FIG. 6.—LEAMING.

medium early. One of the most popular dents, adapted to a wide range of territory, and classed as very productive. Originated by J. S. Leaming, Clinton Co., O.

Maryland White Gourd Seed: Ear 7 to 8 inches long, about $2\frac{1}{2}$ inches in diameter, tapering, 16 rowed; cob white. Kernels white, long, dimple dented. Plants grow to height of about 10 feet. Matures late.

Pride of the North: Ears 6 to 8 inches long, two inches in diameter, rough, 12 to 18 rowed; cobs red, small. Kernels broadly wedge shaped, crease dented. Plants of medium height, maturing early. Resembles Wisconsin Yellow dent. It is claimed* that this variety was originated in Fayette Co., O., about 1813, where

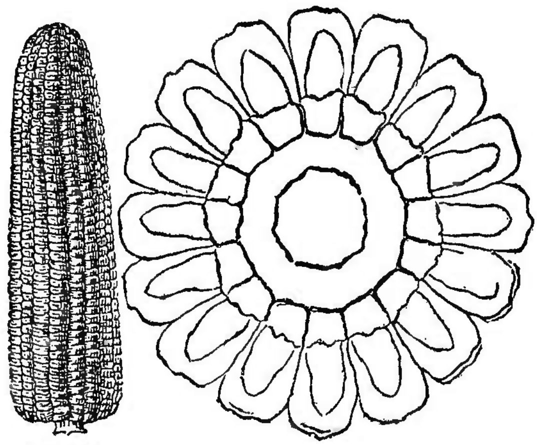

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FIG. 7.—PRIDE OF THE NORTH.

it has been known for many years as Clarridge Corn.

Queen of the Prairie: Ears 6 to 8 inches long and about $1\frac{3}{4}$ inch in diameter, slightly tapering; cob small, red, 16 to 18 rowed. Kernels yellow, flat, deeply dented. Plant about 9 feet tall. Matures medium early.

Riley's Favorite: Ears 8 to 9 inches long, about $2\frac{1}{4}$ inches in diameter, nearly cylindrical, butt and tip well filled, 16 to 22 rowed; cob red, small. Kernels yellow, narrow, wedge shape, deep. Plants of medium size, strong, productive. Mr. James Riley of Boone Co., Ind., originated this corn about 1880, by cross fertil-

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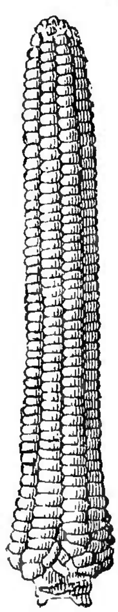
*J. C. in *Farmers' Review*, April 23, 1890.

izing Golden Yellow and Pride of the North. One of the best Yellow dents and has been successfully grown over a wide range of territory.

Smedley: Ears 7 to 9½ inches long, about two inches in diameter, slightly tapering, butt and tip well filled, 10 to 12 rowed; cob red, small. Kernels light orange, deep, broad at top, dented. Plants of medium size, maturing early.

Wisconsin Yellow: Ears 7 to 8 inches long, about two inches in diameter, tapering, butt and tip rounding evenly and well filled, mostly 18 rowed; cob red, medium size. Kernels orange yellow, small, deep, dimple dented. Plants of medium size, early. A well known yellow dent, especially for the northern latitude of the corn belt where dents will succeed.



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Flint varieties.—*Canada,* also known as *Early Canada:* Ears 8 to 10 inches long, about 1½ inch in diameter, bluntly rounded at tip, mostly 8 rowed; cob white, small. Kernels rather large, deep golden orange color. Plant about six feet tall. Matures early

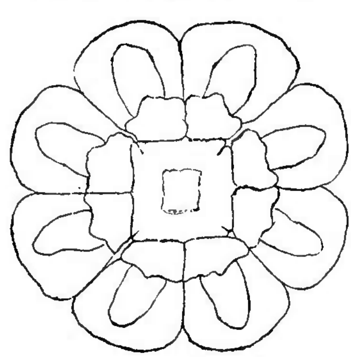

FIG. 8.—CANADA.

Canada Twelve-Rowed; also *Landreth's*

Earliest Yellow: Ears 7 to 10 inches long, about $1\frac{1}{2}$ inch in diameter, tip well filled; cob medium to large. Kernels small to medium, golden orange in color. Plants attain $6\frac{1}{2}$ to 7 feet. A very old variety adapted to the northern line of the corn belt, as is also *Canada*.

Compton's Early; also *Compton's Surprise:* Ears 9 to $9\frac{1}{2}$ inches long and about $1\frac{5}{8}$ inch in diameter, pointed at tip; cob large, white. Kernels medium size, light golden orange color. Plants about seven feet tall. A productive, good variety, widely grown.

Dutton: Ears 9 to 10 inches long and about $1\frac{3}{4}$ inch in diameter, with rounded tip; cob small, 12 rowed. Kernels large, golden orange. Plants 6 to 7 feet high. Was first brought into notice by Mr. Salmon Dutton, Cavendish, Vt., about 1818. "The ears of corn from which it was originally selected on an average were from 8 to 12 inches long and contained from 12 to 18 rows."* A very productive and popular variety in the Northeast. A form of this known as *Early Dutton* has been extensively grown. S. W Jewett says† it is "descended from seed I obtained from Jesse Buel, selecting it myself from his corn crib, at Albany, about 1839."

Eight Rowed Yellow; also *Long Yellow:* Ears

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*Transactions New York State Agricultural Society, 1853, p. 334.

† *Country Gentleman*, May 8, 1834.

10 to 11 inches long, about $1\frac{1}{2}$ inch in diameter, slender, slightly tapering, mostly eight rowed. Kernels not large, deep golden orange.

King Philip; also *Improved King Philip, Eight Rowed Brown, Eight Rowed Copper Colored, Eight Rowed Yellow:* Ears 8 to 10 inches long, about $1\frac{1}{2}$ inch in diameter, resembling *Canada* in all other respects except color,

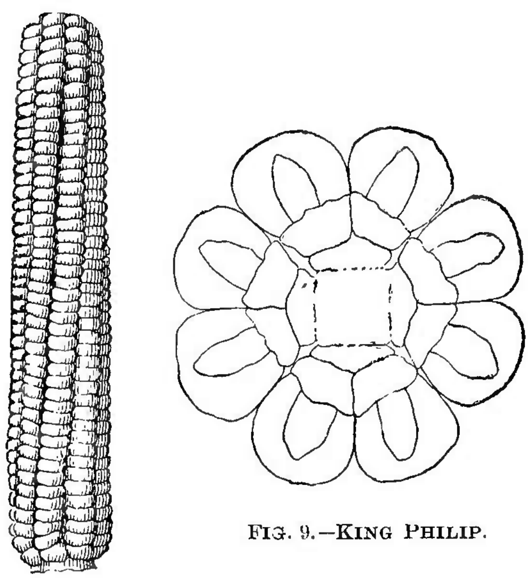

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FIG. 9.—KING PHILIP.

which is copper red. Plant 8 to 9 feet high. Named after the celebrated Indian chief of the Wampanoags, from which tribe it is said* the seeds were obtained. Sturtevant, however, says that this variety was originated by Mr. John Brown, Long Island, Lake Winnipiseogee,

* Transactions New York State agricultural society, 1853, p. 333.

N. H.* This is a hardy variety, adapted to the northern corn latitudes, and is one of the very best and most popular flint varieties.

Longfellow: Ears 9 to 10½ inches long, with tendency to expansion at butt, tapering toward the well-filled pointed tip; mostly six rowed; cob white and small, kernels deep, yellow-

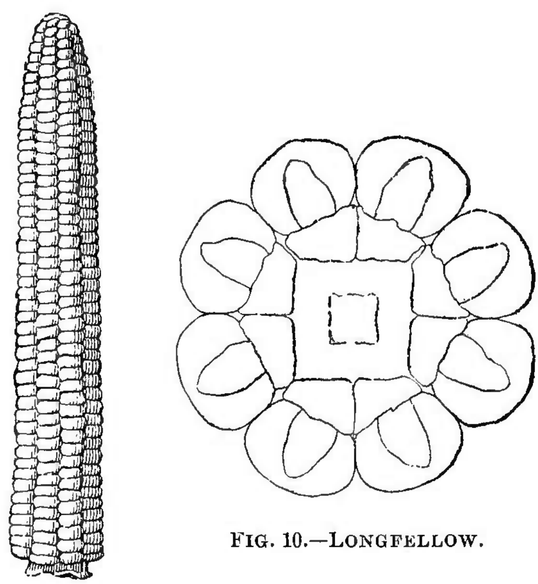

FIG. 10.—LONGFELLOW.

orange, large, well rounded. Plants about 7 feet tall. Gregory in his seed catalogue for 1886 states that "it is the result of careful selection in a family of Massachusetts farmers for 45 years." A most popular and productive variety, well adapted to New England.

New England Eight Rowed: This is the *Canada* or *Early Canada* of many, and it has many

* New York agricultural experiment station report, 1884, p. 166.

local names. It answers to the general character of the Canada variety. Enfield says:* "From this corn the King Philip and some other improved sorts have probably been derived."

Rhode Island White Flint: Ears 5 to 6 inches long and about 1½ inch in diameter, well covered at tip, eight rowed, small cob, often red tinged in the interior. Kernels white, very large and hard. Plants about 7 feet high.

Rural Thoroughbred Flint: Ears 11 to 12 inches long and about 2 inches in diameter, always tapering owing to the space between the pairs of rows toward the butt; mostly eight rowed; cob large. Kernels dingy white, large. Plant 7 to 8 feet high and a vigorous grower. A very late variety, the chief merit of which is in its production of green forage. Introduced by E. S. Carman, editor *Rural New-Yorker*

Waushakum: Ears 8½ to 9 inches long, 1½ inch in diameter, filling completely and roundly at tip; cob small, white; mostly eight rowed. Kernels deep golden orange, rather large, flatly rounded, very close set, plants 7 to 9 feet high, leafy, very productive. Originated by Sturtevant Bros., South Framingham, Mass. "The originals were quite staple varieties of a mixed Canada and New England Eight Rowed

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* Indian Corn, New York, 1866, p. 61.

type, which were allowed to hybridize in 1875, and the ears resulting selected to the desired type. In 1877 and 1878, at the period of

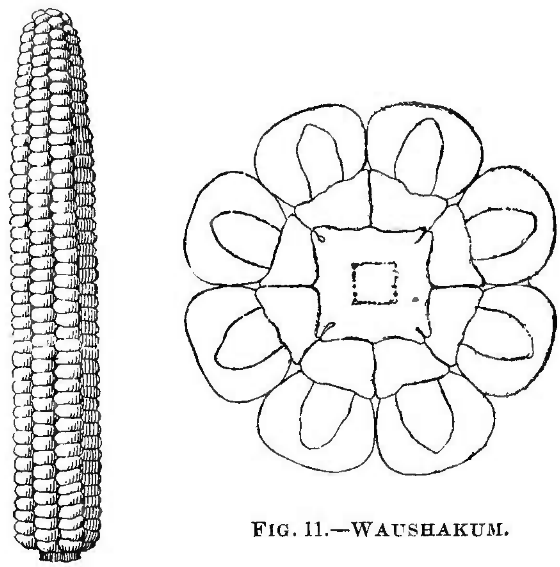

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FIG. 11.—WAUSHAKUM.

bloom, all the tassels from stalks not showing one large ear, and from all imperfect or off type plants, were removed, thus insuring the fertilization of the ears from prolific and typal plants."* An unexcelled yellow variety.

White Flint: Ears 9 to 11 inches long, 1½ inch in diameter, tapering slightly, tip usually not very well filled; cob medium size; mostly 8 rowed. Kernels dingy white, medium size. A very popular, common variety in the North-eastern States.

* E. L. Sturtevant: Report New York State agricultural experiment station, 1884.

Sweet varieties.—*Black Mexican;* also known as *Black Sugar* and *Slate Sweet:* Ears 6 to 8 inches long and about 1½ inch in diameter, cylindrical, tip rarely well filled; cob white,

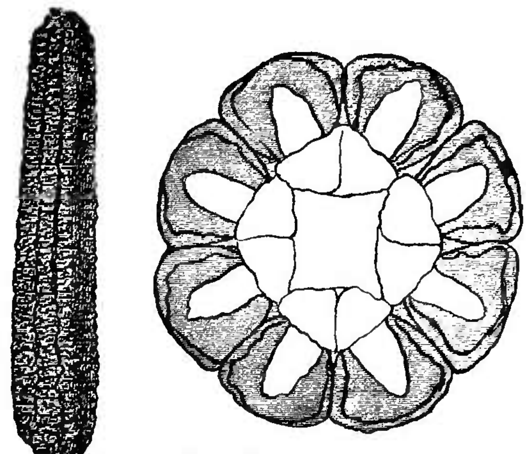

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FIG. 12.—BLACK MEXICAN.

small, 8 rowed. Kernels slate-black, broad, crinkled, compactly set, tender and sweet when ripe. Plants about 6 feet tall. A medium early, of the best quality, that has been known for many years.

Cory; also known as *Early Cory, Cory Early Sugar, Extra Early Cory, La Crosse, Earliest Rockford Market* Ear 4 to 6 inches long, about 1½ inch in diameter, cylindrical, well filled at tip. Kernels whitish, large, broader than deep, crinkled or smooth. Plants small—about five feet tall. One of the very earliest varieties, ripening in about 55 days. Quality fair. Introduced in 1885 and has been very popular as an early sort.

Crosby's Early; also *Extra Early Crosby* and *Crosby's Early Twelve Rowed:* Ears 6 to 7 inches long, about $1\frac{1}{2}$ inch in diameter, slightly pointed toward tip, 12 rowed; cob white. Kernels white, flatly rounded, crimped, of fine quality. Plant $5\frac{1}{2}$ to 6 feet tall. Introduced about 1860. One of the best, and second early.

Egyptian; also known as *Washington Market:* Ears 6 to 7 inches long and about $1\frac{3}{4}$ inch in diameter, tapering, 12 to 16 rowed; cob medium size, white. Kernels amber colored, deep, broad, crimped and slightly wrinkled, sweet and tender, said to be superior for canning. Plant tall and prolific. Late. Introduced about 1878.

Hickox; also *Hickox Improved:* Ears 8 to 10 inches long and about $1\frac{3}{4}$ inch in diameter; 8 to 12 rowed; cob white. Kernels whitish, slightly rounded, nearly as deep as broad, large, crimped, tender. Plants 6 to 7 feet tall. A favorite late variety, introduced about 1883.

Marblehead; or *Early Marblehead:* Ears 6 to $6\frac{1}{2}$ inches long, usually larger toward butt, about $1\frac{3}{8}$ inch in diameter, usually eight rowed; cob reddish. Kernels broadly rounded, crinkled, red or reddish flesh color, very sweet. Plant about $4\frac{1}{2}$ feet tall. Introduced about 1878, and originated by selection from Narragansett, which it closely resembles. One of the earliest varieties.

Minnesota; also *Early Minnesota* or *Ford's*

Early: Ears 5 to 6 inches long, $1\frac{1}{2}$ inch in diameter, rather blunt at tip, eight rowed· cob white. Kernels large, a little pointed, rounded, crinkled, closely set in. Plant about $4\frac{1}{2}$ feet tall, bearing ears about 10 inches above ground. Very early. Introduced about 1874, and thought to be derived from the Narragansett.

Moore's Early; also *Moore's Early Concord, Moore's Concord, Early Concord:* Ears 6 to 8 inches long, $1\frac{7}{8}$ to 2 inches in diameter, rather pointed toward tip, 12 rowed; cob white. Kernels white, very flatly rounded, not closely set on dry ear, of delicate flavor. Plant 6 to $7\frac{1}{2}$ feet tall, bearing ears about twelve inches from

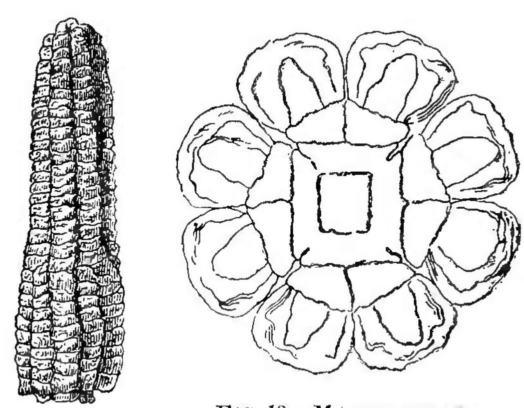

FIG. 13.—MARBLEHEAD.

the ground. A good second early. Originated in 1865 by J. B. Moore of Concord, Mass., by crossing Crosby's Early and Burr's Improved.

Narragansett; also *Early Narragansett.* Ears 6 to 7 inches long, about $1\frac{3}{4}$ inch in diameter, cylindrical, tip round pointed, usually eight rowed; cob reddish. Kernels vary in color from light flesh to dark red. Plants grow about five feet tall, bearing ears 8 to 14 inches above ground. A standard, early, sweet, desirable variety that has been grown many years, being described by Burr in 1865.*

Ne Plus Ultra: Ears 6 to 7 inches long, about $1\frac{3}{4}$ inch in diameter towards butt where it is strongly rounded, and from near which it notably tapers to the tip; irregularly 12 to 14 rowed; cob white. Kernels white, very narrow at base, crimped and wrinkled, thin and translucent, separating readily from the cob. Plants 5 to 6 feet high, bearing ears 18 to 20 inches above ground. Late, but of excellent quality. Introduced about 1882.

Pee and Kay; also *Western Queen, Maule's XX Sugar:* Ears 6 to 8 inches long, $1\frac{3}{4}$ to 2 inches in diameter, cob white. Kernels white, flatly rounded over the top, crinkled or crimped, thick, nearly as deep as broad, very sweet. Plants 5 to 6 feet high, ears 16 to 18 inches above ground. Second early. Popular with farmers and market gardeners.

Stowell's Evergreen: Ears 7 to 8 inches long, about $2\frac{1}{4}$ inches in greatest diameter, often sharply tapering, and then again nearly cylindrical, rarely filled at tip, 16 rowed; cob white.

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*The Field and Garden Vegetables of America, 1865, p. 586.

Kernels white, wrinkled, narrow and deep, loose, shedding readily from the dry ear. Plants $7\frac{1}{2}$ to 8 feet tall, bearing ears about 30 inches above ground. Foliage abundant. Late. Very tender and sugary, a standard of first quality. At Polk's cannery, at Greenwood, Ind., the largest establishment of its kind in the United

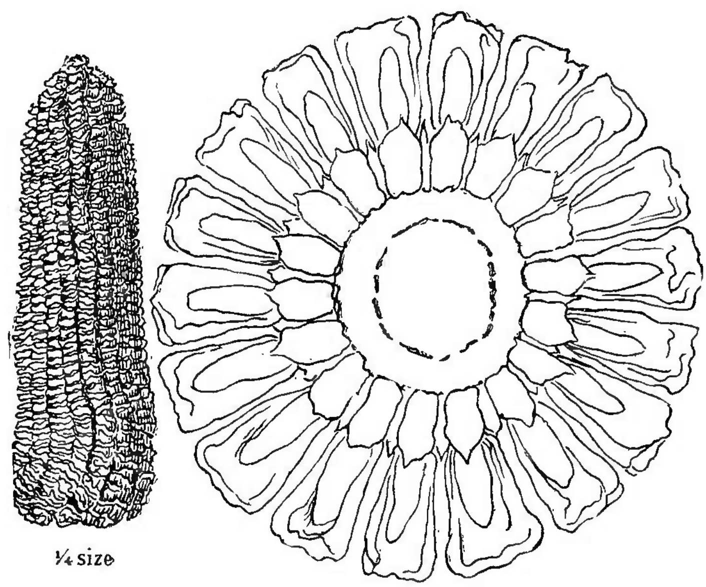

FIG. 14.—STOWELL'S EVERGREEN.

States, no other variety of sweet corn is used. Has been grown many years, and is referred to by Burr in 1865.*

Squantum: Ears 6 to 7 inches long, about 2 inches in diameter at the butt, strongly tapering to a tip that is seldom well filled, 12 to 14 rowed; cob white. Kernels white, large, crimped, nearly as broad as deep, not crowded.

* Field and Garden Vegetables.

Plant 6 to 6½ feet tall, bearing ears about 24 inches above ground. Standard medium maturing. Introduced about 1883.

Triumph: Ears 8 to 9 inches long, about 1½ inch in diameter, slender, tapering evenly and strongly in the lower half, 8 and 10 rowed; cob white. Kernels white, large, broadly rounded,

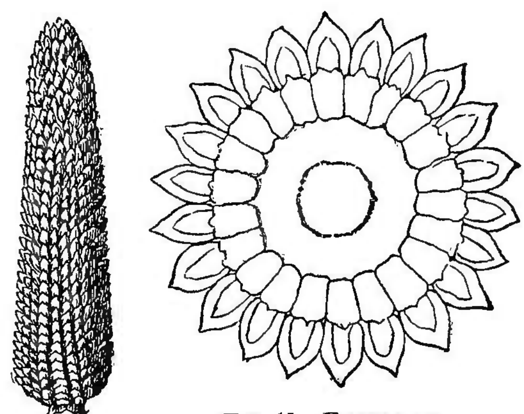

FIG. 15.—EGYPTIAN.

almost flat, very frequently quite open between the pairs of rows, crinkled and crimped. Plant 6 to 7 feet tall, bearing ears about 30 inches above the ground. Introduced in 1874.

Sweet corn for succession.—Mr. E. S. Carman recommends* the following as the best kinds of sweet corn for succession. For first early, either Cory or Northern Pedigree. Next, Shakers' Early, Perry's Hybrid or Stabler's Early Then Moore's Concord, Triumph or Hickox. Last, Stowell's Evergreen, Mammoth or Egyptian.

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* *Rural New Yorker*, Feb. 25, 1888.

Pop varieties.—*Egyptian;* also *White Rice:* Ears 4 to 7 inches long and $1\frac{1}{4}$ to $1\frac{1}{2}$ inch in diameter, strongly tapering, many rowed; cob white. Kernel white, large, of rice form. Plant about 5 feet high, bearing ears about 30 inches above ground. Productive.

Dwarf Golden is the smallest variety of corn grown, the plant usually being about 18 inches high. Sometimes individual plants produce five tiny perfect ears to a stalk.

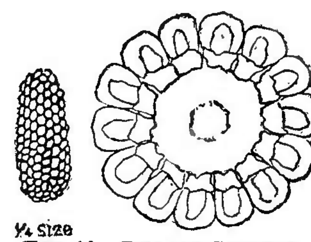

FIG. 16.—DWARF GOLDEN.

New England; also *Nonpareil:* Ear 6 to 8 inches long, about one inch in diameter, eight rowed; cob white. Kernels glossy, rounded, white or yellow according to variety. Plants 5 to 6 feet high, bearing ears about 16 inches above ground. A standard variety, ripening in good season and productive.

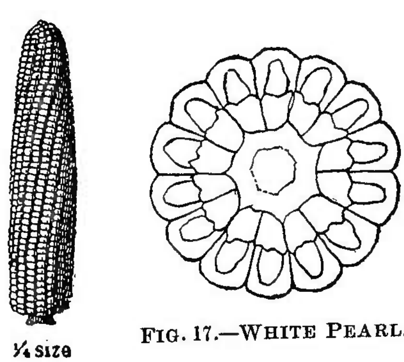

FIG. 17.—WHITE PEARL.

Pearl. Ears 4 to 5 inches long and $\frac{3}{4}$ to 1 inch in diameter, nearly cylindrical, 14 to 18 rowed; cob white. Varieties occur which are white, lemon, red or purple. Kernels flat, much compressed, deeper than broad, triangular, very flinty. A standard, productive variety which has been known for many years.

Rice: Ears 5 to 7 inches long, $1\frac{1}{4}$ to $1\frac{3}{4}$ inch in diameter, strongly tapering, 14 to 20 rowed; cob white. Kernels white or red, pointed into a sort of short spine which is somewhat erect. Plant 6 to 7 feet high, with ear 3 to 5 feet above ground. Very productive.

Adaptability of varieties. — Some varieties seem particularly adapted to a wide range of conditions, while others are less so. A few varieties are given here, as having been grown in the States in which they are listed, and with a degree of success such as will justify their culture. Most of the tests were made at or under the supervision of an agricultural experiment station, from the publications of which much of the data is secured. Where the information is apparently reliable the varieties are named from most to least productive.

Alabama. At Uniontown: Mosby's Prolific, Lee County Field, Blount's Prolific, Head's Field, Madison County Red, Welborn's Conscience, Lloyd's Stock and Strawberry yielded in order given in 1890. At Auburn, in 1891: Experiment Station Yellow, Clayton Bread, Lindsay's Horsetooth and Hunnicutt. Bulletin 52 of the Alabama station (January, 1894,) recommends Clark's Early, Mastodon (yellow), Early Eclipse (yellow), Gentry's Early Market (white), and Improved Golden Dent as the best early varieties.

Arkansas. At Fayetteville: Welborn's Conscience, Common Yellow, Allen's Mammoth, Mastodon Yellow, Golden Dent, Golden Beauty and Hickory King. (Bulletin 22, December, 1892, Arkansas experiment station.)

Colorado. At Fort Collins: Prof. A. E. Blount says in bulletin 2, Colorado experiment station, December, 1887, that Pride of the North and Yellow Flint have proved most valuable. The former is the best.

Georgia. At Experiment: Shannon's Yellow, Ledbetter, Shaw's Improved, Shannon's White, Southern White, Huffman's, Higgins', Patterson's, Tennessee Yellow, Peek's Premium. (Bulletins 15 and 23 Georgia experiment station.)

Indiana. At La Fayette: The following table gives the average yield of varieties tested for five years at the experiment station at Purdue University, from 1888 to 1892 inclusive. The 1893 yield was so badly influenced by dry weather as to be unfit for comparison:

VARIETY.	*Yield in bu.*	*Ave. No. days mature.*	*Per cent. ears to stalk.*	*Color grain.*
Purdue Yellow.......	69.3	112	51.4	Yellow.
White Prolific........	76.7	125	43.	White.
Boone Co. White.....	72.3	126	43.2	White.
Riley's Favorite......	69.9	123	47.7	Yellow.
Leaming.............	61.7	115	44.3	Yellow.
Chester Co. Mammoth	59.7	125	43.1	Yellow.

The following are tests of 1892, with average yields of varieties tested more than one year:

VARIETY.	*Years tested.*	*Yield per ave. bu.*	*Days to mature.*	*Color grain.*
Legal Tender	1	46.2	105	Yellow.
Golden Beauty	3	62.	130	Yellow.
Piasa Queen	1	74.5	122	Yellow.
Mastodon	1	53.	117	Yellow.
Big Buckeye	3	62.4	119	Yellow.
Iroquois	1	85.7	118	Yellow.
Haben's Golden	3	64.7	117	Yellow.
Hickory King	4	44.6	131	White.
Red Cob Ensilage	3	62.6	129	White.
Southern Red Cob	1	79.	118	White.
Burrill & Whitman	2	73.2	138	White.
Munn's Early	2	64.1	110	Yellow.
Champaign Co. Prolific	1	68.9	110	Yellow.
Wisconsin White	4	43.8	106	White.
Ivory Dent	1	86.2	124	White.

Illinois. At Champaign: The following table gives the results of five years up to and including 1892. The season of 1893 was so dry that the results have little value in this comparison. The yield is of air-dried corn in bushels. This table is from bulletin 25, for April, 1893, of the Illinois experiment station:

VARIETY.	*1888.*	*1889.*	*1890.*	*1891.*	*1892.*	*Average.*
Champion White Pearl	70.	94.8	74.9	76.5	65.	76.2
Leaming	86.6	80.6	69.4	67.3	70.1	74.8
Burr's White	85.9	75.7	67.7	67.7	64.2	72.2
Helm's Improved	84.8	102.6	51.1	39.	79.2	71.3
Clark's Iroquois	68.5	81.9	59.	65.4	72.9	69.5
Stewart's Impr'd Yellow	91.2	68.7	54.7	58.4	74.4	69.5
Riley's Favorite	83.7	66.3	55.9	58.6	74.1	67.7
Fisk's Yellow	76.6	79.5	61.7	57.4	60.1	67.1
Legal Tender	84.2	68.7	60.	56.8	60.3	66.
Murdock	80.3	65.	61.6	59.8	57.6	64.9
Edmonds	81.1	66.1	53.3	56.1	58.4	63.

In comparing the average yields of white and yellow varieties for 1892, the white yielded 66.3 bu. and the yellow 66.2 bu.—practically the same.

*Iowa.** Stouffer, Iowa Yellow Dent, Iowa White Dent, Pride of the North, Chester Co. Mammoth, Clark's Early Mastodon, Leaming, Champion White Pearl, Iowa Gold Mine.

Kansas. At Manhattan: "In a comparison of 140 varieties, the following 10 gave the best yields, in the order named: Mammoth White Dent, Hartman's Early White, Silver's Mammoth Yellow, Mammoth Ivory Dent, North Star, Piasa Queen, Leaming, Pride of Kansas, Legal Tender, Large Golden Dent, the yields ranging from 80 to 91.5 bu. per acre. Those found to be excellent ensilage varieties were Hiawasse Mammoth, Little Red Cob, Mosby's Prolific and Parish White." (Bulletin 30, December, 1891, Kansas agricultural experiment station).

Kentucky. At Lexington: Mammoth White Surprise, Boone Co. White, Runnell's White, Golden Beauty, Munn's Early, Riley's Favorite. All these are recommended by "Rusticus" in *Ohio Farmer*, Oct. 23, 1886.

Louisiana. At Baton Rouge: Mosby's Prolific, McQuade's, Golden Dent Gourd Seed, Young's Hybrid, Blount's Prolific, White St. Charles,

* *Orange Judd Farmer*, March 5, 1892.

Leaming, Hickory King, Champion White Pearl. (Bulletin 7, 2nd ser., Louisiana experiment station.) At Calhoun (Northern Louisiana): Calhoun Red Cob, Mosby's Prolific, Welborn's Conscience, Virginia White Gourd Seed, Maryland White, Brazilian Flour, Leaming, St. Charles' Favorite Dent, Blount's Prolific. (Bulletin 21, Louisiana experiment station, 1893.)

Mississippi. At Agricultural College: Mosby, Price, Golden Dent, St. Charles, Eclipse. (Bulletin 33, Mississippi experiment station, 1895.)

Missouri. At Columbia: Logan, Chester Co. Mammoth, Riley's Favorite, Red Cob Gourd, Pride of the North, Golden Beauty, Golden Dent, Piasa King, Blount's Prolific, Leaming, Hickory King, Farmers' Favorite, Queen of the Prairie. (Bulletin 14, Missouri experiment station, 1891.)

Nebraska. At Lincoln: Riley's Favorite, Golden Beauty, Mammoth Cuban, Brazilian Flour, Early California and White Giant Normandy were the best yielders of the field corns. Of the sweet varieties, Cory ripened in 104 days, Honey and Breck's Premier in 111, Moore's Early Concord in 114 and Egyptian and Stowell's Evergreen in 120 days. (Bulletin 6, March, 1889, Nebraska experiment station.)

New York. At Geneva: Of flints, Waushakum, Longfellow, Thoroughbred White, Common White, Compton's. Of dents, Queen of the

Prairie, Pride of the North, Leaming, Chester Co. Mammoth, Adams' Early and Illinois White.

Ohio. At Columbus: Leaming, Blount's White Prolific, Big Buckeye, Riley's Favorite, Edmunds' Premium Dent, Pride of the North, Queen of the Prairie, Wisconsin Yellow Dent. (Bulletin 1, Vol. IV, January, 1891.)

Oregon. At Corvallis: King Philip, Early Yellow Canada, Queen of the North, matured. Leaming, Queen of Prairie, Golden Dent, Chester Co. Mammoth, Blount's Prolific, Thoroughbred White Flint and Hickory King, did not mature, at the Oregon experiment station. (Bulletin 4, January, 1890.)

Pennsylvania. At State College: Of flints Longfellow, King Philip, Waushakum, Improved Eight Rowed and Canada. Of dents, Hickory King, Golden Beauty, Piasa Queen, Golden Dent, Leaming, Queen of the Prairie, Pride of the North. (Annual Report Pennsylvania experiment station, 1890.)

Rhode Island. "Potter's Excelsior (or Squantum) in its purity is the best table corn grown."*

South Dakota. At Brookings: Of dents, Gold Coin, Queen of the North, Pride of the North, Dakota Dent, Davis' White Dent, Hughson's Dent, Dakota King, Prince Albert, Minnesota King, Loveland's. Of flints, Smut Nose, Man-

*J. S. Sprague, Providence Co., R. I., in *New England Homestead*, March 21, 1885.

dan Indian, Canada, Squaw, Pride of Dakota, Compton's Early, King Philip.

Tennessee. At Knoxville: Of dents, Adams' Early (for table), Golden Beauty, Maryland White Gourd Seed, Shannon's Big Tennessee White, Shannon's Yellow, Southern Horse-tooth. Shannon's corn succeeds in the State quite generally.

Wisconsin. At Madison: Of 13 varieties of dent tested, "only three were found sufficiently early to depend upon for a general crop, viz.: Pride of the North, North Star Golden Dent and Queen of the North." Of flints, King Philip and Sibley's White Flint are best. (Bulletin 17, November, 1888, Wisconsin experiment station.)

Wyoming. For Northern Wyoming, Minnesota King, Pride of the North, Mandan, Ninety Day and Flint, are recommended by Joe Harper of Banner. For Northeastern Wyoming, Yellow Dent, Pride of the North, Squaw and Mandan. For Eastern Wyoming, Angel of Midnight, Early Mastodon, Pride of the North and Whitely Dent. (Bulletin 5, February, 1892, Wyoming experiment station.)

Canada. Ottawa, Ontario, Canada, is too far North to grow corn for the grain, excepting in a limited way. Of many tests made at the Central Experimental Farm, but few passed the milk state, and in many cases the ears were scarcely formed. The following varieties ripened: Flints, Adams' Extra Early, Golden Dew Drop, Mitchell's Extra Early, Self Husking, King Philip, Angel of Midnight, Canada Yellow, Longfellow, Landreth's Early Summer Yellow, Pearce's Prolific and Smut Nose nearly ripened. Sweet, Crosby, Extra Early Cory Ford's Early, Marblehead Early, Pee and Kay, and Talbot's First and Best; Hickox, Livingston's Evergreen, Landreth's Early Market, Northern Pedigree Sweet, Potter's Excelsior, Perry's Hybrid Early and Shaker's Early nearly ripened. Tests were made of silage corn, and the yields per acre ranged from 14 to 30 tons. The following are recommended by Director Saunders, as the most productive in the order named: Thoroughbred White Flint, Long White Flint, Long Yellow Flint, Yellow Dutton, Large White Flint, Pearce's Prolific and Longfellow. Excepting Long White Flint, all matured enough to make excellent silage. (Bull. 12, Central Experimental Farm, June,'91.)

Richard Gibson of Delaware, Ont., highly recommends the Butler Co. Dent.* He says: "For the silo, it grows just as much forage in proportion to corn as is profitable; and for the crib, more bushels of shelled corn to bushels of ears than any corn I have yet grown." He thinks it superior to Longfellow in earliness and yield.

* *Farmers' Advocate*, May 15, 1895.

CHAPTER IV

THE SEED.

Upon the quality of the seed planted in a considerable measure depends the character of the crop. Seed to be good should be specially selected and preserved under conditions favorable to prompt, strong germination. As numerous factors of importance relate to the seed and its planting, they will be briefly considered in this chapter under the following titles:

Germination temperature.
Method of selecting seed.
Method of preserving seed.
Relative value of butt, center and tip kernels.
Size of seed.
Type of ear.
Judging corn: a scale of points.

Germination temperature.—Seeds of different classes of corn do not germinate with equal rapidity under the same conditions. Corn from a hot climate, such as the soft varieties, will not germinate at as low a temperature as will that grown in cooler latitudes, as for example, the flints. Sturtevant made an extensive study of germination temperatures for corn at the New York experiment station.* These germination tests were conducted in boxes where the temperature was uniformly under control. Seeds of dent corn germinated at as low a temperature as 43.4 deg. F., after 233 hours, probably the lowest temperature recorded for this seed up to this time. In reporting upon the general results of his trials in 1884, Sturtevant says:†

"First, all the kernels of an ear do not germinate with equal ease or with the same increment of temperature; second, that there is a difference in the time and temperature required between some of the agricultural species of maize; third, that the dent corns germinate at a temperature of 47.6 deg. F., or slightly below; flints at a temperature of 47.8 deg. F., or slightly below; pops and softs ditto; while sweets required 48.5 deg. F., or slightly below; fourth, that the increment of temperature required in our trials was far greater for the sweets than for the other agricultural species."

Under the same conditions of temperature the dents germinate first, flints second, pops and softs next and sweets last, the range being from 168 to 228 hours.

As observed farther on in the chapter on planting a soil temperature of from 50 to 60 deg. F., will justify planting. While the seed may germinate at below this, the chances are that it will decay, or the young plants make a most

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* New York agricultural experiment station. Report 1884, p. 118, and report 1885, p. 64.

† *Ibid.*, pp. 123-124.

unsatisfactory growth. It would not even be especially advisable to plant when the surface soil has a temperature of 50 deg. F., unless quite warm weather could be expected.

Method of selecting seed.—There are two common methods of selecting seed: one to pick out desirable ears in the crib, the other to select during husking. Either method is better than none at all, but the best plan it seems to the writer is as follows: Select a number of ears of the most desirable type and plant this seed in a field by itself, if possible where the plants from it will not be impregnated by the pollen from other corn. Carefully cut out all inferior stalks and ears, and grow only selected plants such as will produce the best ears. From these plants select the seed ears to repeat the operation the next year, thus gradually developing a uniform, high type ear and kernel. This small patch of corn will soon become available as the yearly source of seed. It is assumed, of course, that the person who adopts this mode of selection will practice the best of culture. Where this system is intelligently followed there is no need for corn to deteriorate in quality from year to year.

Preserving seed.—The best method of preserving seed corn known to the writer is that practiced by Mr. James Riley of Boone Co., Ind. A small building is located on a hillside, so that one can drive up to the end of it on a level with the second floor. The corn is unloaded on this floor, which extends the length of the house. This only serves as a sort of platform, with an opening entirely along each side about six feet wide, which is the top of the crib. Below this floor is a stove near the center of one end of the building, with pipe running the length of the house. A fire is kept in this stove and the corn placed overhead is thoroughly dried, after which it is shoveled into the cribs on each side, which extend to the floor below, where it is ready for sacking and shipping. The most favorable conditions for preserving seed are thus insured. This method can be practiced on a smaller scale with ease by hanging the seed corn on the wall of a room back of the stove, where a fire is kept from harvesting to planting time. The seed should be kept perfectly dry, and selections from the crib in the spring may be unsatisfactory.

The old method of braiding a number of ears together at husking time and hanging them up on the side of the barn is better than selecting from the crib in the spring. A dry attic or inside of barn is a better place than the outside exposure. At Purdue we find it satisfactory to put seed corn on the ear in common brown coffee sacks, which are hung from the rafters to cure, away from rats and mice.

Some years ago I collected samples of seed corn from 16 counties in Tennessee, and tested their germination quality. The vitality of the seed was strong. Nearly all of this seed was grown by men who took pains to keep it in dry, well-ventilated places. There was no essential difference in germination between ears stored with and without the husk.

In an article on "Seed corn"* Josiah Russell of Iowa says: "If the corn is not *absolutely* dry when gathered we put the ears for seed in a plastered upper chamber of the house through which a stovepipe goes to the chimney, or we make use of the smoke house. In either case the corn is laid in tiers on lath nailed to 2x4 uprights, one row of corn to each lath, or rather a lath at each end of the corn rows. * * * It takes two laths to hold one row of ears side by side. * * * The smoke-house plan we like best of all, and think the smoke we put in at times during the winter renders the corn objectionable to the ground squirrels in the spring."

The relative value of butt, center and tip kernels does not materially differ. As a rule farmers select the central kernels on the ears, rejecting the small or irregular tip and butt kernels. At the New York experiment station the writer assisted in conducting elaborate experi-

* *Rural New Yorker*, Aug. 25, 1888.

ments comparing the results from seed from different parts of the ear.* In these experiments, extending from 1882 to 1885, the results slightly favored the tip kernels. The following table gives the results:

YIELD PER ACRE IN BUSHELS.

	1882.	*1883.*	*1884.*	*1885.*	*Average.*
Butt seed	62.9	53.8	54.7	54.9	56.6
Central seed	62.5	54.5	56.1	57.6	57.6
Tip seed	64.7	57.1	56.3	56.3	58.6

At the Ohio experiment station the average yields per acre for four years were, butt, 66.9; central, 62.8, and tip 64.8 bu. per acre.†

At the Kansas station the relative productiveness was first from tip, second from butt and third from central kernels.‡

There is not sufficient evidence at hand to justify the rejection of either butt or tip kernels, provided they are of good vitality, in favor of the kernels from the center of the ear.

The size of the seed planted, on the basis of the evidence given above, would not seem to play any special part in productiveness of crop. If the size did affect the yield we should expect

* New York agricultural experiment station; report 1884, p. 90, 1885, p. 38.

† Ohio agricultural experiment station. Report for 1886, p. 126.

‡ Kansas agricultural experiment station, Bulletin 45, December, 1893.

the large central kernels on the ear to produce larger crops than would the tip kernels. In his experiments Sturtevant planted selections of largest and smallest seed from ears of Waushakum corn.* There was not much difference in the yield from seed of each lot. The results were as follows:

	Number ears.		*Bushels ears.*		*Average weight of ears in oz.*
	Good.	*Poor.*	*Good.*	*Poor.*	
Large seed....	14,360	1,630	69.7	2.1	6.21
Small seed.....	14,390	1,950	67.9	2.1	6.04

The selection of large seed would tend toward the ultimate production of a larger ear and seed. This is true, as based on the general law that like produces like. In a discussion before the Society for the Promotion of Agricultural Science "On a New Factor in the Improvement of Crops," Dr. J. C. Arthur gave it as a general law that "large seeds produce stronger plants with a greater capacity for reproduction than small seeds of the same kind."† If, however, the best method of selection is practiced, as outlined in the first part of this chapter, it will not be essential to cast aside the small kernels found on selected ears.

A type of ear should always be noted in the

*New York State agricultural experiment station, report for 1885, p. 42.

† *Agricultural Science*, VII, VIII and IX, p. 340.

crop grown, which should be a pronounced feature. Coarseness ought to be avoided. A very large cob does not accompany great productiveness. The ear stalks should not be too large and long. Prof. Morrow recommends: *

"For Central Illinois a comparatively low, short-jointed, thickish stalk, with the ears borne low on short shanks; the ear about nine inches long, 2 to 2½ inches in diameter; nearly uniform in thickness throughout, with 16 to 20 rows well filled out at each end, and with but little space between the rows; the kernels rather thick, solid, and as deep as may be and of any color preferred, as this has little to do with value."

For the dent corns in general the recommendation may well be applied. Mr. A. W Cheever, a Massachusetts farmer of wide reputation, describes his ideal ear of flint corn as follows: †

"Ear not much larger at butt end than at tip end; would avoid corn with very tapering ears; also those with rows having spaces toward the butts. The corn should fill the ear full all over and be crowded hard in the rows. The more kernels to the inch of row the better."

It may be asserted with perfect safety that Cheever's description would apply equally well to sweet corn. The number of rows to the ear is largely a matter of choice.

As a rule, a desirable type for all varieties means small to medium size of cob, cylindrical ears well covered with kernels at tip and butt,

* *Farmers' Review*, March 23, 1888.

† *Orange Judd Farmer*, Sept. 22, 1888.

rows compact, with no wasted spaces between, and kernels deeper than broad. Early maturity of a variety is also quite essential in the Northern States.

Judging corn: A scale of points.—If corn exhibited at fairs or expositions could be judged on the basis of a scale of points, it would no doubt oftentimes result in greater justice in decisions of judges. This of course applies to a consideration of the individual ear only and not to the plant, its adaptability, productiveness, etc. It has no more value than a scale of points in judging butter, where the breed of cow and her profitable character are not considered.

Yet a score card may be of service. In 1886, in the great corn exhibit at the Exposition at Chicago, the five expert judges worked some days in preparing a scale of points to guide them in their decisions. Mr. Orange Judd, who took great interest in the Indian corn plant, on the basis of much study of this question published the following scale of points for temporary use at the Illinois State fair at Peoria in 1891.* It is here reproduced in the belief that it may be helpful to others in preparing a score card to be used for a similar purpose:

* *Orange Judd Farmer*, Oct. 10, 1891, and Nov. 25, 1893.

SCALE OF POINTS FOR INDIAN CORN.

		Perfection.
A.	Shape of ear	10 points.
B.	Purity or trueness to type	10 points.
C.	Filling out at both ends	15 points.
D.	Ripeness (indicating earliness)	10 points.
E.	Perfection and uniformity of kernels	15 points.
F.	Length of ear (for kind and locality)	5 points.
G.	Circumference of ear (for kind and locality)	5 points
H.	Small spaces between rows	5 points.
J.	Depth and shape of kernels	15 points.
K.	Per cent of grain and cob	10 points.
	Total	100 points.

This scale is not entirely satisfactory. It would be difficult to mark point B, as it is assumed that the judge is passing on a variety, and the question of purity he could not answer. Point D is also a weak one, as the earliness could not be determined by the degree of ripeness. In judging K the corn should be perfectly dry, else the comparisons would not be fair. In any event, such a score card could only be used in scoring exhibits on a mercantile basis, and not a variety one. Not enough is known about variety characteristics to permit this fairly.

At the present time the method of judging in vogue is considered unsatisfactory, and an effort is being made to establish the use of the score card. It is to be hoped that a scale of points will be adopted such as will give satistion and be generally used.

CHAPTER V

MANURES AND FERTILIZERS.

It is a generally recognized fact that to remove a crop from the soil is to take from it a certain amount of fertility or plant food. If this practice is continued without returning this food in some form to the soil it becomes much impoverished and less and less productive.

Fertilizers necessary.—A crop of 50 bushels of Indian corn and 8,000 lbs. of cornstalks per acre will remove from the soil 79.8 lbs. nitrogen, 55.2 lbs. phosphoric acid and 87.6 lbs. potash.* To remove such a crop is a heavy drain on the soil fertility, and to purchase in the markets the amounts of nitrogen, phosphoric acid and potash removed by it would cost about $20. In the great corn-growing region of the country, however, a large amount of land is annually planted which contains so much available plant food that the farmer does not feel justified in placing artificial ferti

* Science in Farming, 1882, p. 153.

lizers upon it, although stable manure is sometimes used. Deep, black prairie soils of the new West do not as yet need additional plant food, although the time is soon coming when they will. Again there are alluvial river bottoms subject to annual overflows which so enrich them that artificial fertilization is unnecessary, for such bottoms grow large, fine crops of corn year after year. In the Eastern, Middle, and Southern States, however, soils have become impoverished by constant cropping, and each year enough plant food should be returned to them to keep them highly productive.

It is safe to say that the only way to determine certainly what manure or fertilizer is best suited to one's land is to experiment on it on a simple, practical basis.

Stable manure is always a standard material for enriching the land, and it is suited to the needs of all classes of crops and all kinds of soils. Its effect is more lasting than the readily soluble commercial fertilizer. Since 1883 an experiment has been in progress at the experiment station at Purdue University to determine how long stable manure will continue to affect the yield of succeeding crops. The plat set apart for this experiment has been producing corn continuously since 1879. To certain plats in the series fresh horse manure was applied in 1883 and again in 1884, amounting for the two years to about 50 tons per acre. No manure has been used in this experiment before or since the two years named. The average results of the 11 years of cropping have shown a yearly gain of 10.42 bu. of corn per acre for the manured plats over those unmanured.

In other experiments at Purdue, in charge of Prof. Latta who conducted the preceding one, fresh horse manure has always given greater returns from its application than artificial fertilizers, singly or in combination. Both six and nine tons of the manure per acre gave larger yields than where fertilizers were used under any circumstances.

At the Connecticut station for four years a comparison has been made of the influence of cow manure, hog manure, and fertilizer-chemicals upon a corn crop grown continuously on the same land.* The yields from plats given cow and hog manure in excess of the exhaustion by cropping have been essentially the same during the four years, averaging, however, slightly in favor of the hog manure. The fertilizer plat, which received more nitrogen, phosphoric acid and potash than the crop removed, gave about four-fifths as much dry

* Connecticut State agricultural experiment station. Report for 1893, p. 286.

matter as did the manured plat, while the unmanured plat gave about three-fifths that of the manured. A liberal manuring increased the albuminoids in the crop; in the kernels there was a marked increase in the protein and nitrogen-free extract.

At the Missouri station barn-yard manure (solid and liquid together) increased the yield.* At the Texas station, on poor, shallow, upland "post oak" subsoil of stiff clay, cow manure gave most profitable returns, though bone meal produced the largest increase in yield.†

Artificial fertilizers have been largely used with profit in this country, notably South and East. It would be useless, however, to recommend to the farmer the use of anything but a complete fertilizer for corn, not knowing the soil conditions or the adaptability of a given farm to this cereal. If the soil is deficient in nitrogen, potash or phosphoric acid, the best way to do will be to try some special fertilizers containing these ingredients, and so determine just what the land needs most. It will be safe, however, unless in exceptional circumstances, to use plenty of stable manure for the cornfield and then supplement this with a dressing of fertilizer.

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*Missouri agricultural experiment station, Bulletin No. 14.

†Texas agricultural experiment station, report for 1889, p. 11.

Experiments with fertilizers.—It is interesting, however, to note some of the results from using fertilizers experimentally on corn. Much of this work has been done with great care, and may be suggestive, if not having a direct application.

In 1881 Prof. W O. Atwater, in an address before the Connecticut State board of agriculture, reported on the effects of fertilizing materials upon corn grown in 73 experiments on sandy or sandy loam soil, extending over the years 1878, 1879 and 1880. In these experiments, "phosphoric acid took the leading place often, potash occasionally, and nitrogen very rarely." Prof. Atwater considers the experiments numerous and decisive enough to warrant the inference that, as corn is commonly grown, nitrogenous fertilizers in any quantity would rarely be profitable.

For several years past fertilizer experiments on corn have been conducted by the Storrs' (Connecticut) experiment station, under the direction of Prof. C. S. Phelps. "The crops grown on light soils were in nearly all cases greatly increased by the use of potash or nitrogen, or both, while in only one case was there any considerable increase from the use of phosphoric acid." On the heavy soils phosphoric acid gave by far the best results. "The experiments thus far made indicate that for corn, on the lighter soils of the State, fertilizers containing a large proportion of potash are needed to give the best results," while fertilizers with relatively large proportions of phosphoric acid produce the best results on heavy, clayey soils.*

At the Massachusetts State experiment station for some years a series of 10 plats of one-tenth acre each in size have been grown to corn and treated with one or two special articles of plant food, or else left unmanured. In 1888 those plats receiving a dressing in which potash was the dominant ingredient gave materially increased yields of grain over the nitrogen plats, though a combination of 97 lbs. of sulphate of potash and magnesia and 100 lbs. of dissolved boneblack gave the best yield.

In experiments conducted over the State of Massachusetts in 10 different counties, by Prof. W P Brooks of the agricultural college, while it was shown that soils differ widely in their requirements, it was also demonstrated that potash more often proves beneficial or much more largely beneficial than either nitrogen or phosphoric acid.† Potash as a rule most largely increases the yield of both grain and stover, but its effect upon stover production is greater than upon grain production.

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* Storrs' agricultural experiment station. Report of 1892, p. 67.

† Experiment Station Record, III, p. 165.

At the Georgia station nitrogen experiments were conducted upon 25 plats of 3-40th acre each. In general the results indicated that "nitrogenous manure increased the yield of corn covered by the experiments; that nitrogen alone, regardless of the source, was more effective in increasing the yield of corn than either phosphoric acid or potash, or both combined; but that when a large amount of fertilizer was to be applied to corn it was best to add all three of the elements."* In the general fertilizer experiments of this station in 1893 nitrogen was the most effective fertilizer used, and it was concluded that at present prices of commercial fertilizers they could not be used with profit.†

At the Ohio station in 1890 and 1891 some increase has followed the use of nitrogen in every case, but in 1888 there is no evidence that nitrogen, whether used alone or in combination with phosphoric acid, has produced any increase in crop beyond the limits of probable variation in the soil itself. "Experiments were conducted on five private farms in five counties, in which it was shown that (1) nitrate of soda in combination with dissolved boneblack or muriate of potash, one or both, has

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*Georgia agricultural experiment station, Bulletin 15, December, 1891.

†Georgia station, Bulletin 23, December, 1893.

produced an increase of crop in 46 out of 48 trials; and (2) in no case has the increase in crop been sufficient to pay cost of fertilizer." * This work is supplemented by further work along the same line.† Twenty-one separate experiments were made on soils varying widely in character and located in different parts of the State, and extending over at least six years. As a result of this work Director Thorne concludes:

"At present prices of cereal crops and of fertilizing materials, respectively, the profitable production of corn, wheat and oats upon chemical or commercial fertilizers, or upon barn-yard manure, if its cost be proportionate to that of the chemical constituents of fertility found in commercial fertilizers, is a hopeless undertaking, unless these crops be grown in a systematic rotation with clover or a similar nitrogen-storing crop; and the poorer the soil in natural fertility the smaller the probability of profitable crop production by means of artificial fertilizers."

At the Kentucky station, on land rich in phosphoric acid, a mixture of muriate of potash and nitrate of soda in the proportion of one part of the former to two of the latter gave the best yields of grain, viz.: an increase of 39 bushels per acre over where no fertilizer was applied. Combinations of nitrogen and phosphoric acid, or single applications of either, gave practically a less yield than where no

* Ohio agricultural experiment station, Bulletin 3, Vol. V. March, 1892.

† *Ibid.*, Bulletin 53, March 1894.

fertilizer was applied, while combinations of potash and nitrogen, or potash alone, gave good yields.*

At the Virginia station phosphoric acid generally increased the yield. A full application of this cost but one-half as much as the potash and one-sixth as much as the nitrogen.† Further, where phosphoric acid was applied there was a larger proportion of the corn to fodder than in the other yields. In no instance did the nitrogen application give a gain equal to its cost.

The Rhode Island station, on the basis of several experiments, advises the use of about 45 lbs. nitrogen, 75 lbs. potash and 54 lbs. phosphoric acid per acre.‡

Summary of experiments.—A careful examination of the experiments in supplying fertility to the corn crop conducted by the different agricultural experiment stations shows, as might have been expected, much difference in the results secured. Wherever used stable or barn-yard manure was productive of good results. Combinations of nitrogen, potash and phosphoric acid gave satisfactory yields in

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* Kentucky agricultural experiment station. Bulletin No. 33.

† Virginia agricultural experiment station. Bulletin 31, August, 1893.

‡ Handbook of experiment station work. Washington, 1893, p. 86.

many cases, but generally the cost of these was too much to make their use profitable. The value of phosphoric acid was especially shown in tests in Alabama, Louisiana, Pennsylvania and Vermont; that of nitrogen in Georgia, Massachusetts (local), New York and North Louisiana; that of potash in Kentucky, New Hampshire, New Jersey and Massachusetts (general).

Cotton seed crushed, or cotton-seed meal is generally considered to be a most desirable nitrogen fertilizer. This used singly or in connection with artificial fertilizer is recommended for the corn crop. The meal may be sowed broadcast before planting and harrowed in, while the crushed seeds may be plowed under, as with stable manure. However, it would be better husbandry to feed the cotton seed or meal to live stock and use the manure, which will contain about all the fertility of the original grain.

Sea weeds, fish scrap or dead fish, night soil and other substances are used for manuring corn lands in a limited way. Refuse fish makes a good nitrogenous manure, and along the coast in places is extensively used.

Green manure offers a valuable means of improving the soil for corn-growing in localities where the land has been long cultivated. This is for the reason that those crops best adapted for this purpose, such as the clovers in the North and the cowpea in the South, increase the soil fertility by returning to it additional plant food secured from the atmosphere or soil. The clover plant, it has been demonstrated, adds materially to the fertility of the surface soil by securing nitrogen from the atmosphere and holding it, and also by absorbing and holding nitric acid from below the cultivated surface, so that clover plowed under decidedly increases soil fertility. In the Southern States the cowpea plowed under is a recognized renovator of worn-out lands.

According to Sir J. B. Lawes,* "the leguminous (clovers, peas, beans, etc.) are the only plants which can be said distinctly to enrich the surface soil when plowed in, and I may mention that in a case where a crop of red clover was grown by us, and twice mown for hay, the increase of nitrogen in the surface soil was sufficient to be measurable by analysis when compared with another part of the field where the grain crop was grown."

Green manure is especially valuable on light soils or heavy impoverished clay land. The crop should be plowed in at about the time of well-advanced bloom, before seed formation.

The plowing under of sod or stubble is in a measure a form of green manuring, for much

* *The Country Gentleman*, March 12, 1885.

sod land is plowed after the green growth has got well started. Those persons who have grown a crop of corn on land in clover or timothy the previous season have noted the increased yields from it, if the weather conditions were satisfactory and the tillage good.

The manurial value of feeding stuffs, as indicated by the amount of nitrogen, phosphoric acid and potash present, is shown in the following table, abstracted from a more complete table published by Dr. E. H. Jenkins, chemist of the Connecticut agricultural experiment station.* The nitrogen is estimated at 17 cents, the phosphoric acid 6 cents and the potash at 4¼ cents per pound. The prices for these substances, however, varies from time to time according to market supply and demand:

AVERAGE NUMBER POUNDS NITROGEN, PHOSPHORIC ACID AND POTASH IN ONE TON AMERICAN FEEDING STUFFS, AND VALUE PER TON FOR MANURE OF SUCH FOODS.

Green fodder.	*Nitrogen.*	*Phosphoric acid.*	*Potash.*	*Value.*
Maize fodder	**4.8**	**2.2**	**7.8**	**$1.28**
Maize silage	**4.8**	**2.2**	**7.0**	**1.25**
Rye fodder	8.4	4.8	12.6	2.23
Sorghum	4.0	1.1	3.7	.91
Clover	13.0	2.6	13.0	2.93
Cowpea vines	8.6	3.4	6.0	1.92
Dry fodder.				
Clover	36.6	13.2	44.0	8.88
Meadow hay	38.2	8.6	32.0	8.37
Timothy	19.2	7.2	29.6	4.95
Cornstalks	**13.2**	**7.8**	**17.2**	**3.44**

* *New England Homestead*, Dec. 25, 1886, p. 457.

Dry fodder.	*Nitrogen.*	*Phosphoric acid.*	*Potash.*	*Value.*
Buckwheat straw............	12.4	12.3	42.2	$4.64
Oat straw....................	10.8	5.6	32.6	3.56
Rye straw...........	14.6	7.4	20.2	3.66
Wheat straw................	16.0	4.2	17.4	3.71
Cowpea vines...............	50.2	8.2	28.0	9.91
Roots.				
Carrots........	4.0	2.2	6.0	1.06
Sugar beets.................	5.8	0.6	3.6	1.15
Globe mangolds.....	5.4	0.4	9.0	1.32
Grain and other seeds.				
Barley......................	39.6	13.4	7.6	7.76
Buckwheat...................	32.0	15.6	11.8	6.88
Cotton seed kernels..........	99.6	34.4	22.8	19.96
Cowpea seed.................	66.4	20.2	20.2	13.36
Indian corn................	**33.8**	**14.2**	**8.0**	**6.94**
Oats........	36.2	16.0	11.6	7.61
Rye...........	34.0	16.0	10.6	7.19
Wheat.......	38.0	18.4	10.2	8.00
Mill products, by-products and refuse.				
Malt sprouts.................	73.4	29.2	33.0	15.63
Cotton seed meal.....	134.6	60.6	35.8	28.04
Linseed meal............ ...	106.0	38.8	28.2	21.55
Indian corn meal..........	**29.0**	**12.8**	**8.0**	**6.04**
Indian corn bran..........	**22.2**	**9.8**	**9.4**	**4.76**
Indian corn and cob meal.	**22.9**	**10.9**	**9.2**	**4.96**
Indian corn cob...........	**8.0**	**4.4**	**14.0**	**2.22**
Hominy meal.....	**30.8**	**23.9**	**12.3**	**7.20**
Gluten meal...............	**94.8**	**9.0**	**1 2**	**16.71**
Rye bran.....................	48.8	27.8	18.0	9.83
Wheat middlings............	41.4	25.2	13.4	9.11
Wheat bran.................	47.4	60.2	32.0	13.03

CHAPTER VI.

TILLAGE.

The subject of tillage includes plowing, harrowing, and cultivating, and each will be considered by itself in the order given. It may be accepted as true that as a rule the more thoroughly the soil is prepared before planting the more satisfactory will be the crop returns. Too many farmers plow, harrow, and cultivate indifferently The ground should be thoroughly pulverized before the seed is planted. This cannot be unless the plow is held back until the ground is in shape to handle reasonably well with both plow and harrow.

Plowing.—For three successive years an experiment has been continued at the Indiana experiment station on deep and shallow plowing for corn. The soil is a dark, compact loam, with a deep layer of gravel about two feet below the surface. The usual practice at the station is for corn to follow on clover stubble, which is plowed in the spring after the clover has started growth. This corn was grown on plats permanently located for that work, which is to continue for a term of years. Where the plowing was 10 and 12 inches deep a subsoil plow followed after the common plow and loosened to the necessary depth. The results of this work, as given by Prof. W C. Latta,* are as follows:

BUSHELS PER ACRE FROM DEEP AND SHALLOW PLOWING.

Depth of plowing.	*1891.*	*1892.*	*1893.*	*Average of 3 years.*
4 to 4½ inches	49.3	52.9	16.1	39.48
6 inches	49.1	58.9	13.6	40.54
8 inches	49.8	60.0	17.1	42.28
10 inches	49.6	59.7	17.0	41.76
12 inches	46.7	61.4	17.5	42.01

Excessive drouth in 1893 accounts for the low yields of that year. The deeper plowings gave the best returns, with that of eight inches slightly in the lead.

According to the tenth census of the United States,† on the basis of the question, "How deep is the soil usually plowed for corn?" the great majority of the answers from the leading corn-producing States were from six to eight inches, some being as low as five and a very few as high as nine. In a further consideration of this subject Prof. Brewer says:‡ "In

* Bulletin 50, Vol. V, Purdue University agricultural experiment station, April, 1894.

† Tenth Census of the United States. Report of the Productions of Agriculture, Washington, 1883, p. 98.

‡ *Ibid.*

States of gravelly or loamy soils, where the yield is rarely high but is rather certain, and where corn follows clover, it is the custom with many excellent farmers in planting on such sod to plow shallow, not more than three, three and one-half or four inches deep, but in the after-cultivation to plow the corn in summer very deep." On heavy, cold sod land, plowing a depth of five to six inches will no doubt be more satisfactory than at a greater one. On light, easily broken soil, the plow may run deeper to advantage. Under circumstances where drouth may occur somewhat better results may be looked for from the deep plowing.

Harrowing.—Having the land properly plowed, it should be reduced to a fine tilth by the use of the harrow. On sod land a disk or cutaway harrow can be most efficiently used to tear and pulverize the overturned turf. This may be followed by a smoothing harrow that will prepare a smooth, fine seed bed. If lumps or clods occur that do not easily break under the harrow they should be broken either with a roller or plank drag. Three oak planks, each about six feet long, ten inches wide and two inches thick, chained on lap edges like weather boarding, and drawn broadside over the field, will rapidly crush obnoxious clods.

Cultivating.—Even before the corn plant has appeared above the surface it may be desirable to cultivate (or lightly harrow), especially if warm rains have occurred and the weeds are vegetating fast. Too much stress

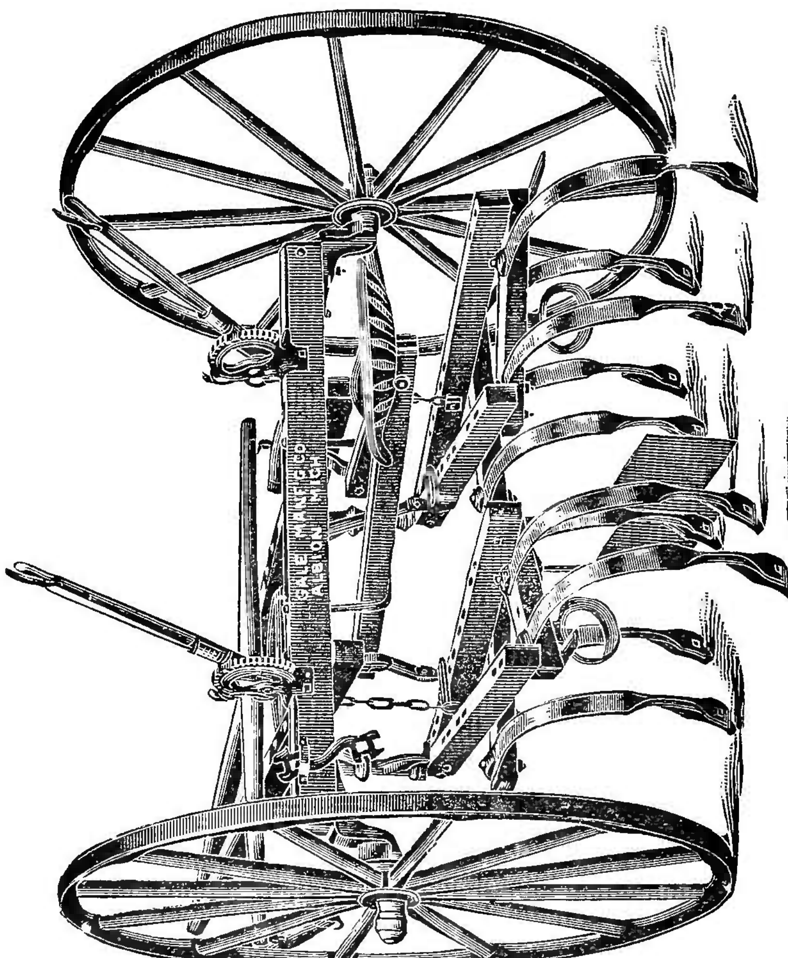

FIG. 18.—ALBION CULTIVATOR.

cannot be laid upon clean, thorough cultivation of the growing crop. The soil should be kept well stirred in time of drouth, and at all times frequently enough to keep the weeds in subjection. The farmer cannot afford to grow a crop of weeds on the land with his corn, for

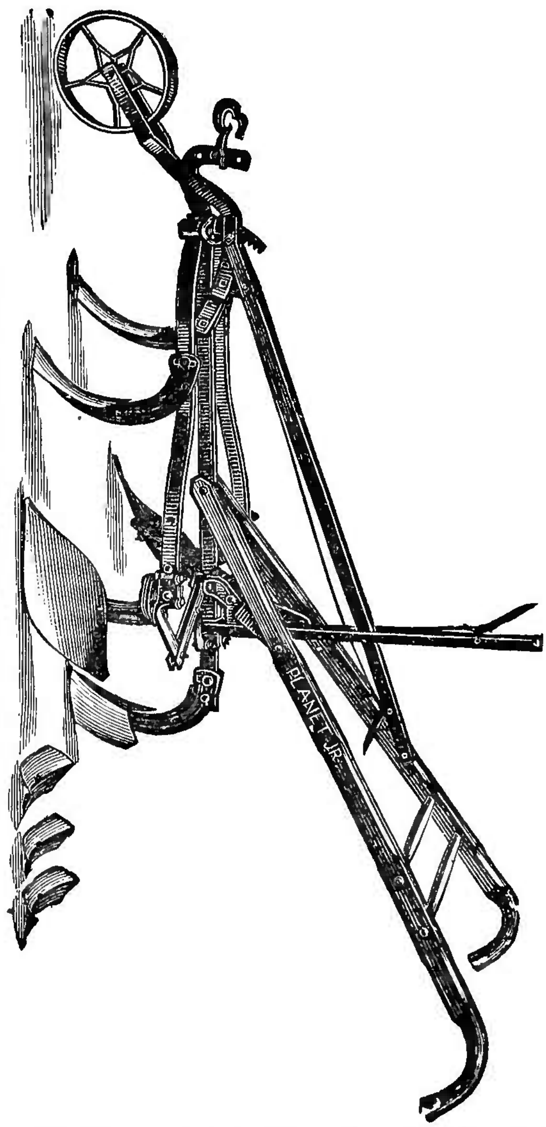

FIG. 19.—PLANET JR. CULTIVATOR, WITH SIDE HOES.

not only will they feed on the food which the corn should eat, but they will pump off needed soil moisture in time of drouth and interfere with the economical handling of the crop at harvest.

The frequency of cultivation will mainly depend upon the conditions of soil moisture

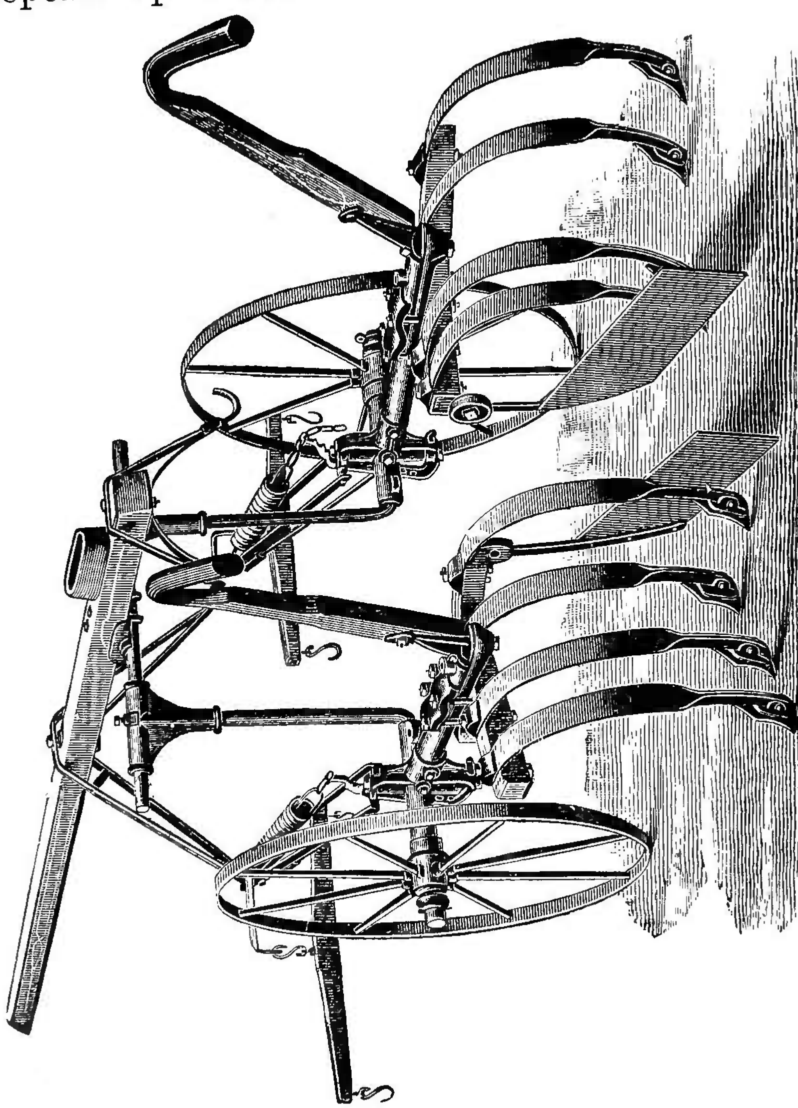

FIG. 20.—REINDEER SPRING TOOTH CULTIVATOR.

and weed growth. If drouth prevails stirring the soil will conserve its moisture. If weeds occur they should be eradicated. For five years Prof. G. E. Morrow conducted a series of experiments at the Illinois experiment station upon the influence of frequency of cultivation upon the corn crop. The average results for the five years ending 1893 are as follows:*

Kind of cultivation.	*Yield in bushels.*
Not cultivated; scraped with hoe (two plats)....	68.3
Shallow, ordinarily frequent....................	70.3
Deep, ordinarily frequent	66.7
Shallow, frequent........	72.8
Deep, frequent..................	64.5

The general results thus favor frequent shallow cultivation, though the increased yield will warrant the employment of but little extra time over that of ordinary frequency.

At Purdue University we ordinarily plan for at least five cultivations during the season.

At the Kansas experiment station quite a number of plats of corn have been submitted to frequent cultivation tests. The average results of three years' trials, as given by Prof. C. C. Georgeson, are as follows.†

Times cultivated.	*Times cultivated during season.*			*Yield in bushels.*
	1891.	*1892.*	*1893.*	
Twice a week	9	11	14	40.3
Once a week	6	6	7	41.3
Once in two weeks.	4	3	4	40.9

* Bulletin No. 31, March, 1894, Illinois agricultural experiment station, p. 355.

† Bulletin 45, December, 1893, Kansas agricultural experiment station, p. 131.

There is no gain found in frequent cultivation, but instead a slight loss. This loss may be due to excessive root-pruning. Where corn was cultivated, however, once in three and once in four weeks a material loss in yield occurred. It would appear that three to four

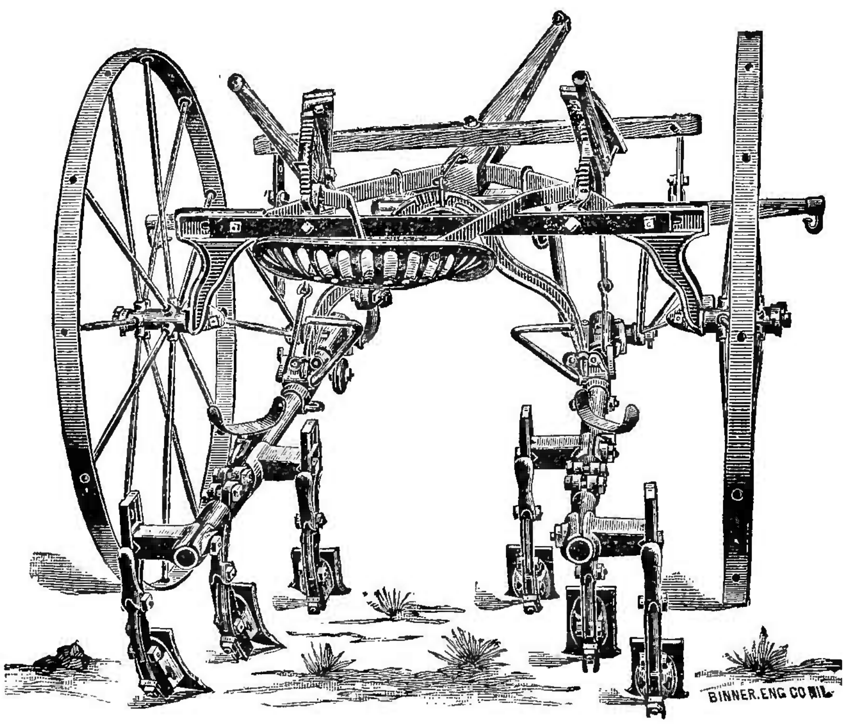

FIG. 21.—STANDARD RIDING CULTIVATOR WITH SIX SHOVELS.

cultivations a season, according to circumstances, might be recommended as a general rule.

Depth of cultivation should be shallow rather than deep. The roots of the corn plant, while penetrating several feet below the top of the ground, are essentially surface feeders. At a depth of three inches for a radius of two feet about the plant may be found a great number

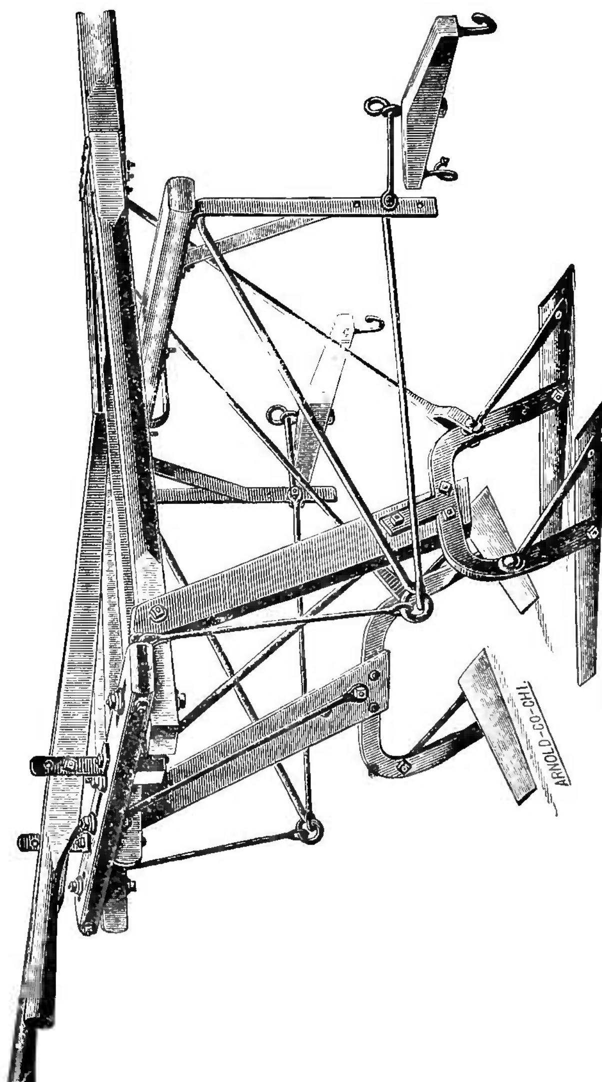

FIG. 22.—BRADLEY GOPHER CULTIVATOR.

of fine roots. It is not desirable to cut these roots more than possible, consequently the cultivation must necessarily be shallow.

At the Purdue University experiment station Prof. Latta has found the average results of cultivating corn for six years, at depths of one, two, and three inches, to have been decidedly in favor of shallow culture, the average yields being 51.06 bu. for one inch, 50.09 for two, and 48.73 bu. for three inches.* By referring back to the report on frequency of cultivation at the Illinois station it will be noted that the shallow gave an increase of four bushels per acre over that of the deep in both ordinary and frequent

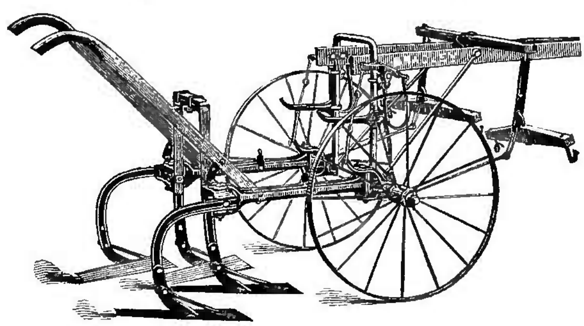

FIG. 23.

cultivation. Figs. 22, 23 and 24 show three interesting forms of culivators specially made for shallow culture.

The root-pruning of corn directly bears upon the subject of depth of cultivation. Some years ago attention was directed to this subject. In 1882, at the New York experiment station, root-pruning of corn was compared with that not root-pruned, by Dr. E. L. Sturtevant, with

*Bulletin 50, Vol. V, April, 1894, Purdue University agricultural experiment station, p. 48.

contradictory results.* This work was carried on more extensively in 1883, and the pruning

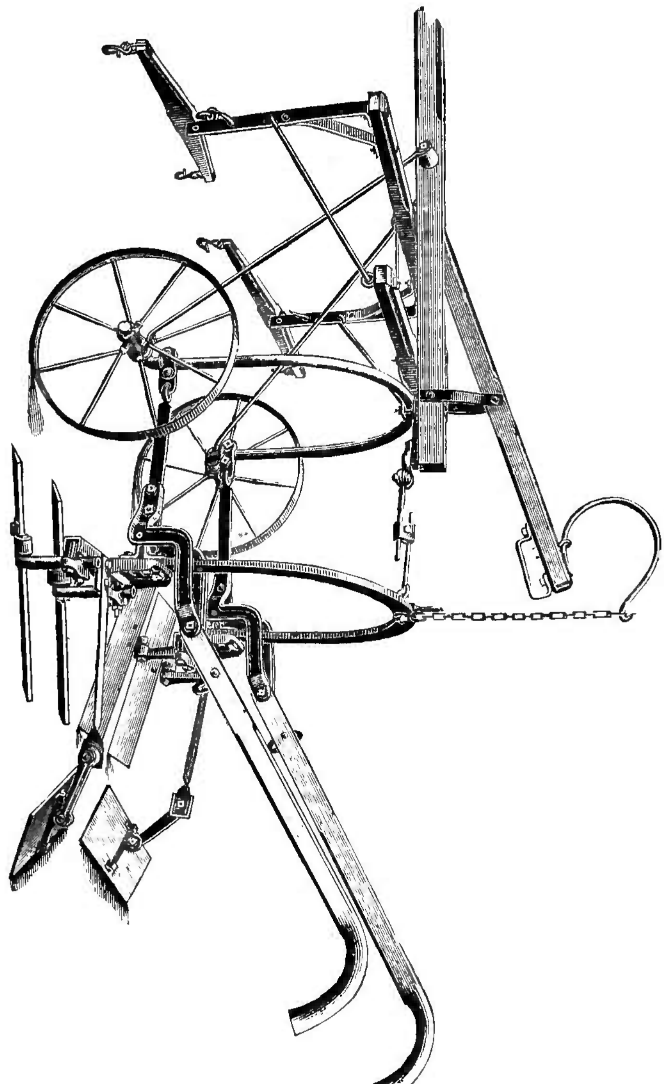

FIG. 24.—TOWER CORN CULTIVATOR.

was found to be detrimental to the plant and

* New York agricultural experiment station. Report for 1882, p. 53.

yield.* Of seven comparisons all but one were very much adverse to pruning.

At the Minnesota station Prof. W M. Hays found† that the root-pruned plats averaged nearly three bushels of corn and 800 lbs. of fodder less per acre than the plats not root-pruned. Another year root-pruning was found to diminish the yield of grain 13½ bushels per acre.

A number of years of comparison of root-pruned with unpruned corn at the Illinois station, by Prof. G. E. Morrow, has shown a general injury from the root-pruning.‡ In 1893 the yield per acre was 100.3 bu. for the unpruned as against 78.8 bu. for the pruned—a very material difference.

The above results show the necessity for shallow cultivation and the injurious results of breaking off the surface corn roots. Set the cultivator so that the teeth will run shallow. The weeds may be easily destroyed by cultivating at a depth of about an inch if the work is done in reasonable season.

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*New York agricultural experiment station. Report for 1883, p. 134.

†Bulletins Nos. 6 and 11, Minnesota agricultural experiment station.

‡Bulletin No. 31, March, 1894, Illinois agricultural experiment station, p. 357.

CHAPTER VII.

PLANTING.

In planting a seed numerous factors must be considered as having an important bearing on the quality and quantity of the crop. These factors will be considered under the following headings:

Time of planting.
Rate or distance apart of planting.
Drills vs. hills.
Depth of planting.
Listing.

Time of planting.—Necessarily two important conditions influence the date of planting corn, viz.: geographical location and temperature of soil. Brewer says* that the most common rule observed as to time of planting is that derived from the Indians on the settlement of New England and the Middle States, to "plant corn when the leaves of the white oak are as big as a squirrel's foot," or as another saying states it, "as big as a squirrel's

*Tenth Census. Report on the Productions of Agriculture, Washington, 1883, p. 98.

foot or mouse's ear." There is considerable significance in this in fact, as the oak is tardy in showing its leaves until the ground has had its spring warming. Corn not only requires a warm air temperature to grow well in, but the soil must be reasonably warm. A temperature of the soil to a depth of one inch of from 50 to 60 deg. Fahr. will justify planting. In the great corn belt planting begins about May 1 and often extends over the entire month. If the ground is ready it is not wise to hurry the seed into the ground too soon, as the vitality of the seed or young plant may be seriously impaired by being exposed to cold rains which often follow stretches of warm April weather. The fo llowing table shows the results of early and late planting conducted by Prof. Latta at the Purdue University experiment station* The experiment began

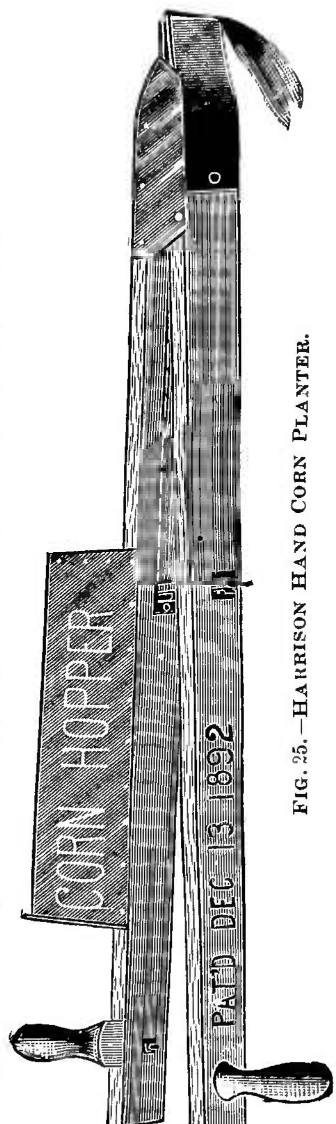

FIG. 25.—HARRISON HAND CORN PLANTER.

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*Bulletin No. 50, p. 45, Purdue University agricultural experiment station.

in 1888, and excepting 1891 has been continued ever since. The yields for May 1 and May 28–30 are averages for four years; those for May 15–16 for three years; the others for five:

Date planted.	*Yield in bushels.*
May 1	46.64
May 8–11	45.56
May 15–16	36.18
May 21–22	41.41
May 28–30	35.75

At the Illinois experiment station Prof. Morrow found,* as the average of six years' work,

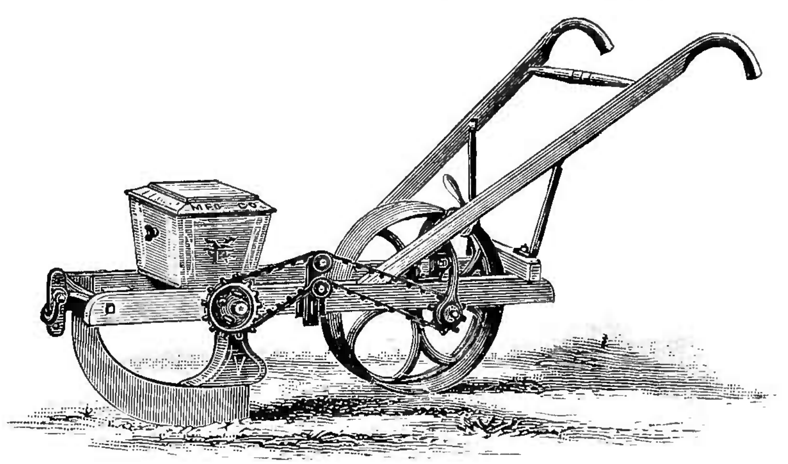

FIG. 26.—FARMERS' FAVORITE ONE-HORSE CORN DRILL.

the largest yield (62.3 bu.) to come from corn planted from May 4 to 9, although there is but a slight falling off below these dates for plantings ranging from April 27 to May 2 and May 11 to 16.

At the Ohio station the largest yields are

*Bulletin 31, Illinois agricultural experiment station, March, 1894, p. 352.

given from plantings made from May 13 to 15.*

In the Southern States planting begins several weeks earlier than in the Northern ones, and with a much longer season for maturity, so that time of planting is not of so great significance, as for example in Wisconsin, where some varieties will not mature at all, while others will barely mature before killing frosts. Every one will have to be his own judge for his special conditions, but it will be well to watch for the young oak leaves and note the temperature of the soil.

Rate or distance apart of planting.—It may be accepted as true that where corn is grown for the grain each plant should have an opportunity for its fullest development. With soil of the same character and fertility it would not be best to plant an acre of the same corn in New York and Tennessee under equal conditions as regards quantity of seed. A less amount would do where the plants grew large and robust; consequently we find a person in one latitude growing one or two stalks in a place, while in another locality, with less favorable conditions, three or four stalks are grown.

At the Georgia station, in tests as to distance of corn grown in hills, 5x4 feet apart gave the

*Annual report Ohio agricultural experiment station for 1888, p. 80.

largest yield per acre. In reporting on this test Director Redding says: "The season of 1890 may be considered as about an average one, and therefore the results of this experiment may be taken as indicating that a distance of 5x4 (or 2,184 stalks to the acre) is not too great for such land."*

In South Carolina in experiments conducted at Spartansburg, Columbia and Darlington on distance apart of planting, the hills ranged from 5x3 to 6x3 feet, and the drills from five to six feet apart. These experiments indicated that

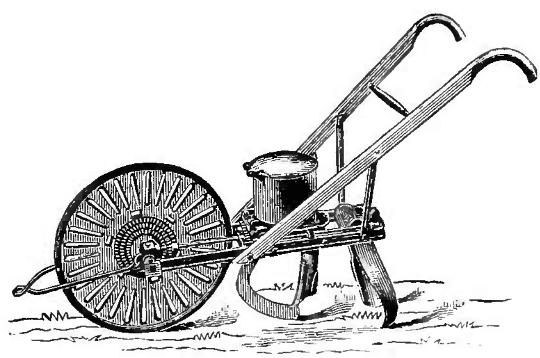

FIG. 27.—FARMERS' FAVORITE ONE-HORSE FRONT RANK CORN DRILL.

"it made little difference whether the rows were five feet or six feet apart or the checks 5x3 feet or 6x3 feet."†

At the New York experiment station numerous experiments with Waushakum corn, ex-

* Bulletin No. 10, December, 1890, Georgia agricultural experiment station.

† Second annual report South Carolina experiment stations, 1889, p. 252.

tending over four years, gave the most satisfactory yields where four to five stalks grew in hills 42 by 44 inches apart.*

At the Illinois station elaborate experiments with dent corn have been carried on since 1888 on number of kernels planted per hill and the distance apart of the hills. As a general thing the largest yields occurred from planting four kernels in a hill, and the average yield of 69.5 bu. of air-dry corn was the greatest amount secured, and this by putting four seeds in hills four feet apart.†

At the Purdue University station the relation of thickness of planting to yield has been studied for eight years.‡ The average results of this work show no material difference in yields where stalks are practically 11, 12 or 14 inches apart, but for distances exceeding this there is a gradual falling off in yield.

In an interesting article on "Distance apart in planting corn," D. S. B. of Hartford, N. Y., says:§

"The distance, after years of experiments on average soils is, in my opinion, 33 inches or six to the rod. This with good tools renders cultivation easy and rapid, and with three

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* Annual reports New York agricultural experiment station for 1882, 1883, 1884, 1885.

† Illinois agricultural experiment station Bulletin 31, March, 1894, p. 354.

‡ Purdue University agricultural experiment station, Bulletin 50, April, 1894, p. 46.

§ *Country Gentleman*, March 18, 1886.

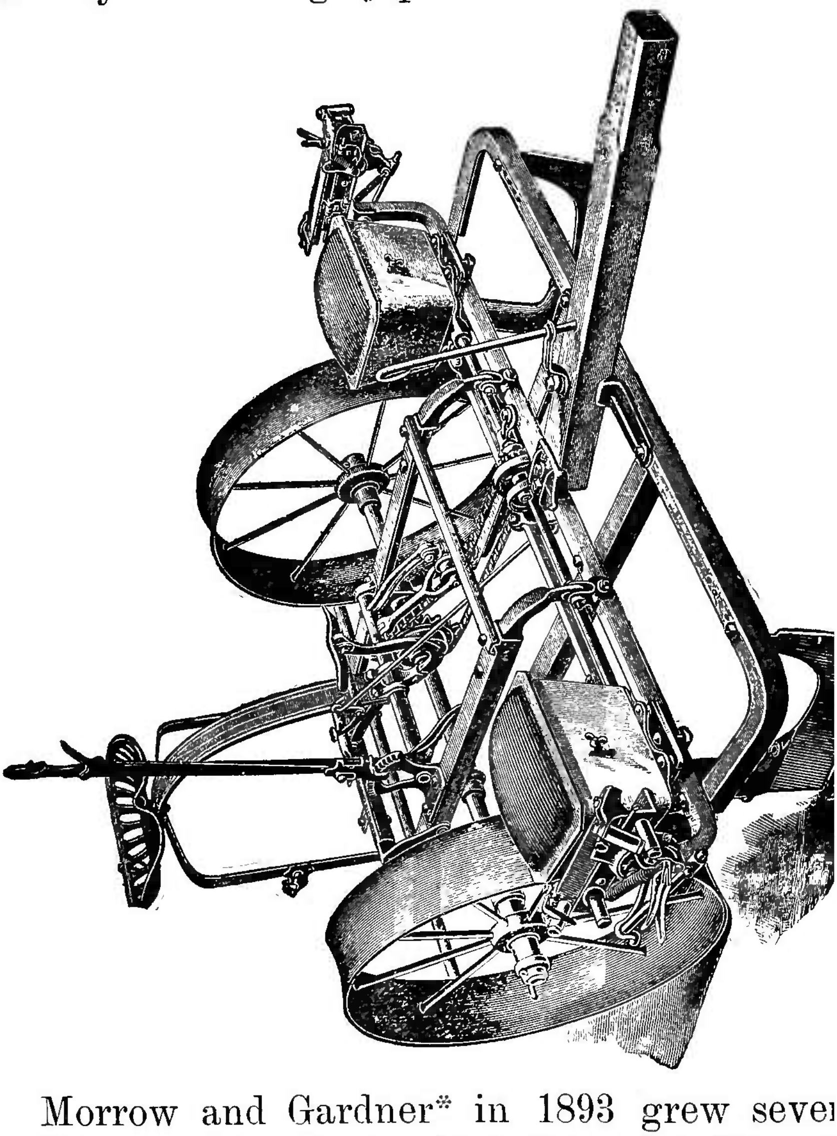
or four stalks in the hill covers the ground thoroughly, smothering, to a certain degree, weeds in the latter part of the season, and yielding maximum crops of grain and fodder. On some soils, with plenty of manure, 30 inches have given the best results, but not so invariably as 33 inches. At the latter distance the ears will be as sound and well developed as at a greater, but not so long; at the same time there will be a larger number, making the yield the same. The fodder is much superior to that grown at greater distance, stock consuming it with little waste, as it is fully developed and if cut at the proper time and properly cured makes superior feed for cows."

This probably applies to flint corn. For the large western dent corn this distance is too close.

If corn is to be planted in hills, in the North as a rule 36x42 inches will prove satisfactory for the large varieties; and if in drills, one kernel every foot in drills 42 inches apart. In the South these distances may be increased to suit conditions.

Drills vs. hills.—Experimental work thus far conducted indicates that it makes but little difference, so far as yield is concerned, whether corn is grown in drills or in hills. Cleaner cultivation can be maintained with the hill system, as the soil may be stirred on all sides of the group of plants. A field of drilled corn, however, by going up and down between the rows, can be kept creditably free of weeds and may require less labor in hoeing than will that planted in hills. In New England and the

Middle States most of the corn is grown in hills, but in the Central West and South the drill system is largely practiced.



Morrow and Gardner* in 1893 grew seve half-acre plats of corn in hills and drills, an

*Illinois agricultural experiment station. Bulletin 3 March, 1894.

found practically no difference in yields. This is in accordance with previous experience.

At the Connecticut State experiment station corn was planted in drills four feet apart, with plants 10 inches apart in the row, and in hills 48 by 40 inches four plants to the hill, and 48 by 20 inches two plants per hill.* The drilled corn gave about six per cent more dry matter and a larger yield of each food ingredient. The composition of the grain was about the same, whether hill or drill grown.

At the South Carolina stations, as already noted, it made no practical difference in yield whether the corn was planted in hills or drills.

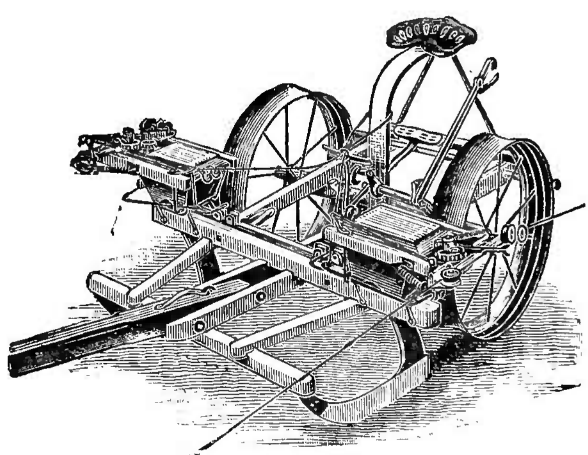


FIG. 29.—CHALLENGE CORN PLANTER.

Where land is fairly level, and the corn crop is an item of special importance on the farm,

* Annual report for 1890 Connecticut State agricultural experiment station, p. 183

on well-prepared land the drill system will be most economical in rapidity of planting and cultivating. This means, of course, that a modern horse corn-planter shall be used.

Depth of planting.—On warm, light soil, the seed should be planted deeper than where it is cold and retentive. The process of vegetation is slower on cold than warm land, as the temperature is lower at the same depth below the surface. In summer if a drouth occurs the greater depth of planting on the light soil is beneficial to the growing crop. If a low river bottom is the corn field, shallow planting will do, as crops rarely suffer from lack of moisture in such a location. Generally speaking the writer believes one and a half inch a satisfactory depth to plant the seed.

As bearing on this subject, the following table of results of experiments on depth of planting, conducted at the Ohio and Illinois experiment stations, is of interest.* The Ohio experiments are average results of six years' work (1883-1888) and those of Illinois of five years' duration (1888-1893):

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* Bulletin No. 31, Illinois station, March, 1894, and seventh annual report of Ohio station, for year 1888, p. 81.

YIELD IN BUSHELS PER ACRE FROM CORN PLANTED AT DIFFERENT DEPTHS.

Year.	Depth planted in inches.							Station.
	1.	2.	3.	4.	5.	6.	7.	
1883	86.3	60.8	50.7					Ohio.
1884	36.9	37.4	41.6					
1885	72.5	64.8	62.5					
1886	58.9	41.3	32.3					
1887	33.7	32.9	28.1					
1888	96.2	93.0	.....					
Average	64.0	55.0	43.0					
1888	109.7	84.4	100.8	88.0	73.1	60.3	....	Illinois.
1889	83.0	83.0	51.0	87.0	81.0	92.0	....	
1890	77.8	72.8	70.3	58.4	62.3	60.3	....	
1892	65.8	64.7	62.7	70.3	56.5	58.5	40.5	
1893	51.3	48.7	40.7	40.0	33.4	29.0	....	
Average	77.5	71.5	65.1	68.8	61.2	60.0	40.5	

At the Ohio station it is to be noted that the shallow plantings gave decidedly the best returns, and at the Illinois station the same practically holds true. It is important to note, however, that the Ohio "corn planted three and four inches deep seemed to retain its vitality longer than that planted at less depth. The roots of the deep-planted corn were found, as we should naturally expect, much deeper in the soil than where the corn was planted more shallow; hence their opportunity to secure food and moisture was materially enhanced." The experiments in both States were conducted on deep, retentive soils.

Listing.—The listing process is peculiarly a Western one, practiced on the big corn fields of Iowa, Kansas, Nebraska, and the other great corn-growing States west of the Mississippi. In 1886 the *Farmers' Review* published* a number of articles on listing, one of which, by Nelson Cowles of Dakota City, Neb., is so clear in explaining the process that it is inserted here in the main:

"The listing plow consists of a double share and mold board, or a right and left-hand plow, so joined together as to

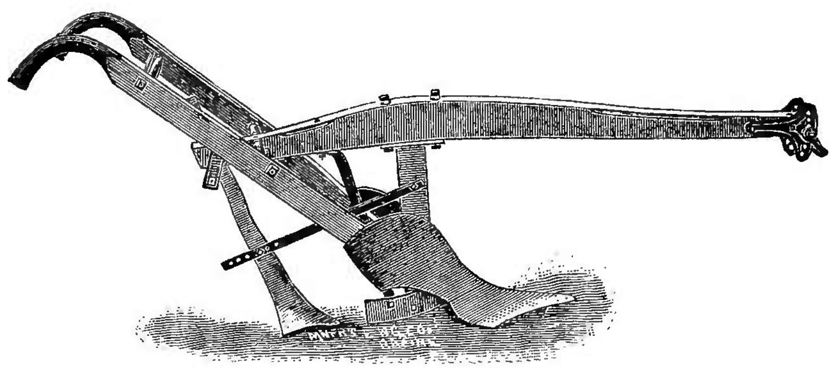

FIG. 30.—LISTING PLOW.

turn the soil both ways from a common center. Attached to the plow is a small subsoiler which loosens the soil in the bottom of the furrow. There are two classes of the different makes of listers, the single and the combined. When the single lister is used a common Hoosier drill follows the plow in the furrow and plants the corn. In the combined implement a drill is attached directly to the plow, thereby saving the labor of an extra man and horse, and if the implement is properly constructed works equally as well.

"There are methods of listing corn known as 'single' and 'double' listing. In the single method work is not com-

* *Farmers' Review*, April 21, 1886.

menced until planting time, when the lister is used in the hollows or middles between the old corn rows, or else on fall-plowed land, where the lister is run through the field from three to four feet apart, according to the soil, kind of corn planted, and judgment of the operator. The single method seems better adapted to sections of uncertain rainfall, being only one-half the labor of the double plow, which is as follows: As soon as the stalks are cleared from the field in the spring, the listing plow, with drill removed, is put at work splitting the old corn rows, thus filling the middles and forming a new ridge therein. This preparation gives drainage and opens the soil to the warming influence of the sun. Then when planting time comes the drill is attached and the new ridge is divided, and the corn planted in the furrow thus made, the drill dropping the corn, one kernel in a place, from 8 to 20 inches apart, as the operator may choose. By this plan more thorough tillage is secured. * * *

"In cultivating after the corn is up the field is gone over with a planker, or what is far better, a smoothing harrow, which smoothes the ridge and prepares the ground for the cultivator, which is used with but one shovel on each side of the row the first time and both shovels afterwards."

Concerning the merits of listing there is much diversity of opinion. At the Kansas experiment station this practice has been commended on the basis of experimental returns.* Four plats listed, compared with four given surface planting, showed a small gain for the former—about four per cent. At the Minnesota station results somewhat unfavorable to listing were secured in 1888.† Francis Mc-

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* Kansas agricultural experiment station. Report for 1889, p. 19.

† Minnesota agricultural experiment station. Bulletin No. 5. 1888.

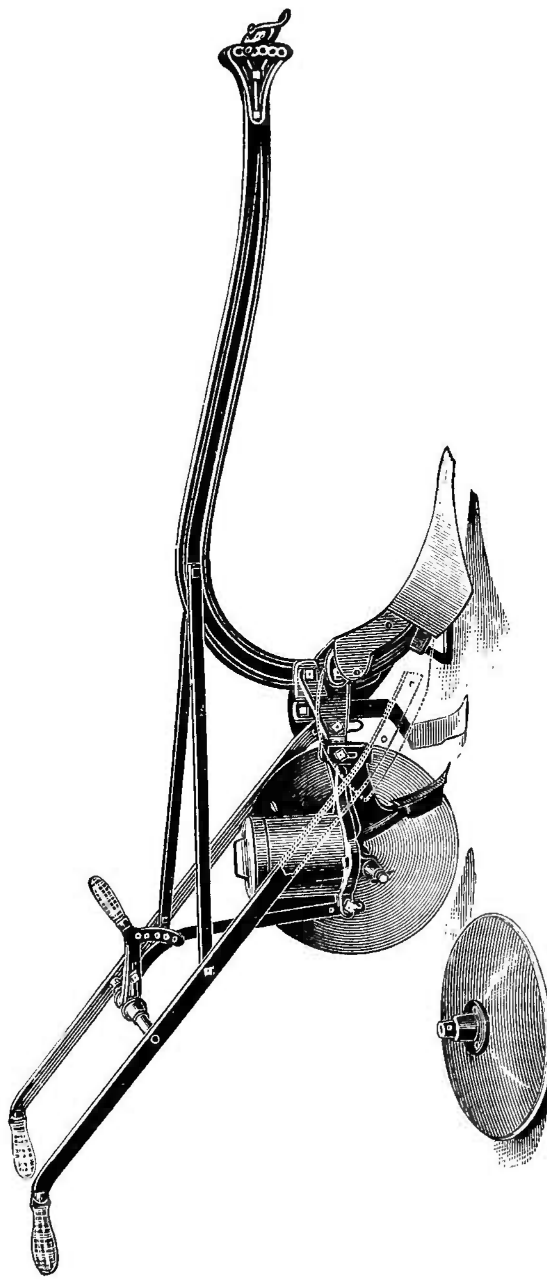

FIG. 31.—ROCK ISLAND DISK LISTER.

Kenzie, in the *Farmers' Review* (April 21, 1886), states that he believes listing is of doubtful utility excepting in very sandy land where the rainfall is deficient. On ordinary prairie land he prefers the standard method. Another writer in this same journal expresses no faith in listing where there is abundant moisture and heavy soil. Prof. Georgeson of Kansas says:*

"Deep planting by the use of the lister is undoubtedly the best means to tide over a drouth. Here in Kansas, where the rainfall is somewhat uncertain, the majority of the farmers list their corn, and in a dry season listed corn frequently yields a fair crop when surface-planted corn is a failure. The roots of listed corn are not so near the surface and they therefore do not feel the drouth so severely. For this same reason listed corn can be cultivated deeper with impunity. But the lister cannot be used to advantage everywhere, especially where the rainfall is usually sufficient to supply the needs of the crop. In such regions listed corn would be liable to be drowned out unless the soil was well drained: Again, on stiff clays listing cannot be practiced with the same advantage as it can on the black prairie mold."

Mr. J. M. Boomer of Kansas says in the *Breeder's Gazette* (Feb. 13, 1895,) that he has been listing corn for fifteen years, and nine-tenths of the corn in his neighborhood is listed. He plants with a single-horse drill, dropping the kernels 15 inches apart. He prefers a single drill to a double one, because if the rows are not just the right distance apart the two-

* *Indiana Farmer*, June 30, 1894.

horse drill does not drop in the middle of the furrow as a single one will. A man and a boy with four horses will list and plant seven acres per day. He prefers listing to plowing the ground and planting on top, as it is more easily done, the land is more easily cultivated, and consequently it is cheaper to raise it in this way. The corn stands the drouth better, does not blow down like top-planted corn, and yields more per acre.

The advantages claimed for this process are: (1) economy of labor, (2) more thorough tillage, (3) ability of the crop to withstand drouth, and (4) increase of crop.

CHAPTER VIII.

HARVESTING.

The general results of investigation indicate that when the kernel on the ear has become glazed or hard on the surface, even though somewhat soft within, it contains as much nutriment as it will possess at any time. Further ripening does not seem to materially affect the grain composition.

Time for cutting.—In experiments at the Iowa station* five plats were cut at periods varying from Sept. 17 to Oct. 13. Plat I was cut when the kernels were "in the dough," not quite all dented, and leaves green; plat II, kernels well dented and leaves just beginning to dry; plat III, kernels ripened and blades about half dry· plat IV kernels thoroughly ripened and blades and husk rapidly drying up; plat V, blades and husk nearly all dry. There was no noteworthy difference in crude protein in the dry matter between the first and last cut-

* Bulletin 23, Iowa agricultural experiment station, 1893, pp. 874–880.

ting. The widest variation in per cent of carbohydrates was less than one per cent, while there was a slight increase in fat from first to last cutting. In any case the feeding value of the corn does not seem to be affected. As might have been expected, the corn-fodder was injured in quality by delaying cutting after the grain was mature. There was a depreciation in crude protein in the fodder from 8.47 in plat I, to 4.05 per cent in plat V, and this loss increased from week to week. Fodder that was left uncut in the field till December was materially damaged. There was also a great loss in fat, this per cent falling from 1.11 to 0.29 per cent. There was something of an increase in crude fiber and carbohydrates, but this would not affect the loss of the more important food components. The largest amounts of dry matter from an acre, 6,782 lbs. in fodder and kernels combined, was secured from the second cutting.

Among the conclusions reached, as based on this study, are the following:

"(1) The stover of a crop of corn seems to reach the highest yield and the best condition for feeding at the stage of growth indicated by a well-dented kernel and the first drying of the blades. (2) The grain of a crop of corn seems to reach the highest yield and the best condition for utility at the stage of growth indicated by a well-ripened ear and half-dried blade, and the best time for securing the crop with reference to the highest utility of both corn and stover would be found at a stage of ripening between the above."

These general results and conclusions are such as have been accepted on the basis of previous investigations. At the Kansas station corn cut in the milk stage (Aug. 20) yielded 35.5 bu. grain and 2.4 tons of fodder per acre: in the dough (Aug. 28), 51 bu. grain and 2.4 tons fodder; when ripe (Sept. 18), 74 bu. grain and 2.7 tons fodder.* These results agree with work at that station for the three years in succession.

Cutting for silage.—Where corn is cut for silage the crop should be harvested when well glazed or dented. At the Minnesota station, where corn grown for silage was cut from Sept. 4 to 24, the dry matter in a dent variety increased from 11.4 to 19.7 per cent, and in a sweet variety from 9.1 to 13.3 per cent.† At the New York State station the dry matter per acre in B. & W corn cut for silage Sept. 11 was 5,004 lbs., and on Sept. 29, 5,660 lbs. In 1889, with King Philip corn, there was an increase in the total amount of dry matter and in the nutritive value of its constituents as the crop approached maturity.‡ At the Cornell University station similar returns were secured

* Kansas agricultural experiment station, Bulletin No. 30.

† Minnesota agricultural experiment station, Bulletin No. 7.

‡ New York State agricultural experiment station. Seventh annual report, 1889, p. 88.

from Pride of the North corn.* The Wisconsin station recommends the cutting of flint varieties for silage when just past glazing and dent varieties when "well dented."† In an interesting experiment at the Pennsylvania station by Hunt and Caldwell, to ascertain the food value of corn-fodder cut at different stages of ripeness, of three cuttings (Sept. 1 and 2, Sept. 25 and Oct. 7 and 8), the best results came from that cut Sept. 25. Cows fed on medium mature corn-fodder produced the largest quantity of butter-fat at the least cost, the late-cut fodder gave the next best returns, while the early-cut made the poorest showing.‡

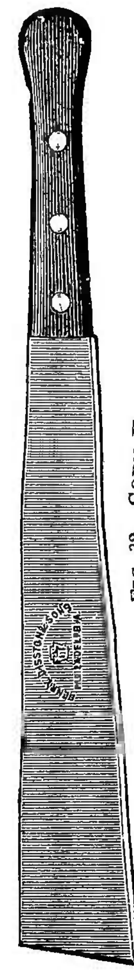
FIG. 32.—CORN KNIFE.

Methods of cutting.—At the present day most of the corn cut for the silo or for shocking is cut by hand with a corn knife. In the West a popular knife has a straight blade (see Fig. 32) about 20 inches long, two inches wide, and rather heavy on the back. In the East a knife with slightly-

*Cornell University agricultural experiment station, Bulletin No. 16.

†Wisconsin agricultural experiment station. Annual report for 1889, p. 126.

‡Pennsylvania State college experiment station. Report for 1892, pp. 34–43.

curved blade, set in the end of a short handle, blade and handle forming an obtuse angle, makes a favorite hand knife. Some people use a grass hook or sickle from preference. The straight-bladed corn knife is unsurpassed for rapid and effective hand work.

Corn-harvesting machinery.—Within a few years machines have been devised for cutting corn by horse power. One method has been to haul between two rows a drag with wings on one or both sides, to which knives are attached. The Buckeye machine (Fig. 33) is one of the most approved types of this class. It is carried on four wheels and is pulled by one horse. In the center of the machine is a tripod with a seat on which two men may sit, one on each end and back to back, each facing a row of corn and grasping the stalks as cut. When not in use the wings with knives may be laid up against the tripod. The knives adjust to leave stubble 6 to 14 inches long as desired.

The self-binding form of the harvester, however, promises to be the important one of the future. In the *Rural New Yorker* of June 20, 1891, Prof. I. P Roberts of Cornell University described a machine he devised for cutting and binding corn. This machine was improved by D. M. Osborn & Co. Since then a number of firms have placed self-binders on the market. The Deering Harvester Co. construct a machine

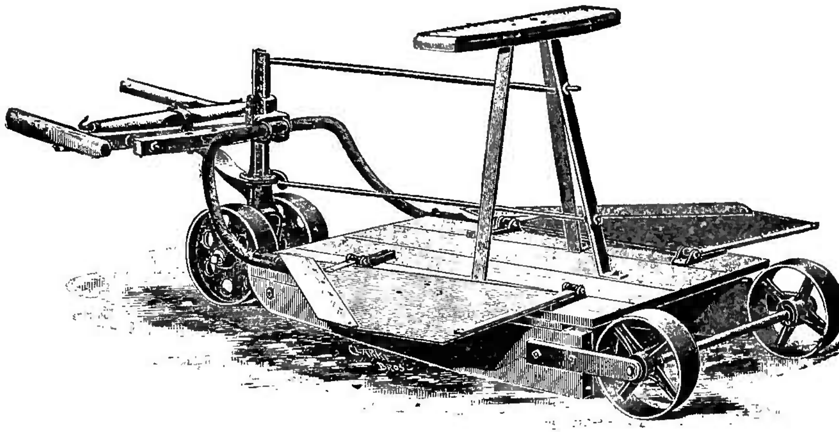

FIG 33.—BUCKEYE CORN HARVESTER.

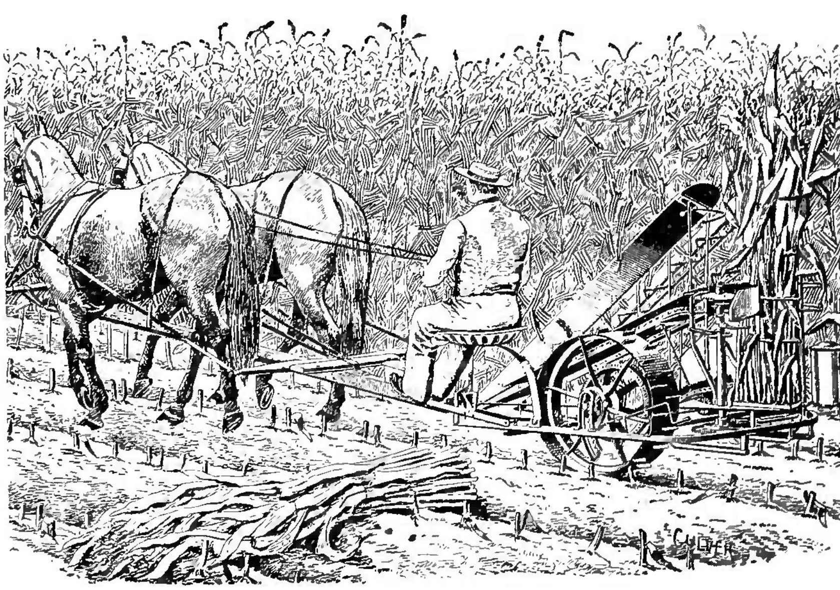

FIG. 33 *a*.—THE McCORMICK CORN BINDER.

which runs on two 38-inch wheels. Two wide gatherer arms embrace a row of corn and guide the stalks to the point where they are cut while standing upright, being pressed against a long, sharp slanting knife. The corn is seized by the strong fingers of a rotary ledger plate and pressed against a long beveled knife. As soon as the corn is cut it is taken up by gatherer chains and laid on the binding deck, tassels backward and bound and discharged, the bundles being tossed off lengthwise between the wheels.

The McCormick Harvesting Co. also make a self-binder (see Fig. 33 *a*) that is being used with much success. The stalks are cut off near the ground and carried in a vertical position to a modified form of the common self-binder, where they are bound in bundles with the butts square and in good shape for shocking. The bundles are thrown off to one side. Ordinary binding twine is used. The machine is adjustable to short or tall corn and may be tilted up or down to pick up sprawling stalks. The McCormick and Osborn machines in a trial at the Indiana experiment station did very satisfactory work.

There has within the past year been a large sale of these self-binders. The Deering Co. state that they are unable to supply the demand, and the McCormicks have sold more than

10,000 machines since making their exhibit at the Columbian Exposition.

Where corn culture is engaged in to an extensive degree the self-binding harvester is a great labor-saving machine, while where less corn is grown the simpler knife harvester can be used to advantage.

In hauling silage corn or fodder a low-down wagon is a great improvement over the high wheels. Fig. 34, re-engraved from the *Country Gentleman*, represents a method of carrying a load close to the ground. It is made by inserting a reach 20 feet long, made of a round pole

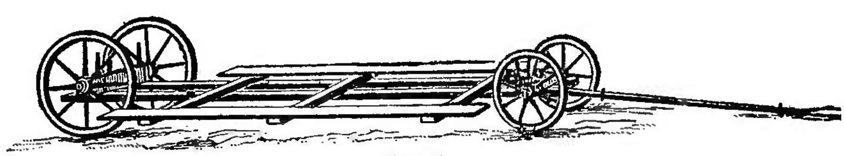

FIG. 34.

bending down with a foot curve. Closely under the axles two stiff timbers over 20 feet long are chained to the axles, and cross pieces 7 feet long are spiked on them to support the two broad boards or planks which are outside the wheels. A platform is thus formed 7 feet wide, over 14 feet long, only a foot above ground. Small wheels may also be bought for common axles, replacing high wheels.

Shocking the corn.—The number of hills or amount of rows which may be placed in one shock to best advantage depends upon the class of corn, whether large or small. If grown in hills, and of medium-sized plants, ten hills square (100 hills) will make a good shock. Of smaller corn, 144 hills may be put into a shock, while of very large corn 81 hills makes a plenty. Yet there is a difference of opinion on this subject and many place over 100 hills of fairly large corn in one shock. However, a medium-sized shock cures out more rapidly than a large one and the ear becomes fit for storing at an earlier date.

Where corn is grown in drill rows about 40 feet each of eight rows will give material enough for a good shock. A medium-sized shock should have a circumference at its base of about 25 feet. Anything much over that might be termed a large shock.

Where wheat is to be sown in the corn rows the shocks should be larger and further apart. Under such circumstances they should be as large and as far apart as economy of labor in construction will permit. Waldo F Brown, in writing of his new method of shocking on wheat seeded corn land, says:*

"We cut the corn and put 10 rows in a shock row, but only eight hills the other way, and in a few days when the corn has dried out so as to reduce the weight about one-half we carry one shock from each side and set around the middle one, which gives us 240 hills to a shock and makes our shock rows 30 rods apart. We do this handling in the morning when the dew makes the fodder tough to handle, and as the

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* *Farmers' Review*, Sept. 26, 1888.

fodder is partly cured we can make the shocks this large without danger of their moulding. If wheat is not sown I prefer 100-hill shocks and husk them as soon as cured."

Careful shocking necessary.—In shocking it is important that the shock be set erect and held firmly in place until husking, so as to keep the contents dry from rain and not retard proper curing of both fodder and grain. A shock that has been blown over and well soaked with water is materially damaged. If the shock is properly placed about one uncut hill, or two hills with plants bent part way

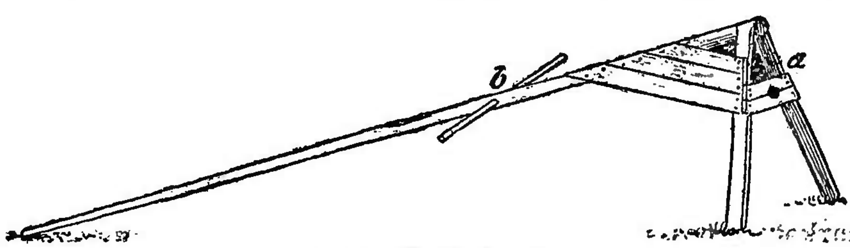

FIG. 35.—CORN HORSE.

over and twisted together, it should not blow down. Care should be taken to place an equal amount of stalks on each side of the shock. If the central hill is cut a corn horse may be used to advantage. This is made by taking a piece of timber 2x4 inches by 12 feet, on one end of which are nailed two legs about three and one-half feet long. An inch hole is bored about five feet from the raised end, through which is loosely inserted, horizontally, a round cross piece. An old broomstick will do nicely. Charles E. Benton, writing of the corn horse, says:* "Where they [the legs] join the main piece, as shown at *a* in Fig. 35, I have nailed on some light strips in such a way as to form a little cage or box in which corn ties are carried, each one with its string snugly wound on its block." The stalks are placed against the corn horse, when the cross stick forms four corners, and the shock is built here. When it is completed the cross stick is pulled out, after which the horse is withdrawn.

Tying the shocks.—After the shock is formed it is tied near the top. A rope with a pulley on one end may be used to advantage for drawing the cornstalks together tightly near the top, after which the tie may be placed on the shock. Rye straw cut in the bloom makes excellent tie bands. Cornstalks themselves are too brittle. Binding twine is strong enough, but may be cut by mice. Tarred twine is strong and is not cut by mice, and may be rapidly tied so as not to slip. When economy is to be considered rye straw is about as satisfactory a cheap tie as can be secured. In Western New York willow twigs are popular bands.

Stacking.—To stack to best advantage, or to handle on the wagon or elsewhere, the corn should be placed in small bundles and tied at the center after curing in the shock. If string

** American Agriculturist*, Sept. 1, 1894.

is to be used for binding it will expedite work to cut it into suitable lengths before getting into the field.

The stack should be located in a convenient and well-drained place and have a foundation of straw, rails or boards, to keep the fodder dry. The base of the stack should have a diameter slightly less than the length of two bundles of stalks laid end to end. The butt ends of the stalks should form the exterior of the stack and the center should always be from two to three feet higher than the outside for that layer of corn. The diameter in well-made stacks slightly increases up to a height of six or eight feet, after which it may contract until topped off. As the stack is built bundles are laid crosswise over each layer about and at the center and over the ends of the bundles forming the outer layers, to keep the whole well bound together and to maintain a sufficient slope to the stalks forming the outer circumference of the stack. When the top is to be formed the stalks may be gradually drawn in and all the bundles placed in layers sloping from center to without, so as to furnish good protection for the fodder below. Sometimes the stalks are laid up to a pole five or six feet long, inserted in the top of stack, to which the bundles may be fastened. Such a covering is not easily displaced by the wind.

Small stacks are preferable to large ones—from 50 to 100 shocks to each one. Such a size can be handled to better advantage than a large one, whether the fodder is fed in field or stable.

Pulled fodder is especially prepared in the South. This operation is well described by "H." in the *Country Gentleman* of Feb. 5, 1885:

"There are usually two stalks in a hill of corn; the blades are gathered as high as the operator can reach, from both stalks, and thrust between them to remain until dry enough to bind into bundles, which are as large as the blades will reach around and tie. This tying is done very late in the evening after the dew begins to fall, when the corn blades, thoroughly dry, are just moist enough not to crumble. The fodder has then to be packed [carried] by hand, either to the ends of the rows, where it can be hauled to the barn, or if the rows are very long, to some central point to be stacked, not in loose leaves, but in bundles."

This method of securing fodder is becoming less and less practiced in the South. The cost of fodder so secured is too great and valuable food material is lost in the stalks left in the field. As a practical business matter the Southern farmer should cut his corn within six inches of the ground and cure it in the shock, as is done elsewhere. The practice of topping corn is equally as undesirable as pulling.

Husking.—In the eastern United States where the weather is somewhat uncertain in the fall, and snow comes early, the corn is usually husked as soon as dry enough. The ears are often pulled from stalks with husks on and carried to the barn, where they may be husked at leisure, or stalks with ears on are placed in shelter, with the husking to follow later. In the great corn-growing States, where less rain occurs in the fall than in the East, field husking is more easily accomplished. Where the corn is not cut and shocked, deep box wagons drive through the immense fields when the corn is well dried, and the ears are pulled from

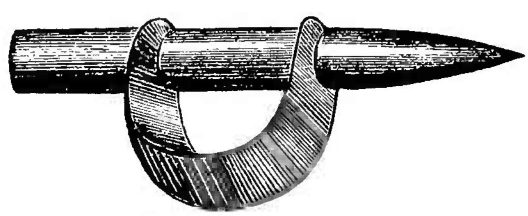

FIG. 36.—FINGER HUSKING PIN.

the husks and thrown into the wagon and conveyed directly to crib or market. Where the corn is shocked, after curing the ear is husked and usually thrown into heaps in between the rows, or into wagons, and the stalks placed back into the shock. Several average-sized shocks of husked stalks are generally combined to make one very large one.

Dispensing with husking.—In an article in the *Rural New-Yorker* published about 1888 Prof. Sanborn favors dispensing with the husking process, on the basis that it involves a threefold cost, viz.:

"First, labor, which is a variable amount, depending upon whether the fodder is saved and the method by which it is saved. If the fodder is not saved the cost will be three cents a bushel for husking and cribbing, and on the assumption that corn sells for 30 cents a bushel, * * * then the food must be 10 per cent more effective simply to repay us for the cost. If the fodder is saved the cost of husking will be doubled and 20 per cent will have to be added to the efficacy of the food to balance the cost of the process, and more must be expected if a profit is to be received. The second additional cost will be the loss of leaves, as the result of husking in the field after the fodder is partly dried. This loss is a material one and involves the most digestible part of the food. It is difficult to estimate the value of this cost, but when added to the third loss, or the risk of the influence of rain with its leaching effect on the fodder through necessary delay in housing the fodder while husking the corn, it is safe to say that $1 per acre is involved, or two to three cents a bushel of corn."

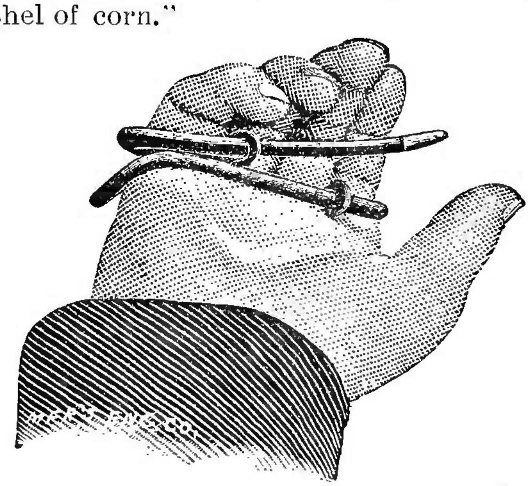

Fig. 37.—Hand Husking Pin.

There are conditions on the farm where it would be wise to profit by the above arguments, especially where steers are to be fed in the feed lot, to be followed by hogs, or where the entire cured plant is to be run through the feed cutter. However, where grain is to be sold in the market, and certain classes of feeding are to be done, husking is necessary.

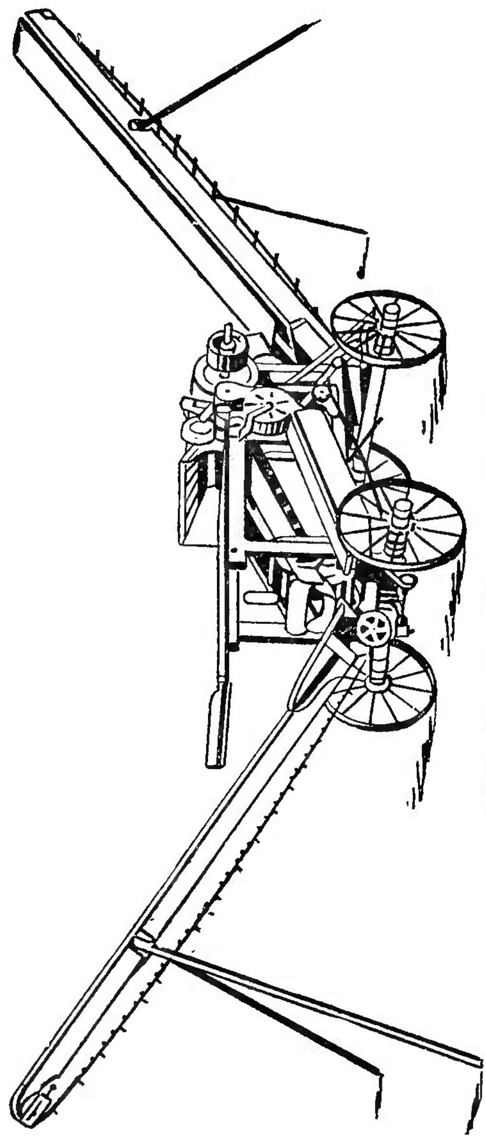

FIG. 38.—KEYSTONE HUSKER AND SHREDDER.

Husking machines.—For several years husking machines have been manufactured that do a very satisfactory class of work. These are quite expensive and are usually owned by parties who go from place to place husking the crop at so much per bushel and shredding or cutting the fodder at the same time. The Keystone husker and shredder (Fig. 38) and the St. Albans shredder (Fig. 39) are two of the prominent shredders on the market, and the manufacturers of the Keystone thus explain its operations:

"The stalks are fed to the machine with the ears of corn on. The feed rollers crush the stalks thoroughly and pass them on to the knives, which cut them into fodder, or to the shredder head, which tears the fodder into fine shreds, leaving it in very much the same condition as hay. The fodder elevator then carries it to the mow of the barn or to the shed or stack. The feed rollers do not crush the ears of corn, but simply snap them off the stalks. The ears drop to the husking rollers beneath the feeding platform, where the husks and silks are taken off. The husks and silks are passed out with the fodder and the ears of corn drop to an elevator which delivers them to the wagon or crib."

This machine is a great invention, and in large corn-growing districts should be an important factor in the economy of handling and saving the crop. The husking is done as well as is usually done by hand.

Shredding.—The shredded fodder will keep satisfactorily in the mow if well dried when put in, but if it is damp it will mold. Care should be taken to avoid shredding damp fodder. This material is very valuable for feed and is being regularly sold on the market. At Lafayette, Ind., the writer has purchased it at the feed store for $5 per ton, while in some other places it fetches $8. In view of the fact that so much corn-fodder goes to waste in the field the shredders offer a valuable medium of rescuing it and placing it on the market in a desirable form for economical feeding. Says the *Breeder's Gazette* (Aug. 15, 1894): "That the invention of the shredder opens up a market for an almost unlimited quantity of fodder, shredded and baled (see Fig. 40), for city trade, is beyond all question. It will soon be quoted regularly in city feed stores * * * and we are informed that a bright, well-cured quality of shredded fodder has sold in bales at city feed stores at $8 per ton."

Testimony concerning shredded fodder.—During the spring of 1895 the *Breeder's Gazette* published many interesting letters from extensive corn growers and stockmen who have shredded their dry corn fodder. The universal testimony seems favorable to this method of preparing the dry plant for feeding. The shredded material may be stacked in the lot, after the manner of stacking hay, though it is preferable to place it under shelter.

The following evidence is abstracted from the various communications in the *Gazette* as presenting valuable information on a comparatively new process of preparing rough food: Wulff Bros. of Nebraska say: "Corn to be shredded ought to be cut just as soon as it is

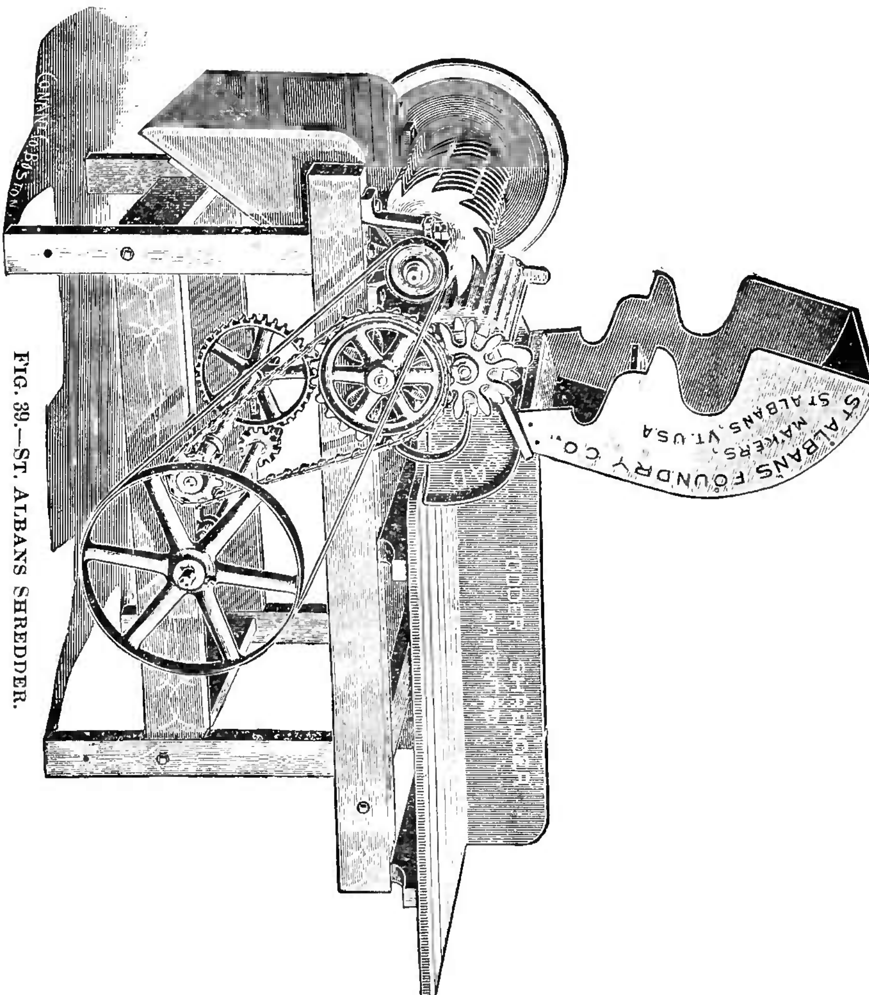

FIG. 39.—ST. ALBANS SHREDDER.

out of milk, and it will shred and handle the best if it is left in the field. It keeps all right if ricked outside with shed roof over it, but it will heat and mould if not bone dry if it is put in barn and in great bulk." H. L. Buschling of Missouri thinks that if entirely dry when shredded it will not mould if put in barn in great bulk. With him the shredder has given entire satisfaction. Samuel Senneff of Illinois writes: "I have stacked it outside and it kept well. It packed so solid the water did not run into it. I would prefer having it under roof, for it is easier to handle during the winter storms." In reply to the question, "Is it not likely to mould and spoil if put in great bulk?" Mr. Senneff says: "It will not if it is fully cured and dry when shredded. I have put the fodder from 40 acres in a barn and it has kept well. I am now feeding to my stock fodder which was cut last October and it is bright and dry." G. H. Robinson of Vermont cuts his corn when ripe, shocks it and lets it stand till the fodder is dry. Then he husks it, after which the stalks are drawn to the barn, shredded, and placed in the mow. He has never had any mould or spoil, and the larger quantity he gets together the better it keeps.

The complaints of this shredded material being spoiled by moulding are very rare, and it is generally agreed that if the stalks are fairly dry when shredded they will not spoil in the heap. While heating sometimes occurs, in the experience of the writers the effects do not appear detrimental. In no case is a record given of spontaneous combustion occurring from over-heating.

The indications are that the shredding of dry

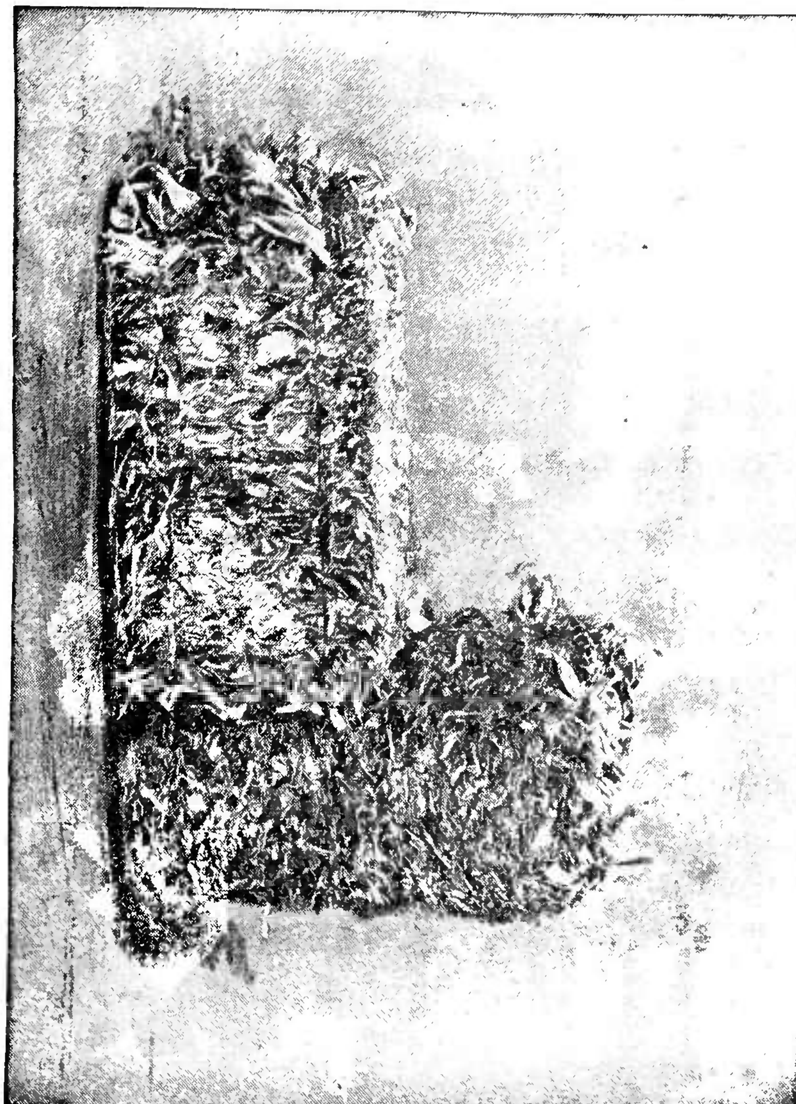

FIG. 40.—BALED SHREDDED FODDER.

corn-fodder will become a popular and economical method of preparing it for winter feeding.

The shredders handle from three to ten acres of corn a day, according to size of machine and character of crop. The prices of shredders are listed at $80 to $130, and of huskers and shredders combined at $150 to $400.

Threshing corn is frequently practiced where threshing machines are common and the crop is large. A common threshing machine is used. W. J. Bingham of South Dakota says:*

"I have threshed it for the past five years, more or less, using a Westinghouse Separator. It is just as easy to thresh as wheat. Leave the cylinder the same as for wheat, and take out all the concave teeth but one single row, putting in blank concaves or boards to fill out. Run the machine about half as fast as for threshing wheat; this will crack the corn some but will not hurt it for feeding purposes. I think this is a superior way of handling corn, especially where you use a binder and bind corn the same as wheat. The fodder is almost equal to that cut by a fodder cutter, and will keep here in Dakota in stack without being covered with anything, but where they have more rain top with marsh hay and it will keep all winter."

Where threshing is practiced the corn must be well dried in the field, else the grain will heat in the bin or pile.

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* *Breeder's Gazette*, Oct. 10, 1894.

CHAPTER IX.

ROTATION OF CROPS.

Numerous factors demonstrate the necessity of growing different crops on the same land during a period of years. Agricultural plants differ in their root development and consequently in their feeding capacity. The clover plant is a vigorous feeder and sends its roots over quite a range of territory, while the sugar beet develops its roots to a much more limited extent.

Rotation rests the land.—We know that rotating crops rests the land for some reasons which cannot be entirely explained. Farmers know that red clover can be grown satisfactorily only a year or two on the same field, when the land becomes what is commonly termed "clover sick." Says Sir J. B. Lawes:*

"Land will also become sick of any other leguminous crop if grown too often; but it is a most singular fact that where one leguminous crop ceases to grow another will thrive. We had a remarkable instance of this in one of our fields which was bean sick, and as all our endeavors to grow this crop were in vain we at last decided to give up the attempt, and

* *Country Gentleman*, March 12, 1885.

in place of the beans we sowed barley and red clover together. The result was that the red clover sown with the barley was so luxuriant as greatly to interfere with its growth, and this too upon land where we had been trying to grow beans without manure for 30 years. In spite of our having grown a leguminous crop something had accumulated in the soil which was more favorable to the growth of another leguminous plant than to that of a cereal crop."

Plants also differ in use of ingredients of soil fertility. Tobacco is notably a potash feeder, while the clovers use comparatively more nitrogen than phosphoric acid or potash. This being the case, one kind of plant food might be accumulating in the soil while a crop was being grown upon it which made only a slight drain upon that particular element. If no manure was put upon the land it is plain, in view of these facts, that the land could be cropped to better advantage by the rotation system than by continuously growing the same class of plants on it.

An important factor in rotation also bears on the plant food left in the roots of the crop last removed from the field. Gulley states* that when either red clover or cowpeas are grown on land of average fertility in the South after cutting off the crop for hay the stubble and roots on an acre of soil contain as much nitrogen, phosphoric acid and potash that may become available to the next crop as a dressing

* First Lessons in Agriculture, 1892, p. 85.

of 300 to 600 lbs. of cotton-seed meal, or 500 lbs. of a standard fertilizer.

Importance of rotation recognized.—In the rotation system the fact must not be lost sight of that the soil may be kept free of weeds to the best advantage. Grass land, followed by a hoed crop, permits clean cultivation.

The importance of rotation is recognized to-day by the practical farmer, even though he may not understand the principles underlying the practice.

In experiments at the Purdue University station very notable gains are shown in favor of rotation as applied to Indian corn.

An experiment was begun in 1880 to compare different systems of cropping without using manures. On one series of plats grain is grown in succession year after year, or two crops alternating with each other, these crops being corn, oats, wheat. On another series of plats the same crops have been grown in rotation with clover or timothy. The yields of corn on the two series for 1893, and the average yields for the last six years, as given by Prof. W C. Latta, are as follows:*

	1893.	*Average for 6 years.*
Crops grown in rotation	22.2 bu.	31.99 bu.
Grain crops only grown	15.1 bu.	27.46 bu.
Gain from rotation	7.1 bu.	4.53 bu.

* Purdue University agricultural experiment station, Bulletin 50, April, 1894.

As no manure was used the yields are naturally small, but the balance in favor of the rotation is a large percentage.

For 18 years rotation tests have been conducted on corn at the Illinois station.* Where corn, oats and clover were grown in rotation a decided gain in yield of corn was secured over those plats which did not receive a dressing of commercial fertilizer, that were not in rotation.

Systems of rotation.—There are numerous rotations including corn which are satisfactory. On the Purdue University farm a rotation of corn, oats, wheat, clover sown on wheat in early spring of third year, and cropped fourth and fifth years, proves quite satisfactory. To favor large cropping stable manure is well distributed over the clover stubble before it is plowed in. The corn has a fertile field and its cultivation cleans it of weeds in good shape for the crops which follow that receive no hoeing. The oat plant is a gross feeder, and following after the corn it finds the ground well enriched with the available food in the roots and stubble and the manure previously applied.

For the Southern States where red clover will grow, Gulley recommends† the following five-year rotation: Corn; clover on corn stub-

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*Illinois agricultural experiment station, Bulletin No. 30, p. 357.

†First Lessons in Agriculture, 1892, p. 86.

ble in spring; clover; oats followed by cow-peas the same year; cotton. Either the cotton or oats may be left out, and a four-year rotation be adopted.

To secure the most economical and profitable cropping of the farm the practice of a judicious rotation is absolutely essential. This fact can easily be demonstrated in noting the practice of successful farmers.

CHAPTER X.

INSECTS.

The purpose of this chapter is to describe briefly some of the more injurious insects affecting the corn plant or its seed and to suggest remedies with which to suppress them. The descriptions and remedies are those given by economic entomologists of high standing, and more especially by Prof. F M. Webster, entomologist of the Ohio experiment station; Dr. J A. Lintner, New York State entomologist, and Prof. S. A. Forbes, Illinois State entomologist. From a valuable paper by Webster on "Insects Affecting the Corn Crop"* numerous important descriptive abstracts were made. The State reports of Forbes and Lintner were also freely used.

Injuring seed after planting.—*The seed corn fly* (*Phorbia fusiceps*, Zetty). This is a yellowish-white, footless maggot, about one-fourth inch long, blunt at posterior and pointed at anterior end. It feeds on the substance of the

*Report Indiana State Board of Agriculture, 1885, pp. 180–215.

swollen kernel in the ground. It has not proved very destructive. A tarring of the seed before planting will doubtless keep off the maggot.

Wire worms (*Elateridæ*). These are the larvæ (grubs) of the common snapping beetles, of which there are many species. These worms (Fig. 41) are greatly abundant only in newly-plowed meadows. They eat into and destroy the kernels of corn or eat off the germinating shoot or roots. Lintner says the best preventive in infested fields is starving out by crops of buckwheat or peas.* Fall plowing of sod land is thought desirable by many farmers, the grubs being disturbed and frozen out. Fig. 42 is of the False wire worm *(Iulus)*.

FIG. 41.—WIRE WORM.

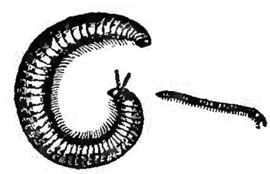

FIG. 42.—FALSE WIRE WORM.

Affecting the roots.—*Corn plant louse* (*Aphis maidis*, Fitch). Small, pale green lice, covered with a whitish mealy substance, feed below the surface on the juices of the corn root. Large numbers of these will be found about the roots of one plant. Later in the season great numbers of dull black and green aphis are found on the leaves, husks and tassels of the plant, which are the same insects in a different stage of de-

* Eighth report on the injurious and other insects of the State of New York for the year 1891, p. 283.

velopment. Ants are nearly always found associated with the aphis, they feeding on a liquid known as honey-dew, which exudes from the body of the louse. There seems to be no

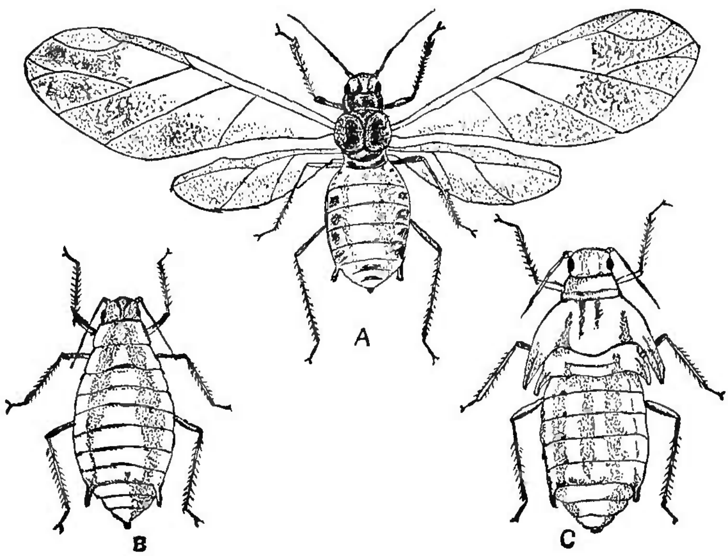

FIG. 43.—CORN-LEAF PLANT LOUSE, *Aphis maidis*, Forbes. *A*. Winged female. *B*. Wingless female that gives birth to young. *C*. Pupa. (After Forbes.)

effective method at present known for destroying these lice on a practical basis.

Corn root worm (Diabrotica longicornis, Say). The developed beetle is green or yellowish-green, about a quarter of an inch long, and resembling in form the striped squash beetle. From the latter part of July till the blossoming period is past the beetle feeds on the pollen and silk. When ready to lay her eggs the female descends to the ground about the roots of the corn and deposits a considerable number of minute white eggs. From these the next spring hatch out minute, active grubs, which begin to feed at once on the corn roots, if a new crop has been planted on old ground. The worms follow these small roots to larger ones, into which they burrow, often to the base of the plant. When full grown the worms are nearly white, a trifle less than half an inch long and about the size of ordinary wheat straw just below the head. When they reach full growth the worms leave the root, crawl to one side in the soil, make a cell there, and transform into white pupa (grub stage), which soon changes into the beetle form.

This insect has done great damage in our corn fields, especially in the Central West. In 1885 Prof. Webster noted damage to the corn crop of Moses Fowler of Lafayette, Ind., amounting to 15 per cent of the entire crop on 10,000 acres—a total loss of about $16,000.*

A rotation of crops is a satisfactory method for preventing damage from this insect, as has been demonstrated on a large scale. Wheat or oats may be substituted for the corn crop, as this insect cannot secure food from their roots, they being too woody and tough. The first crop of corn on grass or clover sod is not usually injured by this pest, although numerous cases have occurred where the corn was injured on clover sod.

*Report Indiana Board of Agriculture for 1885, p. 188.

White grub (*Lachnosterna fusca*, Fröhl). This is the larva of the common brown May beetle or June bug. The beetles deposit small, whitish eggs about the roots of grass which in about a month hatch into small, brown-headed grubs that feed on the roots about them. During the second year the grubs work near the surface and reach their full growth during the spring of the third or fourth year. They are most abundant in old grass lands, and when this is plowed for one or two seasons may work great damage to the corn which may be planted on it.

This is a difficult insect to exterminate. Fall plowing is no doubt advantageous. Pasturing land in the late summer and fall with pigs will be a means of getting rid of many, then plowing during the late fall or spring.

Affecting the stalk.—*Cut worms.* Cut worms are of numerous kinds, all of which belong to one special group—the *Noctuidæ*. The following are characteristics common to nearly all the species, according to Lintner.*

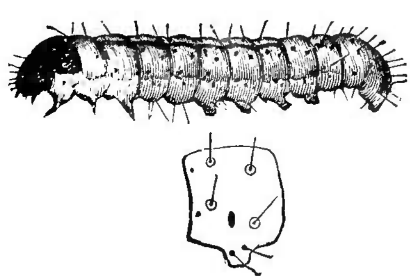

FIG. 44.—GLASSY CUT WORM. Larva of *Hadena devastatrix*. (After Riley.)

When full grown, cut worms measure from an inch and a fourth to nearly two inches in

* Eighth report on the injurious and other insects of the State of New York for the year 1891, p. 231.

length. They have 16 feet, of which the three anterior pairs (true legs) are pointed, and the five remaining pairs (prolegs) stout, blunt, and armed with minute hooks for clasping. In form they are stout, tapering slightly toward the extremities. In appearance they are usually dull colored, greasy looking, dingy brown, gray or greenish, with some light and dark longitudinal lines, and sometimes with oblique dashes. They have a large, shining, red or reddish-brown head. The first ring or collar bears a darker-colored, shining, horny plate, as does also the last one, known as the anal plate. The body is never hairy, but the several rings have upon each six or eight small, blackish dots or humps, from each of which a short hair is given out.

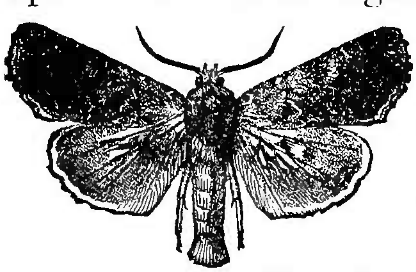

FIG. 45.—MOTH OF CUT WORM shown in Fig. 44. (After Riley.)

The cut worms do most of their feeding at night, during the day being hidden beneath stones, sticks and rubbish. Some cut worms feed on the parts of the young plant above ground and some below.

The parents of cut worms are moths. These deposit their eggs on a plant near by the feeding ground as a rule, although they are also placed on fruit trees. The eggs soon hatch, when the young worms drop to the ground and enter it, where they feed. Later they go deeper into the soil and remain there over winter. In spring they come to the top soil again and feed. In a few weeks they become full-grown worms, when they make cells in the soil, in which they locate and where they undergo a change to pupa, and soon after develop into the moth.

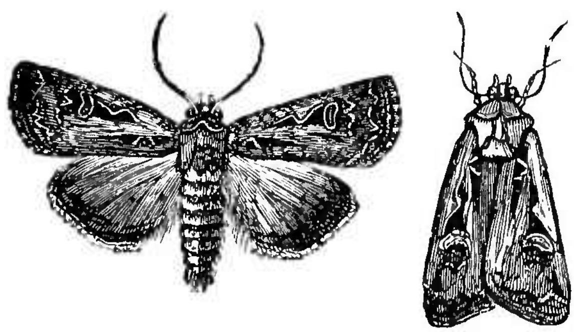

FIG 46.—MOTH OF DINGY CUTWORM *Agrotis subgothica.* (After Riley.)

About 12 kinds of cut worms are especially prevalent on corn. On new sod ground the cut worm is most frequently found.

Numerous methods have been tried to prevent the ravages of cut worms, but as a rule they are more or less unsatisfactory. Lintner recommends the use of a tablespoonful of salt scattered over each hill of corn.* He says this method has been used with considerable success. The explanation of this protection is that the salt dissolves and is taken up by the roots into circulation and makes the food unpalatable to the worms. It appears to the

* Eighth report, etc., p. 239.

writer that great care should be used in applying this salt, as too much will certainly kill the young plants. Lintner also notes* that a gentleman who soaked his corn in copperas water before planting was not troubled by the worms. A bushel of corn is placed in a tub and covered with water, and a pound or pound and a half of copperas water added, which has been dissolved in warm water. This is stirred among the seed, which are allowed to soak 24 to 30 hours.

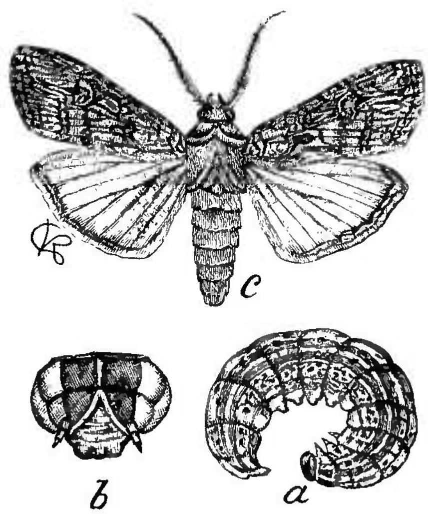

FIG 47.—GREASY OR BLACK CUT WORM, *Agrotis ypsilon*, Ratt. *a*, cut worm; *b*, head of worm from front; *c*, moth. (After Riley.)

Prof. J. B. Smith recommends the use of kainit (a potash salt) to prevent cutworm ravages.† Experiments of his gave favorable results. The kainit should be broadcasted over the field just before planting, as in spreading fertilizer, for such it also is. Riley, Fletcher and others have recommended the poisoning of green grass or clover and placing it in bunches about the fields. The cut worm will be killed

* Eighth report, etc., p. 239.

† Bulletin 75, New Jersey agricultural experiment station, Nov 7, 1890.

by eating the poisoned grass. This should be done just at nightfall.

Stalk borer (*Gortyna nitela*, Guen). A full-grown worm is a little over an inch long, bluish-brown above, with three white lines on the back, the central one continuous, the others interrupted for a considerable space at the middle.* This worm is the product of eggs laid by a moth on grass or early-planted grain. When the eggs hatch the worm crawls down

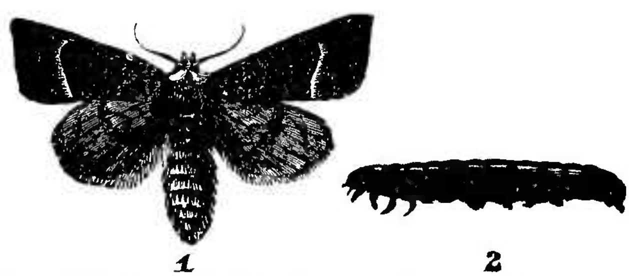

FIG 48.—STALK BORER, *Gortyna nitela*, Guen. *1*, moth; *2*, worm. (After Riley.)

into the stem of the plant. To prevent their ravages, Webster recommends† one ounce of pyrethrum powder in two gallons of water, or one part crude carbolic acid to 100 parts water. Spray or sprinkle the young plants so this liquid will run down among the unfolded leaves.

Chinch bug (*Blissus leucopterus*, Say). This is a true bug that is about three-twentieths of an inch long and one-third its length in breadth.

* F. M. Webster: Bulletin 3, Purdue University, April, 1885.

† Report Indiana State Board of Agriculture, 1885, p. 192.

The body is black and slightly hairy as seen under a microscope. The wing covers are white with a sub-triangular black spot in the middle of the outer margin of each and a few black veins upon their middle. The feet, claws and enlarged ends of the antennæ are black, while elsewhere the antennæ and legs are dull yellow.

The chinch bug deposits at least two sets of eggs, one in the fall upon the crown or the roots of plants, and another in spring. The eggs are very minute and one bug deposits about 500 at intervals extending over several weeks. The eggs hatch in about two weeks. At first the larva is pale yellow, but changes to red, except the two anterior segments of the body, and the legs, which are yellowish. After the first moult it becomes bright red with a pale band across the middle of the body. After the second moult the wing pads begin to show and the general color gets darker, with the pale band still conspicuous. A third moult develops the pupa with distinct wing pads, the anterior portions being dark brown and the abdominal portions grayish, except the tip, which is brown. It takes from five to seven weeks to change from

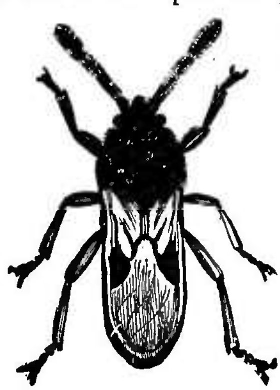

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FIG. 49.—ADULT CHINCH BUG, *Blissus leucopterus*, Say. (After Riley.)

the egg to the perfect insect where winter does not interfere.*

When winter comes the insects seek shelter under sticks, stones, leaves and rubbish of all sorts.

This is one of the most destructive insects, especially as applied to wheat and oats, and also, though in a lesser degree, to corn. Mr. L.

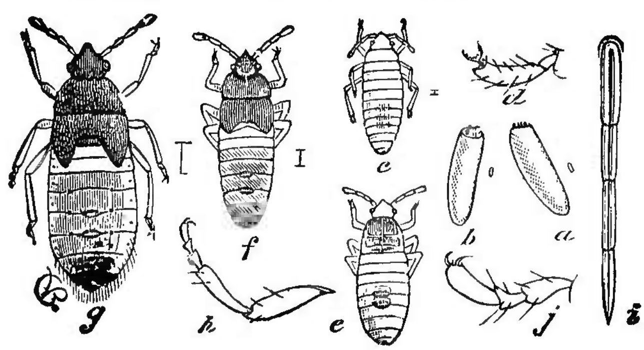

FIG 50.—YOUNG OF CHINCH BUG; *a* and *b*, eggs; *c*, young; *e*, larva after first moult; *f*, larva after second moult; *g*, pupa; *h*, leg of pupa; *i*, beak. (After Riley.)

O. Howard, now United States Entomologist, in 1887 estimated the losses from chinch bugs in nine States to be $60,000,000. Walsh, in 1864, estimated the loss in Illinois for that year caused by this bug to be $73,000,000, while Shimer claimed that during the same year three-fourths of the wheat and one-half of the corn of the Mississippi valley was destroyed by it, involving a loss of $100,000,000.†

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* Abstracted from an article on the chinch bug in the second report of the New York State Entomologist for 1885.

† Second report New York State Entomologist, 1885, p. 156.

Many different methods have been attempted to prevent the ravages of this insect, but each one is more or less unsatisfactory. The area grown to wheat should be diminished. All trash about infested fields should be as fully burned as possible in fall, winter or spring. Insecticides may be used to advantage. Kerosene emulsion, diluted to about five per cent, is perhaps the most effective insecticide. To make the emulsion take one-half pound of common soap and dissolve in one gallon of hot water, after which add to the boiling mixture two gallons of kerosene and churn the mixture violently for about five minutes with a hand force pump. This may be diluted with water to make 30 gallons for use. This seems to be about the best of the insecticides for chinch bugs.

For some years past experiments have been conducted to propagate among chinch bugs a fatal disease. A large amount of work has been done by Prof. F H. Snow of Kansas University in this direction. A peculiar fungi being placed in contact with the bug soon causes its death. Healthy bugs may be inoculated with the disease and set at liberty in the infested fields and may spread the disease with such great rapidity as to practically annihilate the bugs. A perfect epidemic of the disease occurs. This fungus may be propagated and distributed over the country, as done by Prof. Snow, and used to inoculate bugs where necessary. The work of Snow has been most encouraging.*

Clean cultivation is most essential in any case, and Forbes recommends heavy fertilization of lands as an additional safeguard.†

Corn bill bugs (Sphenophorus). There are a number of forms of these bugs which are known as snout beetles or bill bugs. They are all medium-sized, dark-colored insects. With most

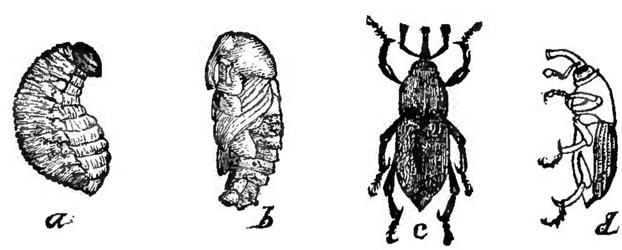

FIG 51.—CORN BILL BUG, *Sphenophorus robustus*, Horn. *a*, larva; *b*, pupa; *c*, beetle, back view; *d*, beetle, side view. (After Riley.)

species the adult insects sink the beak into the stem of the young corn plant and make small cavities in it into which the eggs are deposited, where they hatch later on.

One of the most destructive corn-bill bugs is *Sphenophorus ochereus*, Lec. Its depredations are mainly confined to recently reclaimed swamp lands. Webster, in discussing the life

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*First, second, third and fourth annual reports Director University of Kansas experiment station, 1891, 1892, 1893, 1894.

†Sixteenth report State Entomologist of Illinois for 1890.

history of this pest,* from which the following information is secured, says: "There is the best of evidence that this pest has for several years been working serious injury to the corn crop planted on recently-drained swamp lands in Indiana, hundreds of acres being thus destroyed."

The larva is white with brown head, the latter small, body becoming very robust posteriorly, so much so that it appears to be fully two-thirds as broad as long, and very much wrinkled. The feet are lacking. The adult is black beneath, but varying in color above from pale ochreous to plumbeous and cinereous. Length one-half to nearly three-fourths inch. The insect passes the winter in the adult form, and in spring feeds on the tender parts of stems of reeds and rushes, and later on on the same parts of the young corn. In late May or June the female burrows into the earth and deposits her eggs in or about the bulbous roots of a species of reed. The larvæ burrow in these bulbs, which are often the size of a hen's egg and very hard, and transform to the adult insect therein, appearing on the rushes, reeds or corn in August or September. This species will probably never breed in the roots of corn.

To get rid of this species the best method will be to drain the land thoroughly and get

* *Insect Life*, Vol. II, p. 132.

rid of the plants it breeds in by burning or cultivating them out. Fall plowing has been tried, but I am not informed with what success.

If the stubble is burned in spring some beetles of the other species may be destroyed. An application of paris green to the young plants may be of benefit by preventing injuries.

Affecting the ear.—*Corn worm* (*Heliothis armiger*, Hubn.). This is also known in the South as the boll worm, as it injures the cotton

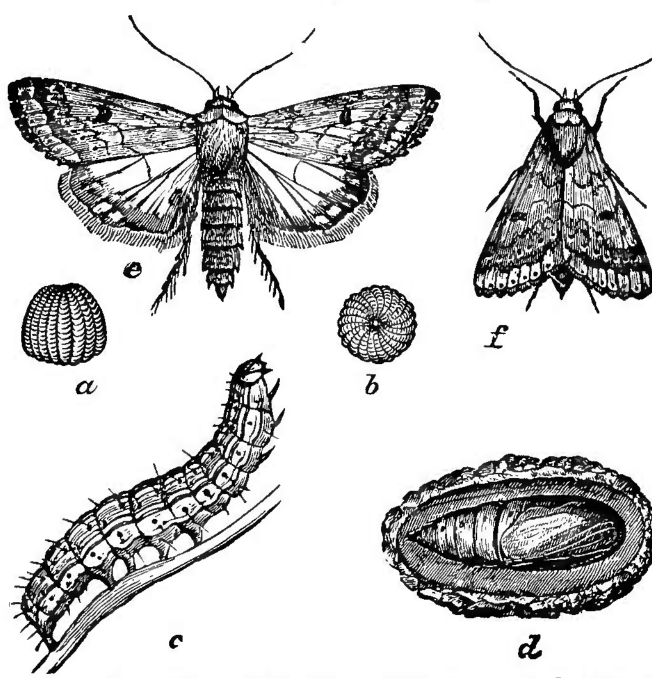

FIG. 52.—THE CORN WORM *Heliothis armiger*, Hubn. *a*, *b*, eggs; *c*, larva; *d*, pupa in cocoon; *e*, *f*, moth. (After Riley.)

boll. The adult insect is a medium-sized, heavy-bodied moth, with yellowish-gray or clayey-yellow fore wings, tinged with light olive-green, marked with lines of darker green and dark brown or black. The hind wings are of a paler shade, with a broad, blackish outer band enclosing a pale spot toward the apical portion.

Comstock states that there are five broods of this insect in a season in the South, while in the latitude of Missouri, Southern Illinois and Virginia, Riley thinks there are but three.

The adult insect deposits its eggs in the tip of the ear, among the silk. After hatching the larvæ feed until about one-third grown, when they begin to tunnel through the kernels under the husks toward the butt of ear. In Tennessee the writer was unable to grow sweet corn successfully owing to the ravages of this pest. The grown worm is about one and one-fourth inch long, rather robust, tapering toward the head. In color the worms vary from pale green to dark brown. There are several black, shining, elevated tubercles on each segment. each bearing a short brown hair.

The full-grown larvæ make a round hole in the earth, the inside walls of which they cement over. At the bottom of these chambers these larvæ change to pupæ, where they pass the winter.

It is recommended to plow in the fall, thus throwing up these chambers and subjecting the pupæ to winter exposure and destroying

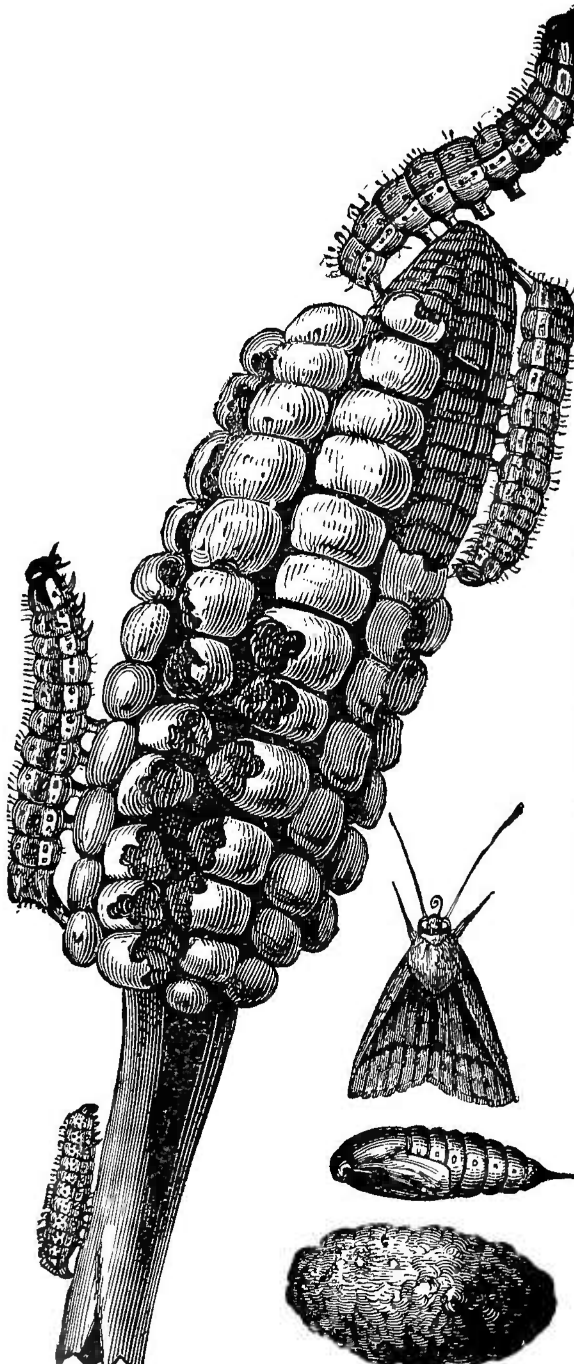

FIG. 53.—THE CORN WORM, showing the worm at different stages of growth; the pupa, the cocoon and the moth at rest. (After Riley.)

them. This is thought to be quite an effective remedy.

Angoumis grain moth (*Sitotroga cerealella,* Oliv.) The adult insect, a moth, is small and slender, having an expanse of wings a little over one-half inch. The body and fore wings are dull yellowish or buff color and satiny appearing.

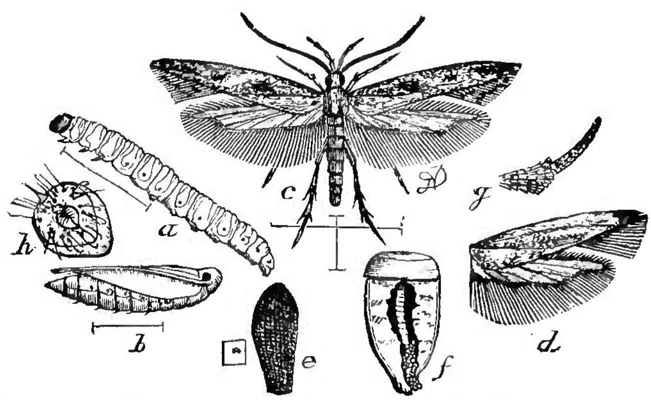

FIG. 54.—ANGOUMIS GRAIN MOTH, *Sitotroga cerealella*, Oliv. *a*, full grown larva; *b*, pupa; *c*, female moth; *e*, egg; *f*, corn cut open showing larva at work. (After Riley.)

The front wings are comparatively long and narrow, freckled with black scales, which are thicker toward the tips and form a line along the plait of the wings. The fringe is paler in color. The hind wings are blackish, of a leaden lustre, narrow, very suddenly becoming contracted to a point near the tip. Under side of wings lead color. Front legs blackish; hind legs with two spurs and fringed with long hairs.

The egg will hatch and the change from larva to adult occur in about a month s time under favorable conditions. A number of eggs are deposited on the side of the kernels. In four to seven days they will hatch, and the larva will then burrow into the kernel and begin to feed on the inside of it. In about three weeks it is full grown, when it is about one-fifth of an inch long. Then it burrows towards the outer end of the kernel, leaving only a thin cap to cover the cavity. A small white cocoon is then made in the burrow, and the larva in this soon changes to pupa, and after a short time emerges in the moth form.

This insect is especially injurious in the South, where stored corn is often seriously damaged. North of Kentucky little injury may be expected from it, as it is a warm climate insect. At the New York State experiment station the writer had considerable experience with it, as it occurred in a collection of corn in the museum. These insects were brought to the museum in specimen ears shipped from the South and before their ravages could be stopped nearly the entire collection was ruined.

In the field there is no known method of combating it. To destroy the insect in the seed, place the grain in a comparatively tight room and pour a little bisulphide of carbon in among the corn. This soon changes into a deadly gas and will destroy all insects inhaling it. But to save the seed the operation should

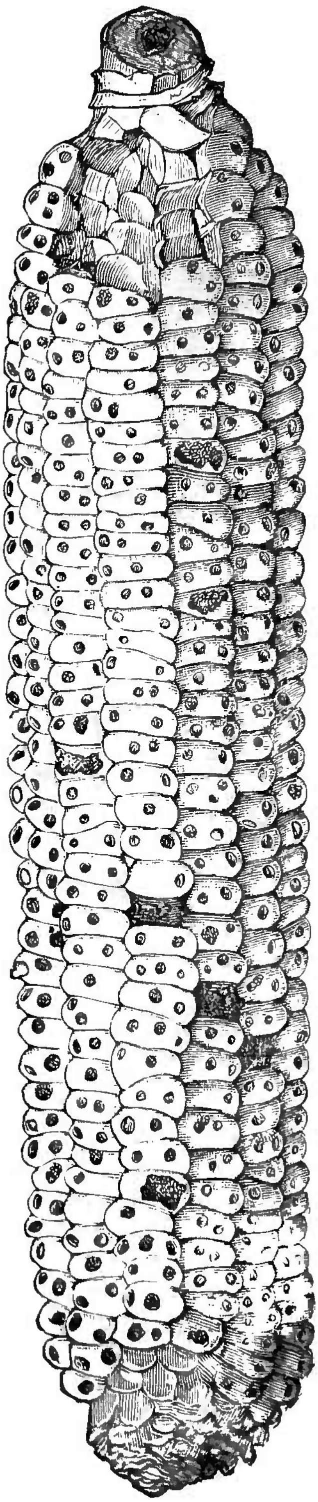

FIG. 55.—EAR OF CORN, showing work of grain moth. (After Riley.)

be repeated as soon as new moths appear. The bisulphide of carbon is very inflammable, as well as poisonous, so great care should be taken not to expose a fire to the fumes. Being heavier than air, the fumes will sink down through a pile of corn. The fumes of this gas would also destroy other insects injurious to stored grain, including the grain or barn weevil, and the grain Sylvanus, both of which are common in the South. According to Webster the worms are destroyed at a temperature of 120 deg. F., for four hours, so if means can be obtained by which to heat the ears to this degree a very desirable thing will be accomplished.

Other Insects.—While there are numerous other insects which injure corn, they do it to so small an extent that it is unnecessary to devote special attention to them. Grasshoppers, blister beetles, leaf hoppers, rose bugs, flea beetles, army worms, etc., all at times do slight damage to growing corn. Usually those insects which feed on the growing plant may be destroyed by spraying the leaves with some form of arsenic poison, such as paris green, london purple, etc.

CHAPTER XI.

DISEASES.

The Indian corn plant is appreciably injured by but very few fungous or bacterial diseases—in fact less than is any other cereal. Of these smut is the only one commonly known all over the United States.

The following diseases are the only ones of sufficient importance to especially merit attention in these pages:

Smut.—(*Ustilago maydis*, Corda.). Smut as seen by the farmer is either a distorted, greenish-white piece of vegetable tissue, or a mass of black, greasy powder, which generally appears breaking out from an ear of corn or from the leaf or stalk when green or succulent.

The source of this disease is a simple, tubular, minute plant, too small to be seen by the naked eye, which grows in the tissues of the corn plant and feeds upon its juice. These little plants, of which there are vast numbers, branch out in tubular form when they find a spot in the corn plant that is especially nourishing. Then, inside of these tubes, minute bodies termed spores (seeds) develop, and finally the spot becomes a mass of these, and then all of

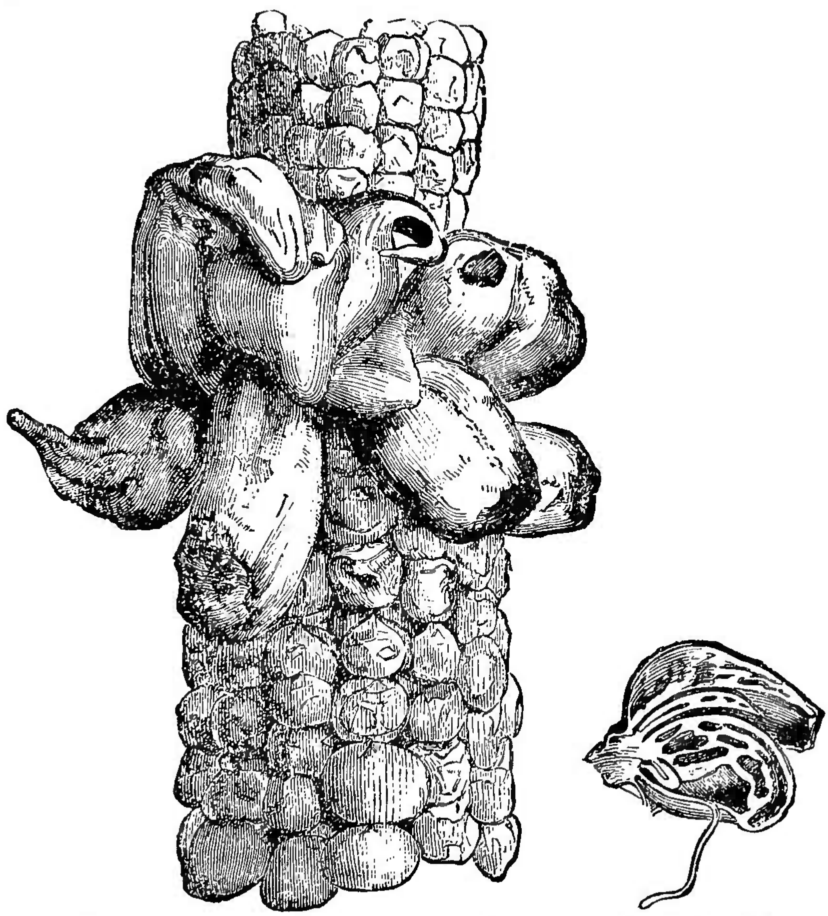

FIG. 56.—CORN SMUT breaking out on the ear. (After Tulasne.)

the little plants excepting the spores wither away. The dark-colored, loose smut, is mostly the mass of spores, of which there are countless numbers. A single cubic inch of them would contain over fifteen billions. The top of a pin-head that has been moistened will bear from 30,000 to 50,000.*

These spores are really seeds, and if the right degree of moisture is supplied they germinate in a few hours and produce very minute, thread-like plants, from which soon develop "sporids." The wind may blow these latter upon a young corn plant, in which case they may grow into its vegetable flesh and develop to a remarkable degree and eventually break out in the common form of smut.

This disease is distributed through the agency of the smut, and the more the spores are scattered about the more prevalent it may become. It is abundant all over the United States and in the corn-growing parts of Europe. While considerable damage may occur from this fungus the extent of this is not generally appreciated by corn growers. Bessey states† that in Iowa he saw a piece of land the crop of which "fully 66 per cent had been destroyed." This, however, is an unusually severe case. Prof. W H. Brewer says:‡ "I have never seen a field which has been injured to the extent of one per

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* Bessey: Bulletin 11, Nebraska agricultural experiment station, Dec. 18, 1889, p. 29.

† Bulletin 11, Nebraska agricultural experiment station.

‡ Tenth census of the United States, Vol. III, report on the cereal production of the United States, p. 107.

cent, but I have heard of cases in the year 1879 * * * where the damage amounted to one-sixth."

Smut said to be injurious.—Smut is generally thought by farmers to be injurious to live stock, yet but little satisfactory evidence is at hand to prove that such is the case, as it is commonly eaten. But three experiments on this point have come to the writer's knowledge. Dr. Gamgee for three weeks fed two healthy cows on smut, wet and dry. The wet did no harm, but a loss in weight followed the eating of the dry. The animals had voracious appetites, were fed three times per day, and ate from 3 to 12 oz. at a dose. In three weeks they ate 42 lbs. of smut.* Prof. Henry of the Wisconsin experiment station performed a similar experiment on two cows.† One cow ate as much as 32 oz. of smut in a day, and the other up to 64 oz. The latter cow died suddenly the next day after eating a large amount of smut. Prof. Henry attributes her death to having eaten this, which is not strange. In making a *post-mortem* examination no serious derangement was found in the intestines, but Prof. Henry thinks the brain was affected. An associated press dispatch in the daily papers of Nov. 10,

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*Report Commissioner of Agriculture on Diseases of Cattle in the United States, Washington, 1871, pp. 73–76.

† *Breeder's Gazette*, Oct. 10, 1894.

1894, comments on the sudden death of cattle in Illinois and says that farmers attribute it to the stock eating smutted corn. Prof. Morrow, so the dispatch says, thinks not, as they had fed a steer two bushels of smut at the University of Illinois and it had not injured him.

It is very questionable if cattle are injured by smut in the fodder; yet it will be safer and better to keep it out of the rations.

Preventing smut.—There is no absolutely sure method of preventing the appearance of smut. The spores on seed corn may be destroyed by the use of sulphate of copper (blue vitriol or bluestone). A strong solution in water should be made, using about half a pound of the sulphate to a gallon of water. The seed may be soaked about half an hour, after which it should be removed from the liquid and dried. The smut may also be killed by soaking the seed in water at 160 deg. F for five minutes.

It is also important to adopt preventive measures. The spores will pass through animals in the manure and germinate, so that is a reason why stock should not eat it. The smut in the field which can be secured should be burned. Rotation of crops will also reduce the degree of prevalence.

Bacterial disease.—This is a disease caused by a very minute class of plants termed bacteria, so small that they can be seen only under powerful microscopes. One of these plants consists of a single cell, with an outer coat, and inside contents. These plants increase by dividing in halves or sections and each developing into a perfect plant, or by spores which they may produce. Bacteria can withstand great extremes of heat and cold. There are many different kinds, one of which causes injury to Indian corn by developing in its tissues and juices.

Symptoms.—The disease is characterized by the plants turning yellow and sickly while young. The roots of the plants, especially the lowest ones, decay. While the whole plant will be affected, the injury is most apparent in the lower part of the stem, which will be discolored and perhaps dying. Sometimes the stem appears corroded, and semi-transparent, firm, gelatinous material gathers upon these marred places. After midsummer the leaf sheaths become discolored and spotted, with an appearance of decay. If these sheaths are stripped off the injury is made more conspicuous. These injured or spotted places appear watery and sometimes are smeared more or less with a thin coating of the gelatinous matter. Finally the ears are attacked, the husks wilt, turn brown and become packed close together, and gummy matter exudes from the tissues.

Often a white fungus occurs and permeates the entire ear.

This disease was first investigated in 1882, and most of the information known of its character is derived from studies made of it by Prof. T. J. Burrill of the Illinois experiment station.* The malady is widely prevalent, without doubt, yet is mainly known in Illinois and Nebraska. It is thought that animals eating cornstalks affected by this bacteria will die of what is called "cornstalk disease."

While this trouble is not confined to special kinds of soils and conditions it has been found most prevalent on rich land.

Thus far the writer knows of no method proposed to prevent the occurrence of this disease.

Rust occurs on Indian corn, but only to a slight extent and at uncertain periods. The loss from this disease is probably very immaterial.

* See Bulletin 6 of that station, August, 1889, pp. 165-175.

CHAPTER XII.

CHEMICAL COMPOSITION AND DIGESTIBILITY.

Several hundreds of analyses of Indian corn have been made at agricultural experiment stations, by the United States department of agriculture, in college laboratories and elsewhere. Most of these analyses are of the grain, although some are of various parts of the plant.

Composition of grain.—All of the available analyses published in the United States up to

TABLE SHOWING AVERAGE CHEMICAL COMPOSITION OF THE SEEDS OF THE VARIOUS CLASSES OF CORN.

	Number Analyses.	*Water.*	*Ash.*	*Protein.*	*Crude fibre.*	*Nitrogen-free extract.*	*Fat.*
Dent..........	86	10.6	1.5	10.3	2.2	70.4	5.0
Flint....	68	11.3	1.4	10.5	1.7	70.1	5.0
Sweet......	26	8.8	1.9	11.6	2.8	66.8	8.1
Pop........ ...	4	10.7	1.5	11.2	1.8	69.6	5.2
Soft.....	5	9.3	1.6	11.4	2.0	70.2	5.5
All varieties and all analyses...	208	10.9	1.5	10.5	2.1	69.6	5.4

September, 1890, showing the food composition of corn, have been collated and published by

Jenkins and Winton,* from which the figures in the foregoing table, representing averages, are given. These represent per cents in fresh or air-dry material.

Mr. Clifford Richardson, as Assistant Chemist of the United States Department of Agriculture, made a special study of the chemical composition of American cereals.† As based upon over 200 analyses of corn from different parts of America, he says: "Corn may be said, therefore, without doubt, to be very constant in its composition within narrow limits." The following figures are taken from Richardson's report, the average results of 202 analyses made in 1882 and 1883, showing per cent in the grain of the substances specified:

Ash	1.55 per cent.
Albuminoids	10.39 per cent.
Nitrogen	1.66 per cent.

Composition of mill products.—The composition of the mill products of Indian corn is shown in the following figures, which are averages taken from Jenkins' and Winton's tables. previously referred to:

* A Compilation of Analyses of American Feeding Stuffs. by E. H. Jenkins, Ph. D., and A. L. Winton, Ph. B., United States Department of Agriculture, Office of Experiment Stations. Experiment Station Bulletin No. 11, 1892, p. 155.

† An Investigation of the Composition of American Wheat and Corn, by Clifford Richardson, Department of Agriculture, Chemical Division. Bulletin No. 1, p. 69; Bulletin No. 4, p. 98; Bulletin No. 9, p. 82. Washington, 1883, 1884, 1886.

	Corn-meal.	*Corn-and-cob meal.*
Number of analyses	77	7
Water	15.0 per cent	15.1 per cent.
Ash	1.4 per cent	1.5 per cent.
Protein (N. ×6.25)	9.2 per cent	8.5 per cent.
Crude fibre	1.9 per cent	6.6 per cent.
Nitrogen-free extract	68.7 per cent	64.8 per cent.
Fat	3.8 per cent	3.5 per cent.

Composition of by-products.—In these same feeding tables are given analyses of the by-products and waste material of corn, including the cob and refuse of starch or hominy mills. The averages of these analyses are as follows, in per cents:

	Number Analyses.	*Water.*	*Ash.*	*Protein.*	*Crude fibre.*	*Nitrogen-free extract.*	*Fat.*
Corncobs	18	10.7	1.4	2.4	30.1	54.9	0.5
Hominy chops	12	11.1	2.5	9.8	3.8	64.5	8.3
Corn germ	3	10.7	4.0	9.8	4.1	64.0	7.4
Gluten meal	32	9.6	0.7	29.4	1.6	52.4	6.3
Starch feed, *wet*	12	65.4	0.3	6.1	3.1	22.0	3.1

These figures show corncobs to contain some nutriment. Gluten meal has a very high feeding value, as based on a large per cent of protein.

Composition of green corn.—The composition of the green corn plant, of silage, and of the dried fodder, and the several parts of the plant, is given in the following table which is also arranged from Jenkins' and Winton's tables of American feeding-stuffs. The figures given are averages in per cents:

GREEN.	*Number analyses.*	*Water.*	*Ash.*	*Protein.*	*Fibre.*	*Nitrogen-free extract.*	*Fat.*
Corn-fodder—							
Flint varieties	40	79.8	1.1	2.0	4.3	12.1	0.7
Flint varieties*	10	77.1	1.1	2.1	4.3	14.6	0.8
Dent varieties	63	79.0	1.2	1.7	5.6	12.0	0.5
Dent varieties*	7	73.4	1.5	2.0	6.7	15.5	0.9
Sweet varieties	21	79.1	1.3	1.9	4.4	12.8	0.5
All varieties	126	79.3	1.2	1.8	5.0	12.2	0.5
Leaves and husks cut green	4	66.2	2.9	2.1	8.7	19.0	1.1
Stripped stalks cut green	4	76.1	0.7	0.5	7.3	14.9	0.5
Silage	99	79.1	1.4	1.7	6.0	11.1	0.8
Dry fodder—							
Fodder, field cured	35	42.0	2.7	4.5	14.3	34.7	1.6
Leaves, field cured	17	30.0	5.5	6.0	21.4	35.7	1.4
Husks, field cured	16	50.9	1.8	2.5	15.8	28.3	0.7
Stalks, field cured	15	68.4	1.2	1.9	11.0	17.0	0.5
Stover, field cured	60	40.1	3.4	3.8	19.7	31.9	1.1

Digestibility.—The chief value of a food depends upon its palatability and digestibility. The digestibility of some of the parts of the corn plant has been determined in feeding experiments, while that of other parts has been computed. The per cents of digestible matter of some of these parts are given in the following table, which is arranged from figures given by Prof. W A. Henry:†

*Cut after kernels had glazed.

†Special Report on the Diseases of Cattle and Cattle-Feeding, United States Department of Agriculture, Bureau of Animal Industry, Washington, 1892, p. 496.

CLASS OF CORN.	Per cent digestible matter in corn of		
	Crude protein.	*Carbo-hydrates.*	*Fat.*
Green fodder—			
Flint varieties	1.5	12.0	0.5
Dent varieties	1.2	12.8	0.4
Sweet varieties	1.4	12.6	0.4
Silage	1.2	11.8	0.6
Dry fodder—			
Fodder, field cured	2.8	29.5	1.0
Stover, field cured	2.0	34.1	0.6
Grain—			
Dent	7.0	63.4	3.9
Flint	7.1	63.0	3.9
Sweet	7.9	61.4	6.3
Average for all varieties	7.1	62.7	4.2
Mill products and refuse—			
Corn-meal, bolted	6.3	61.8	3.0
Corn-and-cob meal	6.5	56.3	2.9
Corncob	1.6	43.9	0.3
Corn germ	9.3	63.6	4.1
Gluten meal	25.0	49.4	5.6

Digestible matter in different parts.—The accompanying table, the result of researches by

	Ears.	*Topped fodder.*	*Blades.*	*Husks.*	*Stubble.*
Total dry matter	1,530	450	197	426	569
Ash	....	5	14	4	5
Crude protein	157	10	6	6	6
Crude fibre	1,343	190	88	168	241
Nitrogen-free extract	.....	232	105	246	304
Fat	30	13	4	2	13

Total digestible matter in ears of one acre..........1,530 lbs.
Total digestible matter in fodder of one acre.......1,642 lbs.

Total digestible matter in entire crop of one acre...**3,172 lbs.**

Mr. H. J. Patterson,* Chemist at the Maryland experiment station, shows the yield in pounds per acre of the digestible matter in the different parts of the corn plant.

The fertilizing constituents to be found in the corn plant as a whole, or in its several parts or by-products, are given in the following table. These figures are the averages of many published American analyses,† as prepared by Mr. W H. Beal, of the Office of Experiment Stations, Washington, D. C.:

MATERIAL.	*Moisture.*	*Ash.*	*Nitrogen.*	*Phosphoric acid.*	*Potassium oxide.*
Green fodder	78.61	4.84	0.41	0.15	0.33
Silage	77.95	....	0.28	0.11	0.37
Fodder, with ears	7.85	4.91	1.76	0.54	0.89
Stover, without ears	9.12	3.74	1.04	0.29	1.40
Kernels	10.88	1.53	1.82	0.70	0.40
Corn-meal	12.95	1.41	1.58	0.63	0.40
Corn-and-cob meal	8.96	....	1.41	0.57	0.47
Corncobs	12.09	0.82	0.50	0.06	0.60
Hominy feed	8.93	2.21	1.63	0.98	0.49
Gluten meal	8.59	0.73	5.03	0.33	0.05
Starch feed (glucose refuse)	8.10	....	2.62	0.29	0.15

These tables, bearing on the composition of Indian corn and its products, will give the

*Bulletin No. 20, Maryland agricultural experiment station, March, 1893.

†From table II, Appendix, Handbook of Experiment Station Work, Washington, 1893, pp. 397–8.

reader nearly all the information necessary to an intelligent knowledge of the subject.

Value of the corn crop.—The great value of the corn crop to America is clearly brought out in these tables. No other plant we grow will produce 3,172 lbs. of digestible food on one acre of land at so little expense. No other cereal crop yields the farmer so large a return for his labor as the Indian corn. It is the king of the cereals.

CHAPTER XIII.

THE FEEDING OF LIVE STOCK.

No one kind of food, unless we except milk, meets all the requirements of the domesticated animal. The composition of all others is one-sided, and it is essential that two or more foods be fed so as to give a ration that will be fairly balanced, and not one-sided. Some foods are more nearly perfect for certain animals than others, but combinations usually bring about the best results in feeding.

Constituents of foods.—The chemist who analyzes a food finds it composed of several groups of substances quite different in character. For the feeder's purpose three of these only need be considered. First is the *protein*, consisting of a class of bodies best represented in the composition of the white of an egg or in perfectly lean meat. The muscles of the body consist mainly of protein. Another group is known as *carbohydrates*, or heat-formers. These consist mostly of starch, sugar, and woody fibre or cellulose. The third group is the *fat* of the plant, as for example the oil extracted from the cotton seed. Those foods which contain a large per cent of carbohydrates and fat are usually termed carbonaceous.

Nutritive ratio.—Foods contain these three groups in different proportions. What we know as a rich feeding stuff, as oil-meal, for example, contains a much larger percentage of protein than is possessed by the average food. An animal cannot eat so much of it as where it is specially abundant in carbohydrates, and not in protein. The relationship existing between the protein on one side and the carbohydrates and fat on the other, is termed the nutritive ratio, meaning one part protein to so many of the other two combined. Where the ratio of a food is 1:2 it may be termed a narrow nutritive ratio, while if it is 1:12 it is a wide one. A food having a ratio of 1:6 would be well balanced, perhaps, but if it was an extreme on either side of this it might be ill balanced.

Feeding standards.—Many feeding experiments, made both in Europe and the United States, have shown that animals require practically certain amounts of each one of these classes of foods to maintain the body or to produce growth. Wolff, a German, after much experimentation, published a table of feeding standards. This table gives the number of pounds of dry matter (food without moisture), protein, carbohydrates, and fat required by the animal per day, per head or per 1,000 lbs., according to circumstances. In connection with these tables Wolff published another table showing how much of the protein, carbohydrates, and fat were digestible in the different foods available. A similar table has been published by Allen showing the digestibility of American feeding stuffs.*

Wolff's feeding standards are given in the following tables:

PER DAY AND PER 1,000 LBS. LIVE WEIGHT.

	Dry matter.	*Digestible food materials.*		
		Protein.	*Carbohydrates*	*Fat.*
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
Oxen at rest in stall	17.5	0.7	8.0	0.15
Wool sheep, coarser breeds	20.0	1.2	10.3	0.20
Wool sheep, finer breeds	22.5	1.5	11.4	0.25
Oxen moderately worked	24.0	1.6	11.3	0.30
Oxen heavily worked	26.0	2.4	13.2	0.50
Horses moderately worked	22.5	1.8	11.2	0.60
Horses heavily worked	25.5	2.8	13.4	0.80
Milch cows	24.0	2.5	12.5	0.40
Fattening steers:				
First period	27.0	2.5	15.0	0.50
Second period	26.0	3.0	14.8	0.70
Third period	25.0	2.7	14.8	0.60
Fattening sheep:				
First period	26.0	3.0	15.2	0.50
Second period	25.0	3.5	14.4	0.60
Fattening swine:				
First period	36.0	5.0	27.5	
Second period	31.0	4.0	24.0	
Third period	23.5	2.7	17.5	

*The Feeding of Farm Animals, by E. W. Allen, Farmers' Bulletin No. 22, United States Department of Agriculture, p. 7, 1895.

PER DAY AND PER HEAD.

	Av. live weight per head.	*Total dry matter*	*Digestible food materials.*		
			Pro-tein.	*Carbo-hydrates*	*Fat.*
Growing cattle—Age.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
2 to 3 months..........	150	3.3	0.6	2.1	0.30
3 to 6 months..........	300	7.0	1.0	4.1	0.30
6 to 12 months..........	500	12.0	1.3	6.8	0.30
12 to 18 months........	700	16.8	1.4	9.1	0.28
18 to 24 months........	850	20.4	1.4	10.3	0.26
Growing sheep—Age:					
5 to 6 months..........	56	1.6	0.18	0.87	0.045
6 to 8 months..........	67	1.7	0.17	0.85	0.040
8 to 11 months..........	75	1.7	0.16	0.85	0.037
11 to 15 months........	82	1.8	0.14	0.89	0.032
15 to 20 months........	85	1.9	0.12	0.88	0.025
Growing fat swine—Age:					
2 to 3 months..........	50	2.1	0.38	1.50	
3 to 5 months..........	100	3.4	0.50	2.50	
5 to 6 months..........	125	3.9	0.54	2.96	
6 to 8 months..........	170	4.6	0.58	3.47	
8 to 12 months..........	250	5.2	0.62	4.05	

Standard confirmed in practice.—It is not to be expected that an animal will receive the exact amount of digestible material in the rations as specified in this table, but a reasonable approximation to it, it is believed, will give the best results in feeding. For example, Wolff gives for a milk cow weighing 1,000 lbs. a ration containing 24 lbs. dry matter, 2.5 lbs. protein, 12.5 lbs. carbohydrates and 0.4 lbs. fat. After examining into numerous rations fed by prominent dairymen the Wisconsin, New York and Connecticut experiment stations have found the above amounts recommended by

Wolff to be substantially near those fed by these dairymen. The feeder, however, has to keep in mind that he is dealing with individual animals with different appetites and digestive capacities, so that rather than attempt to feed each by rule he should hardly expect the feeding tables to more than assist him in judiciously selecting and combining the foods and suggesting the extent to which they may be fed.

Ration for dairy cow.—A complete calculated ration for a dairy cow is shown in the following table given by Allen* The corn plant plays an important part in this ration:

Material fed.	*Total dry matter.*	*Digestible protein.*	*Digestible carbohydrates.*	*Digestible fat.*
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*
12 lbs. clover hay, 20 lbs. corn silage, 4 lbs. corn-meal, and 4 lbs. wheat bran.	21.28	1.66	10.86	0.57
4 lbs. gluten feed	3.69	0.82	1.75	0.34
Total	24.97	2.48	12.61	0.91
Wolff's standard	24.00	2.50	12.50	0.40

This is a close comparison, excepting for fat, which is not so important as the other two ingredients.

Corn a carbonaceous food.—Indian corn is a carbonaceous (carbohydrate) food rather than protein, and in making feeding rations this

*Farmers Bulletin No. 22, 1895.

forms the most valuable source of an economical carbonaceous food we have.

It has long been known that the grain of Indian corn is a most valuable food for domestic animals. It is generally relished by farm animals and imparts a quality to meat, milk or butter which ranks it among the most, if not *the* most, important common feeding-stuffs at our command. During recent years it has been well established, also, that the mature plant, independent of the seed, has a high food value, either green or as dry fodder.

Rations illustrated—Without attempting any elaborate discussion of the merits of Indian corn as a food, and presenting a large number of feeding rations, the balance of this chapter will be devoted to a few illustrations of rations and to demonstrating its importance when fed on the farm under certain conditions. Many different combinations of foods might be discussed, with corn as a part of each ration, but the space to be occupied here will not admit of this. The purpose is rather to note the desirable and undesirable use of corn as a food in common practice, so that a brief amount of space will be devoted to corn as a food for each class of farm animals.

Horses.—In that part of the country where corn forms a prominent grain crop, as in the Central West, and in much of the Southern

States, the principal grain fed horses is corn on the ear. Each horse is given a number of ears at a feed, dependent upon the amount of labor he is performing and the size of ear and character of grain upon it. In addition to this, timothy hay, especially in the North, forms the balance of the ration. In many cases, however, clover hay is fed. The writer has fed cut cornstalks instead of hay with much success. The horses eat the cut or shredded fodder with relish.

It would not appear, however, the best practice to feed horses corn alone for grain. This food is too heating in summer, as it is essentially a heat and fat-forming food. Some of the corn may be replaced to advantage with oats, which is more of a muscle former. Stewart says* the rations of thousands of horses on street railroads in this country have finally been fixed. The ration for summer is half oats and half corn, ground together, 16 lbs. to each horse, with 12 lbs. of cut hay. In winter 16 lbs. of corn-meal, with the same amount of hay, forms the ration. This practice he specially refers to as occurring in New York city, but states that in many other cities the corn and oats are fed the year through. This ration, it is to be understood, was fed to a class of horses that worked hard seven days a week.

*Feeding Animals, 1886, p. 378.

Where corn is fed to horses the most economical results may be attained by giving chopped rough fodder or hay, moistened, with the ground grain well mixed with it. Corn-meal ought never to be fed by itself, as it will tend to cause colic. The digestive fluids are not able to act freely on compact masses of the grain alone. Stewart notes that "probably more cases of horse colic arise from feeding corn-meal than from all other foods combined."

A committee of the American Institute Farmers' Club in 1855 made an examination of the rations fed stage horses in New York city. Hundreds of animals received hay and corn-meal only for their feed. The New York Consolidated Stage Co. reported on 335 horses, weighing from 1,000 to 1,100 lbs. each, that traveled on an average $21\frac{1}{2}$ miles per day. They had for feed 8 lbs. of hay and 17 lbs. of corn-meal per day. This meal was used in cut feed.

Stewart recommends the following ration as one more satisfactory with him than anything else:* Grind together 950 lbs. oats, 950 lbs. corn and 100 lbs. flax-seed. The 20th part of flax-seed improves the ration in protein and very much in fat—35 lbs. or $1\frac{3}{4}$ per cent to 2,000 lbs. This is well balanced as a working ration, is just laxative enough for health, and keeps the coat fine and glossy.

* Feeding Animals, 1886, p. 390.

A writer in the *Breeders' Gazette* (Jan. 11, 1893) feeds horses to be shipped to city markets with half oats and half shelled corn. To this grain he adds one pint of oil-cake meal per feed. He feeds all the grain they will eat up clean, and liberally of hay at night and only at night. While horses should never be fat, those poor in flesh must be fed up to a suitable condition for shipment.

For the use of the by-products of corn for horses the reader is referred to the experience of Prof. Caldwell, given further on in this chapter under by-products.

No one need hesitate at feeding horses with the dried corn plant in place of hay. At a liberal estimate three pounds of fodder may be considered equal to one pound of timothy hay. If the fodder was carefully harvested and well cured probably two pounds would be its equivalent. Silage does not seem so well suited for horses, although a small amount of it may be fed with safety and with beneficial results. Ten or 15 lbs., in the writer's opinion, would be ample. See reference to silage for horses under chapter on silos and silage.

Cattle.—No kind of grain is relished by cattle more than corn-meal, while well-preserved corn-fodder or silage is becoming more and more popular as rough feed for these animals. For dairy cattle this food is unexcelled for giving good quality to milk or butter. For this reason corn-meal is extensively fed, although there are other grains, as bran for example, that may increase the milk flow. Among the great cattle feeders of the West either the grain or the fodder of the corn plant forms the leading food for beef production. It is not desirable, however, as has already been explained, to feed corn entirely. Bran or shorts and a little oil-meal may be added to the grain rations where fed to milk or beef stock and better results secured. This question was asked Prof. Henry by a reader of the *Breeder's Gazette:* "With corn at 25 cents per bushel, oil-meal $22 per ton, bran and shorts $12 per ton, would you recommend feeding a so-called balanced ration, and what should the steers eat of the mixture?" This is the reply: "At the price named for corn some oil-meal or bran or both can be fed to profit, I think, keeping the ration largely corn, however. Five or six pounds of bran or two or three of oil-meal per day will aid digestion and keep the steer in better condition and less liable to get off feed than if the ration is made up wholly of corn." This ration was for a 1,000-lb. steer.

In making a study of 100 feeding rations used by owners of dairy cattle in the United States, Prof. Woll of the Wisconsin station notes* that

**Farm and Dairyman*, January, 1885.

corn silage was fed 68 times, corn-fodder and stalks 35 times, corn-meal 42 times and corn-and-cob meal 14 times. Excepting bran, no other grain food was used as much as corn-meal, and corn silage was fed much more than any other kind of coarse fodder. From these 100 rations the writer selects the following as representing a notable use of the corn plant or its products. Where corn silage is fed it is assumed that it contains the grain that was on the plant:

(1) 40 lbs. corn silage, 7 lbs. hay, 1 lb. straw, 2 lbs. oil-meal, 2 lbs. corn-and-cob meal, 2 lbs. wheat bran.

(2) 30 lbs. corn silage, 8 lbs. hay, 5 lbs. corn-fodder, 4 lbs. oats, 2 lbs. pea meal.

(3) 40 lbs. corn silage, 15 lbs. hay, 5 lbs. bran, 2 lbs. cotton-seed meal, 3 lbs. corn-meal.

(4) 50 lbs. corn silage, 9 lbs. clover hay.

(5) 32½ lbs. corn silage, 6 lbs. clover hay, 3 lbs. corn-fodder, 5 lbs. corn-meal, 4 lbs. shipstuff, 2 lbs. oil-meal.

(6) 24 lbs. corn-fodder, 5 lbs. corn-meal, 3½ lbs. bran, 1½ lbs. oil-meal, ½ lb. cotton-seed meal.

The above rations are not given as perfect ones, but as representing some of those fed by prominent dairymen of the country

The late Prof. E. W Stewart gave much attention to feeding problems. The five following rations were recommended by him for the purposes specified:*

For fattening cattle, 1,000 lbs. weight: 20 lbs. corn-fodder. 6 lbs. corn-meal, 6 lbs. linseed cake.

*Bulletin No. 38, Wisconsin agricultural experiment station, p. 44.

For dairy cattle, 1,000 lbs. weight: (1) 10 lbs. corn-fodder, 10 lbs. oat straw, 2 lbs. linseed-meal, 4 lbs. malt sprouts, 10 lbs. oat and corn-meal.

(2) 60 lbs. corn silage, 5 lbs. hay, 2 lbs. linseed-meal, 4 lbs. bran.

(3) 18 lbs. corn-fodder, 8 lbs. wheat bran, 4 lbs. cotton-seed meal, 4 lbs. corn-meal.

(4) 17 lbs. clover hay, 3 lbs. wheat bran, 10 lbs. corn-meal.

The writer has fed very young calves skim-milk in which was stirred 2 to 4 oz. of very fine corn-meal per feed, with satisfactory results. Numerous old feeders drop a handful of shelled corn in the milk bucket when feeding calves, and they soon learn to clean up the grain with avidity.

Sheep.—In the West, shelled corn is more often fed to sheep than any other kind of grain, a pint a day in a general way being given mature animals, although many feed much heavier in finishing for the market. It is an interesting fact that while if mature cattle are fed shelled corn some of it will pass through them whole, sheep will digest the kernel entirely.

Feeding experiments on sheep have been undertaken at the Michigan station by Smith and Mumford to an extensive degree.* During the winter of 1893–94 125 lambs were divided in nine lots and fed different rations for fattening. In all of these rations but one corn was fed, as

*Bulletin 113, Michigan agricultural experiment station, October, 1894.

is shown in the following table, which gives a summary of the results of the experiment. These figures refer to the average effects of the food per lamb per lot:

Lot.	RATION.	*Weekly gain.*	*Cost of 1 lb. gain—cents.*	*Pounds dry matter fed to 1 lb. gain*	*Protein fed per day per 1000 lbs.*	*Carbohydrates fed per day per 1000 lbs.*	*Nutritive ratio.*
1	Corn	2.18	4.6	7.02	2.0	16.0	1:8
2	Corn and roots	2.64	4.6	6.41	2.1	16.7	1:8
3	Corn, oil-meal and roots	2.61	5.3	6.72	2.7	16.1	1:6
4	Corn and oil-meal	2.38	5.1	6.99	2.8	15.7	1:5.6
5	Corn and bran	1.78	5.3	9.13	2.5	14.8	1:6
6	Corn and wheat	1.97	5.4	7.64	2.1	15.5	1:7.5
7	Wheat and oil-meal	1.94	6.3	8.04	2.7	15.0	1:5.5
8	Corn (self feed)	1.65	5.7	8.57	2.0	15.7	1:7.9
9	Corn and bran (self feed)	1.58	6.8	10.03	2.6	16.1	1:6.2

It will be noticed that the best results in cost of one pound of gain occurred where corn or corn and roots were fed. The other feeds were somewhat more expensive.

At the Wisconsin station a ration of shelled corn, silage, and cut corn-fodder, fed fattening wethers, yielded the cheapest gain. One hundred pounds of gain cost $3.46 in 1890 at this station when fed this ration. In 1891 the same kind of ration made 100 lbs. of gain cost $3.70. This ration was 1.3 lbs. corn-fodder, 0.8 lb. corn silage, and 1.3 lbs. shelled corn per day and head. A ration of corn and oats, equal parts by weight, clover silage and clover hay, made the cost of 100 lbs. of gain $4.01. A ration of oil-meal and oats, clover silage and clover hay, made 100 lbs. gain cost $6.09. The wethers receiving the clover and oats and oil-meal produced more wool than the corn-fed ones, but this increased weight was chiefly due to increase in yolk.

Pregnant ewes should not be fed a fattening food like corn. In fact corn is essentially a fattening food for sheep. If this end is not desired, then oats, bran, and oil-meal may be fed to better advantage, along with roots or silage.

Writing some years ago* Mr. F D. Curtis, then a well known student of sheep husbandry, said:

"No argument can now convince me that corn is a good kind of grain to give sheep to make them grow well or fit them for the lambing season. A very little corn will do mixed with other grain. * * * Corn makes the sheep fevery, and this dries the wool, makes it brittle and checks its growth. It inflames the udders of the ewes and makes a big show of milk, whereas it is actually mere fever, inflammation and swelling. It makes the lambs weak and tends to cause the ewes to forsake them, or not to own them."

It is well to hear both sides of this question, but it is practically true that the grain of corn should not be fed pregnant animals of any class, sheep as well as others, especially toward parturition. Bran or oats are much better at this time. But for promoting the laying on of flesh corn is a superior feed.

Corn-fodder and silage have not as a rule been largely fed sheep, but their use is becoming more and more common. Either one of these coarse foods may be fed sheep with sig-

* *Country Gentleman*, Jan. 29, 1885.

nal success. Mr. A. O. Fox, one of the most extensive owners of Shropshire sheep in America, writing of feeding shredded fodder, says in a recent letter:*

"When I first put the ewes into winter quarters upon the dry fodder I feared they would not relish it, but I soon found they took to it even more kindly than to good hay. They ate it ravenously and would fill themselves to perfect satisfaction and lie down in contentment to sleep. I am now thoroughly convinced that they have done better upon the corn-fodder ration than they would have done upon good, bright mixed clover and timothy hay. The corn-fodder did not have the slightest constipating effect. I have fed the lightest grain rations this winter that I ever gave my ewes and they are in fine bloom. Their fleeces are much cleaner than if they had been fed hay, and as for lambing, we are now well into the most successful lambing season we ever experienced; 98 ewes have to-day 158 lambs, which you will see is 160 per cent. Every lamb is strong and hearty from birth. The ewes are experiencing no trouble with their udders, and in fact I do not see any objection to confining them exclusively to corn-fodder instead of hay."

At the Wisconsin station corn silage has been fed wether lambs and suckling ewes with most satisfactory results. In the 1893 report of the station Prof. Craig says, where fed wethers, "the corn silage, considering its action as a food and the fact that it can be preserved cheaper and better than the clover silage, was the most satisfactory." Further, in referring to this food for breeding ewes, he says: "Of the succulent fodders, the best re-

* *Breeder's Gazette*, March 13, 1895.

sults were secured from feeding corn silage. It is cheap, the ewes like it, and they can easily be kept in a healthy condition when it forms part of the ration. The only danger lies in the fact that it may contain too much corn for breeding ewes." At the Michigan and Cornell University stations silage has also been fed with success. There is plenty of good evidence in the agricultural press of the past ten years demonstrating that corn silage is a valuable succulent food for sheep.

Swine.—Being the cheapest food available to the corn-grower in the West, most of the hogs shipped into the market have been raised and fattened on corn as the only grain food. In the past, however, pigs have been fed corn too exclusively. Numerous experiments have shown that better results are secured where some other grain is fed, using corn, however, as the principal food. Prof. Henry at the Wisconsin experiment station has probably conducted the most extensive feeding experiments on swine extant. His work emphasizes the importance of using other foods in connection with corn. Brood sows should be fed lightly of this and mainly with bran, shorts or some such food, before and at farrowing time, to get the best results. Pigs fed corn exclusively lack the strength of bone and desirable meat quality that is possessed by those that receive in connection with the corn some food rich in protein and ash. The following table, from the eleventh annual report of the Wisconsin station, contains in concise shape much valuable information bearing on the question of amount of food required to produce 100 lbs. of pork. It is to be noted here that corn is the important grain factor in these rations:

KIND OF FOOD.	*Time year.*	*No. trials*	*No. animals.*	*Average weight at beginning trial.*	*Food required for 100 lbs. gain.*
Whole corn..................	Winter	3	8	229 lbs.	784 lbs,
Corn-meal..................	Summer	5	12	71 lbs.	534 lbs.
Corn-meal..................	Winter	3	8	177 lbs.	517 lbs.
Barley meal................	Winter	4	12	159 lbs.	567 lbs.
Shorts.....................	Summer	1	3	58 lbs.	525 lbs.
Sweet skim-milk...........	Summer	2	4	66 lbs.	1,877 lbs.
½ corn-meal, ½ shorts (dry)	Fall	4	12	137 lbs.	531 lbs.
½ corn-meal, ½ shorts (wet)	Fall	4	12	136 lbs.	431 lbs.
Corn-meal and skim-milk..	Summer	5	10	95 lbs.	147 meal 892 milk
Corn-meal and skim-milk..	Summer	4	10	234 lbs.	379 meal 189 milk
Corn-meal and skim-milk..	Summer	4	10	251 lbs.	432 meal 216 milk

By this table it will be seen that far less corn and shorts were required to make 100 lbs. of gain than where corn was fed alone, and the showing is much better than that made by corn-meal alone. The first ration also has the advantage of being much the cheapest of the three.

The practice obtains to a large extent of feeding steers corn on the ear and letting pigs follow after and feed on the grain which passes through the steers undigested. Where steers are thus fed this is unquestionably the most economical practice. At the Wisconsin station a bushel of shelled corn made 11.4 lbs. of pork when fed alone to pigs, while a bushel fed to them when running with corn-fed steers made, with the help of the droppings of the steers, 17.6 lbs., or over one-half more.

Corn-and-cob meal vs. corn-meal.—The question is often asked as to which is the more valuable food, corn and cob ground together or corn-meal alone. Considerable experimental feeding has been conducted to throw light on this question, and very generally the information secured favors the grinding of the corn and cob together. It is assumed that the pure meal packs in the digestive organs and is not so readily permeated by the digestive fluids as is the corn-and-cob meal, the cob making the mass more porous.

At the Maine experiment station Jordan fed two lots of pigs 81 days, one receiving corn-and-cob meal, the other pure meal. There was but little difference in the gain made by each lot. Shelton at the Kansas station found that it required 650 lbs. of corn-and-cob meal to make 100 lbs. of gain when fed to pigs, while it required 670 lbs. of pure meal to make an equal gain. In a steer-feeding experiment Prof. Shelton also secured results favorable to the use of the cob with the corn.

General testimony seems to show that a

pound of corn-and-cob meal has the same feeding value as a pound of pure corn-meal. In this connection it is important to grind the cob finely. The writer has had difficulty in successfully feeding corn-and-cob meal to pigs when the cob was flaky or coarse, as they refused to eat it unless well milled.

The by-products of the corn plant embrace most important and valuable feeding-stuffs. The glucose and starch factories, distilleries and hominy mills produce by-products from the corn grain that are used for stock food on an extensive scale. They include gluten meal, gluten flour, gluten feed, glucose meal, glucose feed, maize or starch feed, sugar feed or meal and grano-gluten. These are produced by different methods of manufacture and so vary widely in composition. Quoting from Allen:* The corn is soaked until it is swollen and soft, and is passed through the mill while wet, the hulls and germs of the corn being rubbed off. In some cases the starch is separated from this mass by means of running water and the wet residue is dried and sold as gluten feed. In other cases the mass after grinding is bolted, the starch and gluten passing through, while the husk and germ remain behind. In some factories the latter (husk and germ) are dried and sold as corn-germ feed, corn-germ meal,

*Farmers' Bulletin No. 22, p. 16, The Feeding of Farm Animals.

etc. In others the material is treated to extract the oil from the germ and then sold under the name of maize feed. The material which passes the bolting cloth is treated to separate most of the starch, and the residue is sold as gluten meal, cream gluten, etc. The Chicago gluten meal, it is said, has had a part of the fat extracted from it. In some cases the gluten meal is mixed with the hulls and germs without the oil being extracted. This is said to be the case with Buffalo gluten feed. These materials should not be compared with grano-gluten, which is a dried distillery refuse. The residues from these factories are frequently sold in their wet condition, containing from 60 to 70 per cent of water, under the names of wet starch feed, sugar feed, glucose feed, etc. These wet products must be used at once, as they ferment. The dried products from the same factory often vary considerably in composition. Owing to these variations, and to the fact that there is such a variety of names for these products it is difficult to make any helpful classification; the farmer can only be certain of what he is buying when he buys on a guaranty of composition or from lots that have been analyzed.

Hominy chop, meal and feed are by-products from the manufacture of hominy and contain the germ and coarser portions of the corn.

The composition of a number of these feeds is given further on in this chapter. The wet foods are undesirable for summer use, unless fed when perfectly sweet, as they soon become badly fermented and offensive. If the dry product can be bought it is much preferable. The writer has fed wet starch feed, and when sweet it is eaten with relish, but the same product freed of excess moisture he found to be more satisfactory. He has also used gluten and hominy feeds. The former is high in protein and serves as a valuable substance to balance up with carbonaceous material, such as cornmeal. Hominy feed contains much less protein, but it is one of the most satisfactory corn by-products that the writer has ever used in feeding cattle. Gluten feed is not relished by cattle, in the author's experience, as generally as the hominy feed.

Testimony from users of by-products.— Four well-known feeders of dairy cattle contribute articles on feeding by-products of corn to the *Breeder's Gazette* of Sept. 5, 1894. The following quotations from three of these articles are of interest.

Prof. W H. Caldwell, who had charge of the Guernsey herd in the dairy cattle tests at the World's Columbian Exposition, says: I have used gluten meal, both the Chicago and Buffalo brands. To horses it has only been fed when I desired to winter cheaply and had no heavy work. The mixture used was two parts gluten, two parts bran and one part linseed meal, with plenty of good hay. Were I to do the same again I would add one part of what is called in the East provender, half corn and half oats, ground. I have never noticed any ill effect from the use of gluten with dairy cows. Some believe it to make butter soft, or with less body to it. The cream from my own dairy herd has always gone to the creamery, but butter was made from that of the Pennsylvania experiment station herd, with which I have been associated, and there was never any difficulty in making a fine quality of butter that controlled a good market. * * * During last winter's feeding, with the high price of bran, gluten was made the basis of the mixture, as three parts gluten to one part oil-meal and one part cotton seed.

C. A. Sweet: Has fed considerable gluten meal of the Buffalo brand to his herd of Jerseys. Feeds three quarts per day in two feeds, mixed with double the quantity of bran. Has only used it in cold weather and mixed it with water about twelve hours before feeding. He believes it a wholesome food for the cattle, and that it increases the milk flow.

H. H. Hinds, in charge of Short-horn cattle in dairy test at Columbian Exposition, says:

Owing to high price of corn-meal he fed to Exposition cows considerable corn hearts from hominy mills and gluten feed. These were liberally used with other grains. The corn hearts, considering cost, gave satisfactory results.

Digestible constituents in by-products.—The following table is given by Prof. W A. Henry, in answer to a correspondent,* showing the digestible constituents in 100 lbs. of each of the by-products of corn:

	Protein.	*Carbohydrates.*	*Fat.*
Corn	7.1 lbs.	62.7 lbs.	4.2 lbs.
Hominy chops	8.9 lbs.	61.9 lbs.	6.3 lbs.
Corn germ	8.9 lbs.	61.4 lbs.	5.6 lbs.
Germ meal	9.3 lbs.	63.6 lbs.	4.1 lbs.
Gluten meal	25.0 lbs.	49.4 lbs.	5.6 lbs.

Each one of these contains more protein than the corn, and the gluten meal more than three times as much.

* *Breeder's Gazette*, Sept. 5, 1894.

CHAPTER XIV

SOILING.

In the dry summer season when pastures become scant it is important that green food be supplied farm live stock. The process of soiling commonly means the feeding of stock green food in the stable during the summer, rather than pasturing the animals. In some places, near cities, where land is expensive, soiling is resorted to exclusively in season. One cannot always afford to pasture land worth $100 per acre. In other places, where pasture grasses dry up and become short, the stock is fed some specifically grown green crop additional to the pasturage. Either method embraces the principles of soiling.

Importance of green food.—The importance of supplying plenty of green food to stock in summer, and especially to cattle, cannot be emphasized too much. Quincy says* there are six advantages to be derived from this process:

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* Essays on the Soiling of Cattle. Boston, 1866, p. 56.

1. From the saving of land.
2. The saving of fencing.
3. The economizing of food.
4. The better condition and greater comfort of the cattle.
5. The greater product of milk.
6. The attainment of manure.

To this it is fair to add that if cattle are soiled in darkened stables a seventh benefit comes from reduced attacks of flies. In the case of the hornfly this is an important consideration.

Every farmer should provide a summer supply of succulent food to his cattle, sheep and swine. If this is not done when hot, dry winds prevail the pastures will become short and the animals will fall off in weight or in milk yield. At this time the far-sighted feeder draws upon a provision of green food, which maintains the balance on the ledger account in his favor through the critical feeding season.

Crops for soiling.—At the Indiana experiment station the writer has practiced soiling for several years, although the cattle have had the run of the pasture during the entire season. For two months each summer, however, the blue grass is dried off and eaten to the ground, so that extra green food has to be provided. To get the best results for a season of soiling the following crops planted in the order given may be recommended: Rye sown in the fall gives the earliest green fodder in spring. Oats and peas planted just as early as the soil can be suitably worked give a good succession to the rye. If two sowings of oats and peas follow each other at intervals of ten days, or thereabouts, one will secure a most nutritious and palatable green fodder that will yield heavily. Common oats and Canada field peas in the North make a good combination. A very satisfactory way will be to sow broadcast a bushel of peas to the acre and plow the seed under three to four inches; then harrow thoroughly and drill in two bushels of oats per acre. Some persons drill in oats and peas at the same time, but the peas should be planted twice as deep as the oats.

As soon as the seed can be safely put in the ground the corn crop for soiling should be planted. Three seedings may be made, so that a succession of green food will follow to frost. The rows may ordinarily be about three and one-half feet apart, and the seed six inches, or thereabouts, apart in the row. While the most nutriment is secured from the plant at maturity it will be desirable and profitable to begin feeding the green fodder just as soon as it assumes a size that will justify cutting, say at the time the blossom first appears.

Red clover and sorghum also make important soiling crops. The latter plant seems to do especially well in localities where considerable dryness often prevails in summer, and it furnishes a good succession of green food.

Of all the soiling crops, however, that which may be depended on by the feeder over the longest period of time, that will give the greatest yield at the least expense, is Indian corn, Green rye may injure the flavor of milk given by cows fed this crop, but Indian corn assists in producing the finest quality of milk and butter.

Soiling at Wisconsin station.—In an experiment at the Wisconsin station this amount of green food was supplied between June 15 and Oct. 15, from an acre and a half of land, according to Prof. Henry:*

Fodder corn....	23,658 lbs.
Green clover..........................	19,762 lbs.
Green oats............................	2,385 lbs.

Early variety of corn desirable.—In planting corn to secure the first crop it will be desirable to get an early variety. The early varieties of sweet corn produce but small plants and comparatively little fodder, while the later sweet corn is no improvement over the field varieties, and as a rule does not yield so bountifully of forage. Of the sweet varieties Stowell's Evergreen is among the best for this purpose.

* *Breeder's Gazette*, Nov. 21, 1894.

Results at the Iowa station.—At the Iowa experiment station, according to Prof. James Wilson,* the following yields of soiling crops on an acre of land each were obtained:

	Total green food.	*Total dry matter in green food.*
Oats and peas........	20,800 lbs.	6,656 lbs.
Second-crop clover...	14,400 lbs.	2,880 lbs.
Rape........	54,400 lbs.	5,755 lbs.
Sweet corn.........	**36,800 lbs.**	**12,512 lbs.**

While the corn gave a smaller yield of the green food than the rape it produced more than twice as much dry matter.

The milk made by cows fed different soiling crops was taken to the college creamery and the butter made from it was scored for flavor by experts, rating 45 points for perfection. Blue grass, oats and peas, and clover butters scored 42, rape butter 39 and sweet corn butter 45, or perfection. Prof. Wilson says: "The sweet-corn butter had the very finest flavor and suggests the reason why Western corn-fed butters rank so high. Many Iowa farmers feed nothing but corn and its fodders."

Experiments at Pennsylvania station.—At the Pennsylvania station experiments were conducted for three years to ascertain the food yield of forage corn.† Two kinds of corn were planted, some plats thick, others thin, on plats

* *Breeder's Gazette*, March 7, 1894, p. 151.

† Annual Report Pennsylvania agricultural experiment station, 1892, p. 22.

one-twentieth of an acre each, and samples from each plat were taken at intervals and analyzed. According to the results secured Breck's Boston Market, sown thick, yielded in the milk or just past this stage from 4,043 to 6,494 lbs. of digestible food per acre. The digestible protein in this food ranged from 110 to 314 lbs. per acre. These figures show that a large amount of food may be secured in the plant some time before full maturity, when the largest amount of nutriment is usually obtained.

Beneficial effect of green food.—In soiling stock, however, it is to be noted that an unknown value may be attributed to these green foods, which is shown in their influence on the general health of the animals. There are some who disapprove the use of corn silage because a ton of it, water-free, contains no more digestible food than a ton of dry fodder, but these men as a rule overlook the physiological effect of a green food on the system—an influence that cannot be measured by chemical standards.

Stewart on corn for soiling.—In discussing the corn crop for soiling Stewart says:*

"Corn is adapted to the soil of all the States, and produces, under favorable circumstances, enormous yields of green fodder. The author has grown 28 tons to the acre; but M. Goffart, of France, grows from 30 to 50 tons, as he has stated in his work upon "Ensilage." * * * There is no

*Feeding Animals, 1886, p. 194.

doubt that it produces a larger weight of green food than any other crop raised in the United States except, perhaps, sorghum, and this renders its study as a soiling crop of the highest importance. * * * It is a most desirable crop, as it can be fed in combination with clover, oats and peas, and other more nitrogenous food. The largest crops may be grown with the large Western or Southern varieties of field corn; and next to these, Mammoth sweet corn and Stowell's Evergreen sweet corn. The quality of the sweet varieties is better than the field varieties. The greatest amount of desirable nutriment is obtained by planting in drills 32 inches apart, so that the corn can be thoroughly cultivated. The sweet corn will then grow ears upon a large proportion of the stalks, and these ears in the soft state greatly improve the quality of the food for both fattening and milk production. When thus grown cattle fatten rapidly upon it and cows yield milk abundantly. Corn is so easily grown and produces so largely that dairymen make it the principal green food to sustain their herds upon short pasture. Judicious feeders, when they have no other green food but fodder corn, are in the habit of feeding wheat bran and middlings with the corn-fodder, so as to make it a well-balanced food."

Early cutting objectionable.—If cut at a very early stage green corn is too watery, and unsatisfactory results may ensue unless grain or hay is fed in connection with it. Corn especially lacks in protein, but this may be supplied in bran or other grain which contains a fairly large per cent of this substance. Says the late Prof. L. B. Arnold, than whom there was no better authority on dairying fifteen years ago:*

"Those who have condemned it have fed it too young, or have sown it so thick that its aliment (nutriment) was not

*American Dairying, 1879, p. 72.

developed. When too thickly planted its stems and leaves are soft and pale, its juices thin and poor, and the effect is a growth somewhat like a potato vine in a cellar. If sown thin, or in drills, so that the air and light and heat of the sun can reach it, and not fed till nearly its full size, it is a valuable soiling plant and is fed with satisfactory results."

Soiling on pasture.—It is a good thing, where entirely feasible, to have a corn field convenient to the pasture or stable. This may be planted as though to be harvested with the ears as an important factor of the crop. When the plants begin to flower use from the field for soiling until the plants pass beyond their usefulness for that purpose. When maturity arrives this field may also be drawn upon for filling the silo. If the field is conveniently situated plants may be cut from day to day and thrown into the pasture. This is a most satisfactory method.

CHAPTER XV

SILOS AND SILAGE.

At the present day a silo is generally represented by a pit or room, in some cases with partitions, which is filled to the top with green fodder. The silo is built of stone, brick or wood, and is necessarily of strong construction in order to withstand the side pressure of the contents, which in deep silos is very great.

The practical use of the silo in the United States really dates from 1876. Since then thousands of them have been built in this country and Canada.

Constructing a silo.—In building a silo there are important points which it will be well to take into consideration. It should be made deep. The greater the pressure from above the more the air is expelled from among the silage and the better it will keep. A depth of 24 feet is shallow enough, and if deeper it will be better still.

The wall of the silo on the inside should be smooth. If of brick or stone it should be covered with a coat of smooth cement. If wood is used the inside lining should have a smooth dressed face. The purpose of this is to enable the silage to settle evenly. No blocks or rods should interfere with the settling process.

There should be as few corners as possible, for it is in corners, at the door casings and on the surface that the most silage spoils. Consequently a round silo offers advantages over a square or rectangular one. Corners may be boarded off and the angles reduced. Door boards should fit smooth and flush with the side of the silo.

Gas tar may be profitably painted over all woodwork, for as a preservative it is of the highest character. No wet or green wood should be used, and only the dry timber be tarred. This material can be applied to best advantage when hot.

Most desirable forms.—The two most desirable forms of silos are round and square. The round contains the least amount of waste space, and owing to its form of construction presents more strength to resist side pressure than any other shape, as it is equally distributed against the walls at every point.

The square or rectangular silos may be often built to advantage in the barn, in a corner or in a bay. If to be built to stand by itself the square form is preferable to the rectangular. The walls are stronger. For equal capacity there is less waste wall space in the square.

Lining and floor.—The most satisfactory inside lining for the walls of wooden silos consists of two layers of boards with tarred paper laid between. The first layer would be placed horizontally against the studs, next would come the paper, and last the inner layer of boards nailed on vertically, smooth side out. With the round form the lining all goes on horizontally. Strips one-half inch thick and four to six inches wide are placed on each other tightly and so as to break joints. This construction strengthens the silo, as a hoop does a pail. There can be no springing out at one place in the side and not at another. An equal pressure extends from the center to the circumference on all sides.

It will be well to have the floor of stiff clay or of cement. It is important to have it ratproof, as these pests burrow up into the silage where the floor is soft and cause great damage by admitting air into it.

Walls.—The walls of wooden silos remain sound longest when they are well ventilated. Where they are tightly boxed up moisture accumulates within and decay occurs. Auger holes bored between studs at bottom give sufficient ventilation if there are openings at top of wall. All these holes or openings should be covered with wire netting to keep out rats and mice. The studs must be strong enough to guarantee against springing out under the greatest pressure they are likely to undergo.

The feeding door should be two and one-half to three feet wide and extend in sections from sill to within three or four feet of the top, each part being about five feet long. A space two to three feet wide should be left or iron rods should be placed in between the doors at sufficient intervals to make the wall perfectly strong. One or two extra studs on each side of door casing secure the strength of wall here. Boards as long as the door is wide are placed horizontally in the frame, edge to edge and flush with the inside of silo, resting against cleats nailed on inside of casing or fitting into grooves. These boards may be put in place as the silo is filled.

Weather boarding is not essential, though in the North it assists in reducing freezing. Within the barn only the inside linings are at all necessary.

Fasten cables or ties of timber across the tops of square or rectangular silos, attaching to opposite studs, to prevent the walls from spreading. Ties every seven or eight feet will answer.

Sills.—The sills, well tarred, should rest on a good foundation that extends below frost line and be bedded in cement or mortar. Have the sills placed freely above the outside soil. In square or rectangular forms the sills must be anchored to the wall to keep them absolutely in place. Usually bolts are set in the wall when it is built, and these project enough above this to just extend through the sills to permit capping with washers and nuts.

Roof.—A roof is required only on silos out of doors. This may be built to suit, but it should at least protect the silage from rain and snow. It should, if of permanent character, contain a dormer window or door in roof through which the elevator may carry the cut fodder and deposit it within the silo.

Capacity of silo.—The capacity of the silo depends on the needs of the farmer. A cubic

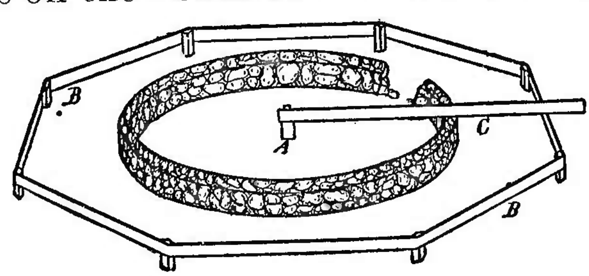

FIG. 57.

foot of silage under average conditions will weigh 40 lbs.—perhaps a little less. A day's feed for one cow would not probably as a rule exceed this amount. If silage is fed one cow 200 days she will consume, say 8,000 lbs., or four tons. On this basis 10 cows will require 40 tons, though it would be well to make the capacity 50 tons.

Plans for round silo.—The accompanying illustrations, reproduced from Bulletin 28 of the Wisconsin experiment station, by Prof. F. H. King, explain in a measure the process of constructing the round silo. Fig. 57 shows a method of laying and leveling the foundation. *A* is a center post with top level with top of proposed wall; *B B* are straight-edge boards

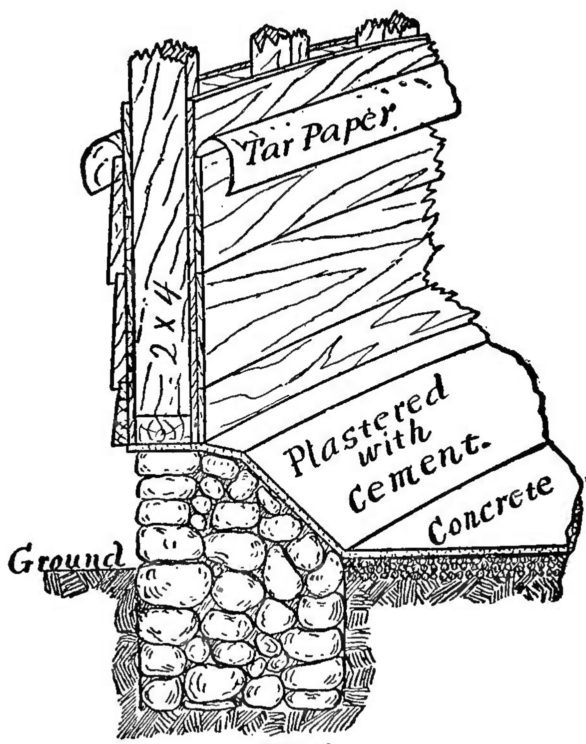

FIG. 58.

nailed to stakes driven in the ground; *C* is a straight-edge fixed to turn on a pin at *A*; *B B* are all nailed level with top of post *A*.

Fig. 58 shows the construction. The sills are 2x4s, cut in sections on a radius of the silo circle; these should be sawed out with much care. After being bedded in mortar they may be nailed together. The plates are the same spiked to top of studs, which are 2x4s, one foot apart. Short lengths of studs may be used, lapped to get the depth; 16s and 14s will give a silo 30 feet deep. Linings are made from fencing ripped in two to give one-half inch in thickness; outside sheeting the same. Use for silos under 28 feet, outside diameter, common

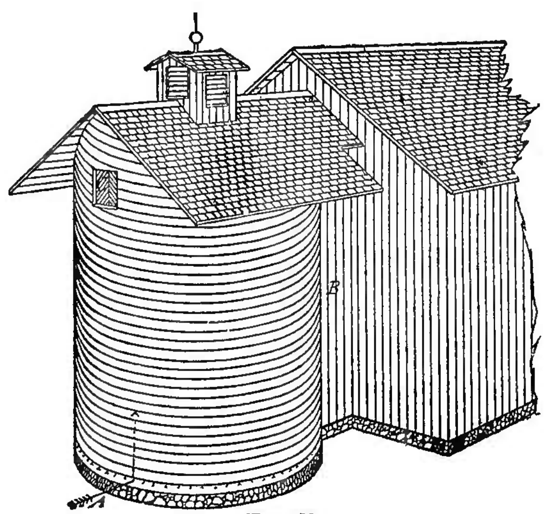

FIG. 59.

siding, rabbeted; for diameter over 28 feet outside, common drop siding or shiplap may be used.

In Fig. 59 is seen a method of roofing a round silo and manner of connecting it with a barn. *A* shows where air is admitted between studding to ventilate between the lining; *B* is the feeding chute; *C* is filling window, and the cupola serves as a ventilator.

Square silo.—In building the square or rectangular silo the sills may be of 2x10 plank, in two layers, halved and spiked at the corners. The 2x10 studs are toe-nailed to the sills, 18 inches apart, center to center. If the silo is to be more than 20 feet deep then 2x12 sills and studs would be better, on account of increased side pressure. The base of each stud may be cut on the outside to block against a 2x4 piece spiked along the outer line of sill to keep base of studs from being forced outward. The studs at the top are fastened with a strong plate, to which they are spiked.

Cost of silo.—The cost of a silo depends upon many conditions, and no estimates can be given that will apply to all localities, there being such a difference in cost of materials, labor, etc. A cheaply constructed silo, however, is an expensive one in the long run. It will pay much better to build carefully and well, having the construction strong, tight, and free of air-holes at sides and bottom. Most of the condemnation of the silo has resulted from trials where the construction has been poor and the contents badly preserved. Prof. King gives in Bulletin 28 of the Wisconsin station estimates on the cost of a well-constructed round silo of 180 tons capacity as $344.44, or $1.91 per ton. Numerous estimates have been published by different persons where the cost is much less than this, but King's figures represent first-class work and include all the details of construction.

Corn the best for silage.—Indian corn is recognized as the plant superior to all others for silage when cost of production, yield of food material, etc., are taken into account. Other plants are used to an insignificant extent for silage as compared with this, and it is not the purpose of the writer to consider their merits.

Indian corn is adapted to a wide geographical range and will produce the largest amount of desirable silage per acre of any crop we can grow. Fifteen to 20 tons of green fodder can be produced on an acre without difficulty over a large part of the United States.

Varieties best suited for silage.—All of the large varieties of corn are suitable for silage. It is important, however, that the variety mature in the region grown in. Southern corns as a rule will not mature in the North sufficiently to justify planting them where the corn-growing season is short. Perhaps the safest way is to plant the best known heavy yielding variety grown in the county or vicinity—one well adapted to the local conditions. If other varieties are to be grown they should possess early-maturing powers and also yield heavily of both forage and grain. A reference to the varieties in Chapter III will assist one in selecting what may be a satisfactory variety for a given locality and conditions. In the South there are numerous varieties which produce the best of material for silage that would not mature in New England, Michigan or Wisconsin sufficiently to warrant their being planted there.

Growing corn for silage.—The writer recommends that silage corn be grown under ordinary field conditions, and that such of the crop be used for the silo as circumstances make necessary, using the remainder for the later harvest. This is a method which he has found in practice to be very satisfactory. Prof. Georgeson of Kansas, however, recommends* planting thicker than ordinary when the crop is grown for silage. At the Kansas experiment station they always plant the silage corn in drills, and have found by experience that they get the heaviest yield when the stalks are four to eight inches apart in rows one and one-half feet apart. At this distance the ears are small and totally unfit for market, but the plants furnish a large amount of nutrition and make up in number what they lack in size.

The same rules for caring for common field corn will apply to that intended for the silo. The cultivation should be frequent enough to destroy all weeds and encourage a rapid growth of the plant. Unless a rotation of crops or

* *Prairie Farmer*, June 8, 1895.

other conditions prevent, it will be well to have the cornfield as near to the silo as possible to save time and labor in hauling. For information on cultivating and field harvesting the reader is referred to the chapters on tillage and harvesting. In the latter chapter the harvesting of silage crops is given special attention.

Filling the silo.—The fodder-cutter should be placed convenient to the silo, so that the carrier may be made as short as possible. The stalks are eaten up most completely when cut very short, and one-half an inch is a desirable length.

After much experimental work it seems to be demonstrated that rapidity of filling is on the whole unimportant. Some fill as fast as they can haul and cut, while others allow an interval of two or three days to occur in course of harvesting when no material is placed in the silo. In each case the preservation may be eminently satisfactory.

The cut fodder can be handled to best advantage if deposited in the center of the silo and distributed to the sides from there. Some recommend a cloth chute to be fastened at one end of carrier, and the other end tied from time to time in different directions, so as to generally distribute over the entire surface. While the practice is not universally followed, the writer has had the best success in preserving when the corn was well trampled at the sides in filling. The more uniform the packing throughout the better will the silage be preserved.

Covering the top.—When full the contents may be allowed to settle for a day or so, when more corn may be cut into the silo, or cut straw or chaff may be filled on the silage to a foot or so of depth. A layer of tarred paper may first be laid on the silage and the straw placed on this. Some dispense with the paper, while others begin feeding the silage from the top as soon as filled, never covering at all. No pressure on top of the corn is necessary.

Wetting the silage.—When the corn is cut in a very dry season, and is not as juicy as common, the writer has found it advisable to pour water on it after the temperature reaches a high point. If one has a water pressure and can turn on through a hose, that will be a convenience. Plenty of water may be used to advantage, but no fixed rate of application can be recommended.

Cost per ton.—The cost of corn silage per ton varies, and the estimates made by those owning silos vary widely—from 25 cents to $4 per ton. At Lafayette, Ind., the writer estimated the cost to be $1.50, and this included higher-priced labor than many pay for, and numerous other factors, such as taxes on land, etc., that are not taken into account by the farmer.

Feeding it out.—The silage may be fed at any time. As already stated, some begin to feed as soon as the silo is filled. The feeding should be from the top if possible, so as to allow no part an opportunity to decay. Where long, shallow silos, however, are used, the better way is to keep the top covered, excepting toward one end, and then to feed from the end, working off a vertical section to the floor from time to time.

Corn silage has been found, as a result of large practice, to be a valuable food for cattle and sheep. Swine do not eat it to any appreciable extent, excepting for the grain it may contain. There is considerable diversity of opinion as to its value for horses. Mr. M. W Dunham of Wayne, Ill., one of the greatest breeders and importers of horses in the United States, if not in the world, writes the author that after carefully testing it on a large scale as a food for horses, during two years, he finally discarded it as unfit for them. Others, however, feed horses silage with satisfactory results. It is important to remember that horses have comparatively small stomachs and should be fed lightly of this food, otherwise colic or bowel trouble is liable to occur. For a further consideration of silage as a food the reader is referred to Chapters XII and XIII.

CHAPTER XVI.

STATISTICS.

Indian corn is the most important cereal crop grown in America, as based on crop production and values. The crop for 1893 had a much greater money value than the combined ones of wheat, oats, rye, barley, and buckwheat for the same year. The magnitude and commercial value of the corn crop of the United States can only be comprehended by a study of statistics bearing on this subject.

The corn crop of 1888 amounted to nearly 2,000,000,000 bushels. Commenting on this fact, one of the agricultural journals* presented its readers with the following graphic statement. If the corn crop were put into 40-bushel wagon loads, and 30 feet be allowed for the wagon, team and headway in the road, the string of teams would stretch 284,090 miles, or 11 rows around the world, and 9,000 miles more of teams not in line. If in car-loads of 500 bushels per car, allowing 40 feet for length and

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* *Orange Judd Farmer*, Sept. 29, 1888.

couplings, the corn crop of 1888 would require 4,000,000 cars, and they would make up a continuous freight train 30,303 miles long; or 10 trains from the Atlantic to the Pacific; or one freight train of corn clear round the world with enough cars left over to form two continuous trains from the Atlantic to the Pacific.

STATES AND TERRITORIES.	*Acres.*	*Bushels.*	*Value.*
Maine	13.553	410,656	$254,607
New Hampshire	25,074	794,846	453,062
Vermont	44,094	1,428,646	871,474
Massachusetts	40,460	1,355,410	840,354
Rhode Island	8,949	218,356	150,666
Connecticut	43,557	1,228.307	786,116
New York	517,135	15,255,483	8,390,516
New Jersey	277,183	7,179,010	3.733.101
Pennsylvania	1,273,418	31,198,741	15,287.383
Delaware	199,874	4,916,900	1,966,760
Maryland	623,667	15.078,221	6.634.417
Virginia	1,652,595	31.234,046	14,367,661
North Carolina	2,435,310	29,954,313	14.977,157
South Carolina	1,623,511	12,501,035	7.500,621
Georgia	3,034,079	33,678,277	18.859,835
Florida	506,120	4,909,364	3.338.368
Alabama	2,463,349	28.328,514	16,713,823
Mississippi	1,970,777	25.817,179	14,199,448
Louisiana	1,071,568	15,216,266	8,673,272
Texas	3,475,623	61.170,965	33,032,321
Arkanses	1,982,149	32,110,814	14,449,866
Tennessee	2,988,247	63,649,661	24,823.368
West Virginia	649,265	14,089,051	7,748,978
Kentucky	2,893,960	68 008,060	29,243.466
Ohio	2,709,549	64.487,266	25,794,906
Michigan	919,432	21,790 538	9,805,742
Indiana	3,456.226	85,368 782	30,732,762
Illinois	6,247,100	160,550,470	49,770,646
Wisconsin	971.686	28 956,243	10,134,685
Minnesota	887 052	25,103,572	8.535,214
Iowa	7,428,677	251,832,150	67,994,681
Missouri	5,670,169	158,197,715	47,459,315
Kansas	6,547,263	139,456,702	43,231,578
Nebraska	6,241,226	157,278,895	42,465,302
South Dakota	865,472	20,511,686	5,127,922
North Dakota	20.142	416,939	158,437
Montana	1,102	30.305	21,214
Wyoming	2.071	38,314	24,138
Colorado	123,107	2,031,266	1,035,9[illegible]6
New Mexico	25.155	636,422	451,860
Arizona	4.604	81,951	54,088
Utah	8,575	184,363	106,931
Nevada	....	....	....
Idaho	1,628	31.746	22,540
Washington	8,405	179,027	110,997
Oregon	13.132	324,360	152,449
California	71,775	2,275,268	1,137.634
Total	72,036,465	1,619,496,131	$591.625.627

Area planted to corn.—The preceding table* gives the number of acres of corn planted in the United States in 1893, number of bushels of grain grown, and its value. The corn crop for 1894 was the smallest, with one exception, harvested in the past fifteen years, being almost 390,000,000 bushels less than the average for 1890–1894, and over 490,000,000 bushels less than the average crop of the ten years 1880–1889. For this reason the 1893 yield of the several States is given, instead of the 1894:

The average rate of yield, 22.5 bushels per acre, is the lowest for ten years, with the exception of the years 1886, 1887 and 1890. It is only a little lower, however, than that of 1883, which was 22.7, or two-tenths of a bushel greater. The average value per bushel is 36.5 cents, which is 2.9 cents, or about 7 per cent lower than the value of 1892. This value is 6.1 cents less than the average of the ten years 1870–1879, 2.8 cents less than that of the decade 1880–1889, and 6.6 cents below the average value of the three years 1890–1892. In the ten years preceding only four crops, viz., those of 1884 (35.7), 1885 (32.8), 1888 (34.1), and 1889 (28.3), have had a lower average value.

Magnitude of corn crop.—The significance of the corn crop of the United States, as cover-

*From December, 1893, report of of the Statistician of the United States Department of Agriculture.

ing a term of years, can be best shown in the following table:*

	Total production, bushels.	*Total area, acres.*	*Total value, dollars.*
Average for 10 years, 1870-1879	*1,184,486,954*	*43,741,331*	*504,571.048*
1880	1,717,434,543	62,317,842	679,714,499
1881	1,194,916,000	64,262,025	759 482,170
1882	1,617,025,100	65,659,545	783,867,175
1883	1,551,066,895	68,301,889	658,051,485
1884	1,795,528,000	69,683,780	640,735,560
1885	1,936,176,000	73.130.150	335,674.630
1886	1,665.441,000	75,694,208	610,311,000
1887	1,456,161.000	72.392,720	646,106,770
1888	1.987,790,000	75,672,763	677,561,580
1889	2,112,892.000	78,319,651	597,918,829
Average, 1880-1889	*1,703,443,054*	*70 543,457*	*668.942,370*
1890	1,489,970,000	71,970,763	754,431,451
1891	2.060,154,000	76.204,515	836,439,228
1892	1,628.464,000	70,626,658	642,146,630
1893	1,619,496,131	72,036,465	591,625,627
1894	1,212,770,052	62,582,269	554.719,162
Total	8,010,854,183	353.420,670	3,379,364.098
Average, 1890-1894	*1,602,170,837*	*70.684,134*	*675,872,820*

Statistics of yield and price.—The table on next page, prepared from the reports of the Statistician of the United States Department of Agriculture and the United States census, has a special interest as bearing on the two preceding tables.

The exports of Indian corn from the United States have been and are comparatively small. From 1870 to 1893 there has been exported each year 3.8 per cent of the entire crop grown, as an average for that period of years. The greatest percentage amount exported in one year—6.5 per cent—was in 1877, while the smallest amount, 1 per cent, was exported in 1870, although the amount was only 1.7 per cent in

*Report of Statistician of the United States Department of Agriculture, Report 3, December, 1894, p. 720.

1887. Notwithstanding the United States Department of Agriculture under Secretary Rusk's administration made an effort to disseminate information abroad concerning the value of Indian corn as a food, by sending a special agent, Mr. Charles J. Murphy, to Europe, there has been no striking increase in the

YEAR.	*Population.*	*Corn crop. Bushels.*	*Bushels per head population.*	*Average price per bushel.*	*Average yield per acre.*
1839	....	377,531,875	22	....	....
1849	....	592,071,104	25	....	....
1859	....	838,792.742	27	.. .	....
1869	37,756.000	874,320.000	23	75.3	23.5
1870	38,558,371	1,094,255,000	28	54.9	28.3
1871	39,555,000	991.898,000	25	48.2	29.1
1872	40,596,000	1,092,719.000	27	39.8	30.7
1873	41,677,000	932,274.000	22	48.0	23.8
1874	42,796 000	850,148,500	20	64.7	20.7
1875	43.951,000	1.321,069,000	30	42.0	29.4
1876	45,137.000	1,283,827,500	28	37.0	26.1
1877	46 353,000	1,342,558,000	29	35.8	26.6
1878	47.598.000	1.388,218,750	29	31.8	26.9
1879	48,866,000	1,547.901,790	32	37.5	29.2
1880	50.155,783	1,717,434,543	34	39.6	27 6
1881	51,316.000	1,194,916,000	23	63.6	18.6
1882	52,495,000	1,617,025,100	31	48.4	24.6
1883	53,693,000	1.551,066,895	29	42.4	22.7
1884	54 911,000	1,795,528,000	33	35.7	25.8
1885	56,148,000	1,936,176,000	34	32.8	26.5
1886	57.404.000	1,665,441,000	29	36.6	22 0
1887	58,680,000	1,456,161,000	25	44.4	20.1
1888	59,974,000	1,987.790,000	33	34.1	26.3
1889	61,289.000	2,112,892.000	34	28.3	27.0
1890	62,622.250	1.489.970.000	24	50.6	20.7
1891	64,002.000	2,060,154.000	32	40.6	27.0
1892	65,403.000	1,628,464,000	25	39.4	23.1
1893	66,826,000	1.619,496,131	24	36.5	22.5
1894	68,275,000	1,212,770,052	18	45.7	19.4

export trade. A verification of this statement may be found in the following table. In spite of this fact, it is confidently believed that the persistent and judicious work of Mr. Murphy will result eventually in a decided increase in our export trade. With a firm belief in the value of Indian corn as a food, he has sacrificed much of personal fortune and time to properly present the merits of this grain to the several European governments. Mr. Murphy will never reap the reward he deserves for the service he has bestowed upon American corn growers:

TOTAL CROP AND EXPORT OF INDIAN CORN.

YEAR.	*Total yield.*	*Bushels exported.*	*Per cent exported.*
1870	1,094,255,000	10.673,553	1.0
1871	991,898,000	35,727,010	3.6
1872	1,092,719,0 0	40,154,374	3.7
1873	932,274,000	35.985,834	3.9
1874	850,148.500	30,025,036	3.5
1875	1,321,069,000	50,910,532	3.9
1876	1,283.827,500	72,652,611	5.7
1877	1,342,558,000	87 192.110	6.5
1878	1,388,218,750	87,884,892	6.3
1879	1,754,591,676	99 572,329	5.7
1880	1,717,434,543	93,648,147	5.5
1881	1,194,916,000	44.340,683	3.7
1882	1,617,025,100	41.655,653	2.6
1883	1,551,066.895	46,258,606	3.0
1884	1,795,528,000	52,876,456	2.9
1885	1,936,176,000	64.829,617	3.3
1886	1,665,441,000	41,368,584	2.5
1887	1,456,161,000	25,360,869	1.7
1888	1,987,790,000	70,841,673	3.6
1889	2,112,892,000	103,418,709	4.9
1890	1,489,970,000	32,041,529	2.2
1891	2,060,154,000	76,602,285	3.7
1892	1,628,464,000	47,119.524	2.9
1893	1,619,496,000	66,489,529	4.1
Average	1,495,169,749	56,568,021	3.8

These figures show that the largest shipments abroad were made in 1879 and 1889, and that after 1879, up to 1892, excepting 1889, the shipment fell below the average amount exported yearly for 23 years.

The average yield in bushels per acre for the country, for the years 1890–94, has varied from 9.6 for Colorado in 1893 to 51.7 for Connecticut the same year. New Hampshire shows the highest general average yield, being 44.6, 45.7, 43.2 and 47.3 bushels respectively for the years 1890 to 1893. The averages of all the States for the same periods were 23.1, 28.7, 26.8 and 25.9 bushels. The relatively high yield of the New England States is due to the intensive methods of farming practiced over a small area, in which either stable manure or artificial fertilizers are largely used.

Corn crop of the world.—Before leaving this subject it will be well to note the extent of the Indian corn crop of the world. About 80 per cent

COUNTRY.	*Year.*	*Acres.*	*Bushels.*
United States	1891	76,204,515	2,060,154,000
Canada	1891	241,086	9,432,559
Austria-Hungary	1890	5,691,886	109.126.632
France	1890	1,350,641	23,815.177
Italy	1890	4,724,110	74,961,075
Portugal	1891	1,284,920	20,225.700
Roumania	1891	4,184,372	59,977,319
Russia	1890	....	24,233 177
Japan	1887	55,365	1,245,016
Cochin China	1889	13,245	304,180
Natal	1887	206,368	2,566,628
Argentine Republic	1888	....	49,200,612*
New South Wales	1890	173,836	5,523,611
New Zealand	1891	5,759	246,393
Queensland	1890	99.400	2,448,625
Victoria	1891	10,357	592,178

of that grown is produced in the United States, while the large share of the balance is grown in a few countries along the lower Danube river in Europe, in Spain, Argentine Republic and Mexico. An entirely satisfactory statement of the world's crop cannot be secured, owing to the fact that statistics are not available of the crop grown in Mexico and many other countries. The above table is as recent a statement

* Commercial estimates.

as the writer could secure of the yields of corn of different countries, and is compiled from many government reports.*

When the Indian corn harvest of the United States is better than an average one the total world's crop of this cereal exceeds in size that of the total yield of any other cereal.

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*Production and distribution of the principal agricultural products of the world. Compiled from official statistics. United States Department of Agriculture. Report No. 5, p. 15.

CHAPTER XVII.

MISCELLANEOUS.

A number of subjects of interest and importance are placed in this chapter. They seemed inappropriate to the subject matter of the preceding chapters, yet of sufficient importance to be classed by themselves under this general heading.

Detasseling.—Since 1888 this subject has received considerable attention at some of the experiment stations. According to McLaren* in 1739 James Logan of Philadelphia published an account of some experiments made by him where he removed the tassels of the corn plant and transposed the pollen. In 1879 Beal called attention to the fact that a corn plant does not naturally fertilize itself, the pollen being discharged from the tassels before the appearance of the silk.†

Among the early experiments made at the stations some evidence seemed to indicate that

*Agricultural Science, Vol. 7, p. 319.

†Michigan Board of Agriculture Reports, 1879, p. 198; 1880, p. 283.

a larger crop was secured by detasseling. Later investigations, however, in most cases gave evidence of reduced crop yield due to this practice. In 1888 Shelton of Kansas found a loss of nearly 10 per cent due to detasseling.* Roberts in 1890, at Cornell University, however, secured a gain of 50 per cent due to detasseling, and this experiment attracted wide attention to the subject.† Further work at Cornell seemed to corroborate this result in a measure. In 1892 there was a gain in weight of good ears amounting to 15 per cent, and of poor ears of 26 per cent on the detasseled rows, besides being a gain in number of ears.‡

At the Illinois station, however, several years of experimentation have shown no advantage to be derived from this process, but if anything a loss. At the Nebraska station, a decided loss is shown from detasseling.§ Ten detasseled rows 20 rods long each gave a yield of 528 lbs. of corn; 10 alternate rows, not detasseled, 1,220 lbs., and 20 undisturbed rows elsewhere in the field, 2,369 lbs. The cost of detasseling was estimated at $1.25 per acre. At the Kansas station in 1891 the results were adverse to detas-

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* Kansas experiment station. Report of 1888, p. 27.

† Cornell University experiment station. Bulletin 25, 1890.

‡ *Ibid.*, Bulletin 49, December, 1892, p. 317.

§ Nebraska experiment station. Bulletin No. 25, Dec. 1, 1892, p. 4.

seling, while in 1892 they were favorable.* As based on this experience the Kansas investigators state that in seasons favorable to the production of much pollen, when the pollenation can take place under normal conditions (as to rainfall and temperature) it is advantageous to remove a portion of the tassels, but * * * where the contrary conditions prevail the practice results in diminishing the crop."

No doubt the practice will have but few followers. In numerous experiments the operation has been thought to be a direct injury to the plant. Further, the operation of detasseling involves extra cost of crop, while the returns where an increase has occurred in most cases were not remarkable.

In case the corn-grower wishes to experiment in this work the following suggestion by Watson of the Cornell University station may be of service:† "From these three experiments made at this station in detasseling corn it has been observed that it is of the utmost importance to have the tassel removed at the earliest time possible, certainly before they have become expanded, and still better if enclosed within the folds of the leaf." The operation of

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* Kansas experiment station. Bulletin 45, December, 1893, pp. 132–138.

† Cornell University agricultural experiment station, Bulletin No. 49, December, 1892.

removing the tassels was by giving them an upward pull by hand, which caused the stalk to break off above the upper joint without injuring the leaves at all.

Cost of growing a crop.—Much has been published in the agricultural press on the cost of growing a crop or acre of Indian corn. Of course, as might be expected, there is a great diversity of opinion on this subject. Many statements have been printed and often these have been quite imperfect in detail. No interest may be allowed on money invested in land, tools, buildings; no account is taken of taxes and loss of soil fertility in many instances, yet all these facts bear on the cost of producing the crop. Says Sanborn:*

"We wish to repeat again, what we in effect have already said, that we have not seen by any writer a fair statement of the cost of a crop. Such cost must include something of the manager's time, something for the use of machinery and its breakages, something of the time lost in purchase and sales, and loss of time in dull weather and winters. A true calculation will add, probably, at least 25 per cent to the apparent cost."

The following figures bearing on the cost question are from some of the most complete statements secured by the writer. These are given simply as evidence along a line in which the corn-grower takes much interest. None of the figures are really conclusive, but are more or less interesting and suggestive.

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* *Mirror and Farmer*, Dec. 6, 1894.

In 1886 the Secretary of State of Michigan published a crop report giving information on the cost of producing wheat, oats and corn crops in that State.* The estimates are based on 817 reports from correspondents representing 650 townships. The cost of producing and marketing one acre of corn in the State was $19.14, or 21.4 cents per bushel of ears. This is based on the average price for corn on Jan. 1, 1886, viz.: 24 cents per bushel of ears. The cost for the year 1885 was estimated at 20.9 cents per bushel of ears.

In 1889 the Secretary of the Kansas Board of Agriculture investigated this subject in that State and estimated from the returns that it cost the farmers of Kansas, where an average yield of 30 bu. per acre was grown, 21 cents a bushel to produce and deliver.

For a number of years the *Farmers' Review* published numerous articles from corn-growers on the cost of crop production. In the *Review* of April 7, 1886, A. S. Morley, Arlington, Neb., gives the following figures from his ledger:

TWENTY-FIVE ACRES CORN.

Fall plowing, 9 acres at $1.25	$11.25
Interest and taxes, at $3	75.00
Cutting nine acres stalks	2.25
Plowing 16 acres, at $1.25	20.00
Cultivating 9 acres—fall plowing	3.00
Harrowing and marking	4.00

* Michigan Crop Report, Jan. 1, 1886. No. 51, page 8.

Planting at 25c. per acre	$6.25
Seed	1.50
Double harrowing	6.00
Cultivating 12½ days	37.00
Total cost	$166.25
Cost per acre	6.65

Yield per acre, 50 bushels. Cost per bushel in field, 13.3 cents. Adding 4 cents per bushel for husking and marketing, the cost will be 17.3 cents.

S. B. of Clinton Co., Ind., in the *Indiana Farmer* (March 19, 1892), gives the following figures, based on the cost of raising 12 acres of corn:

Plowing 8 days at $2.50	$20.00
Preparing ground 3 days	7.50
Planting	4.00
Seed	1.00
Cultivating 10 days at $2.50	25.00
Husking 600 bushels at 2½c.	15.00
Rent of land at $4 per acre	48.00
Total cost unmarketed	$120.50
Cost per acre	10.04

At 50 bushels per acre, cost per bushel 20 cents.

At a meeting of the Oxford (Ohio) Farmers' Club President L. N. Bonham gave the following itemized statement of the cost of growing a 24-acre field of corn 110 rods long.*

Breaking stalks	$1.50
Raking and burning	1.50
Plowing ten days	25.00
Harrowing 2¼ days	5.62

* *Farmers' Review*, June 24, 1885.

Planting 1½ days	$3.75
Seed (3 bushels)	2.00
Replanting	3.25
Rolling 2 days	5.00
Cultivating 3 times, long way, 3 days	15.00
Cultivating 2 times, short way, 4½ days	22.50
Thinning	3.50
Total cost of cultivating	$68.62
Husking 8 days, 4 men, 2 teams	56.00
Tax on land	24.25
Interest on land or rent	120.00
Total cost unmarketed	$268.87
Cost per acre in crib	11.87
Cost to cultivate and gather per acre	5.20

There were 60 bushels per acre, or a total of 1,440 bushels, worth at husking time	$360 00
Worth per acre	15.00

Cost per bushel, 18.6 cents.

No allowance is here made for the fodder, which is worth as much as average hay if properly cured.

The *Practical Farmer* a few years ago published a number of articles on the cost of growing corn. Among the contributors to this subject was Mr. T. B. Terry, who gave the figures of the cost of the crop of Mr. E. A. Peters of Central Ohio. They are as follows:

Plowing 30 acres, 20 days at $3	$70.00
Harrowing and working land 15 days	45.00
Planting, 3 days at $4	12.00
Seed, 5 bushels at 60c	3.00
Cultivating, 20 days at $3	60.00
Cutting 750 shocks at 7c. each	52.50
Husking 2,400 bushels at 4c	96.00

Hauling to cribs, 18 days at $3	$54.00
Rent of land	200.00
Total	$592.50
By 750 shocks at 10c. each	75.00
	$517.50

Cost per bushel a trifle over 21.5 cents.

In the Eastern States the cost of production is somewhat higher. It is interesting to note that in these figures the question of impoverishment of soil is not considered, although it is far from an insignificant one.

Large yields of Indian corn.—In 1889 the *American Agriculturist* offered a number of valuable prizes, which were supplemented by other parties, for the production of large yields per acre of farm crops of certain kinds. In the corn class the first prize offered was $500 cash in gold. A number of other prizes were offered. The crop was in each instance grown on not less than one acre of land and a complete record kept of the work of preparing land, fertilizing, labor, etc. The harvesting was done in the presence of three disinterested witnesses, who measured the product, and whose signatures attested the honesty and correctness of the contestant's report, which was made out on a form properly prepared and sworn to. Forty-five people filed competitive reports, and the average yield of crib-cured shelled corn for the 45 was 89 bushels per acre. The largest yield was secured by Z. J. Drake of Marlboro Co., South Carolina, who grew 239 bushels of crib-cured shelled corn on one acre of land, or 217 bushels, free of all water. This the writer believes to be the largest yield of corn from one acre of land on record.

The land on which this crop was grown was sandy in character, the original growth on it being oak, hickory and long-leaf pine. It has a gentle slope, with northern exposure, and was well drained naturally. The soil "was a fair specimen of much of the poor land in the South." In 1885, planted to corn, almost no crop was secured, and in 1887 not over five bushels per acre was obtained.

The following table gives some facts as to how this acre was fertilized for the crop of corn:

1,000 bushels stable manure	$50.00
867 lbs. kainit	7.80
867 lbs. cotton-seed meal	10.80
200 lbs. acid phosphate	2.00
1,066 lbs. manipulated guano	13.32
200 lbs. animal bone	4.00
400 lbs. nitrate of soda	12.00
600 bushels cotton seed	120.00
Cost of application	7.00
Total cost	$226.92

There were other items of expense, such as labor, interest on land, etc., amounting to $37.50, bringing the total cost of crop to $264.42.

Corn at that time in South Carolina was valued at 75 cents a bushel, which makes the grain worth $191.16, and adding the fodder value, $15, makes a total of $206.16 value in receipts. In February stable manure was hauled on the land, followed by applications of guano, cotton-seed meal and kainit. The land was then plowed, and following the plow cotton-seed meal was strewn in the furrows. A subsoil plow came after, breaking the soil to a depth of 12 inches. A Thomas smoothing harrow followed after the plowing. One bushel of Southern white dent corn of the gourd-seed variety was planted on March 2. The rows were furrowed out, alternately three and six feet apart, and five or six kernels were dropped to each foot of the row. Between the wide rows, later on in May, guano was applied, and then later, in June, a mixture of 500 lbs. of guano, cotton-seed meal and kainit was spread in the wide spaces. Still later, in June, 100 lbs. of nitrate of soda was scattered between the narrow rows and hoed in. Frequent cultivation was employed, but the land was kept flat, not ridged.

The plants grew so large it became necessary to erect posts and nail slats to them on both sides of each row to prevent the corn from falling. The harvesting was done in the presence of a large number of spectators. J. C.

Campbell, representative of the *American Agriculturist*, G. B. W Dunn, J. W Reynolds and John J. Tart were the witnesses to the harvesting.

Besides winning the $500 in gold offered by the *American Agriculturist* Mr. Drake also won an additional prize of $500 offered by the South Carolina Board of Agriculture to the person who would bring the first prize to that State.

In competition for the same prize, Mr. Alfred Rose, of Penn Yan, N. Y., won the second prize, growing 191 bushels of shelled crib-cured corn on one acre of ground. The total cost of producing Mr. Rose's crop was $55.

The third prize went to George Gartner of Pawnee Co., Neb., who grew 151 bushels of shelled crib-cured corn on one acre. The total cost of producing his crop was $49.70.

Cross fertilization.—The subject of crossing varieties of Indian corn has been studied at a number of the experiment stations, especially Illinois, Kansas, Minnesota, New York and Ohio. Of these Illinois has published the largest amount of information concerning this work.*

It is commonly known that if two different varieties of corn are grown near each other they will "mix" or cross fertilize. In this way.

* See bulletins Illinois experiment station, especially 21 and 25.

unintentionally, the purity of seed is injured and perhaps new varieties are accidentally begun.

In crossing it is essential that the female parts of the plant be kept covered, so that the only pollen to come in contact with the pistil shall be of the variety it is desired to cross with. The following is given by McCluer as the method most satisfactory at the Illinois station:[*]

> "We have found the best method to be to eover up, before the silks are out, both the tassel and the coming ear, with a closely-woven eloth bag. Covering the tassel of the stalk desired for a male parent insures a full supply of pollen, whieh seems to retain its vitality for several days if kept dry. * * * When the silks reach a length of three or four inches the ear is ready for fertilization. We then gather the pollen on a sheet of smooth paper and roll it up funnel-shaped. Next raise an umbrella and hold it in such a way as to keep all flying pollen from the ear, remove the bag, and apply the pollen until the silks are almost hidden. In favorable corn weather a single application of pollen is suffieient."

The practical results of cross fertilization to produce new varieties are as yet slightly felt, so far as experimental data goes. The results now published are interesting, yet contain much of uncertainty. Morrow and Gardner think, however,[†] that increased yields can be obtained by crossing two varieties, and note

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* Illinois experiment station. Bulletin No. 21, p. 100.

† *Ibid.*, No. 25, April, 1893, p. 179.

that a few farmers are changing their practice accordingly. This practical crossing is accomplished by planting in one row one variety and in the next another, and removing the tassels of the one as soon as they appear. Of course the ears of the plants lacking tassels will be fertilized by the other row where pollen exists, thus producing a cross from which seed may be selected.

Not much effect may be seen as the result of planting crossed seed the first year, while the second it may be very marked.

Interesting data concerning several crossing experiments is given by McCluer in the bulletins previously referred to from which the following notes are gleaned. Figs. 60, 61 and 62, loaned by the Illinois station, show the effects of some cross fertilizing done there:

"Of 142 plats planted with sweet corn, pop corn, and these crosses, it is safe to say there was as much uniformity in any one of the crossed plats as in any, and very much more than was found in most of the plats planted with pure varieties.

"Corn grown from the crosses the second year has continued to be comparatively uniform in type where the parent varieties were similar; but where the parent varieties were widely different, as in the crosses between sweet and dent, the progeny has tended strongly to run back to the parent forms, while at the same time taking on other forms different from either.

"From the work so far done there seems to be no way of telling beforehand what varieties will, when crossed, produce corn of an increased size, and what will not.

"In the production of new varieties by crossing it will

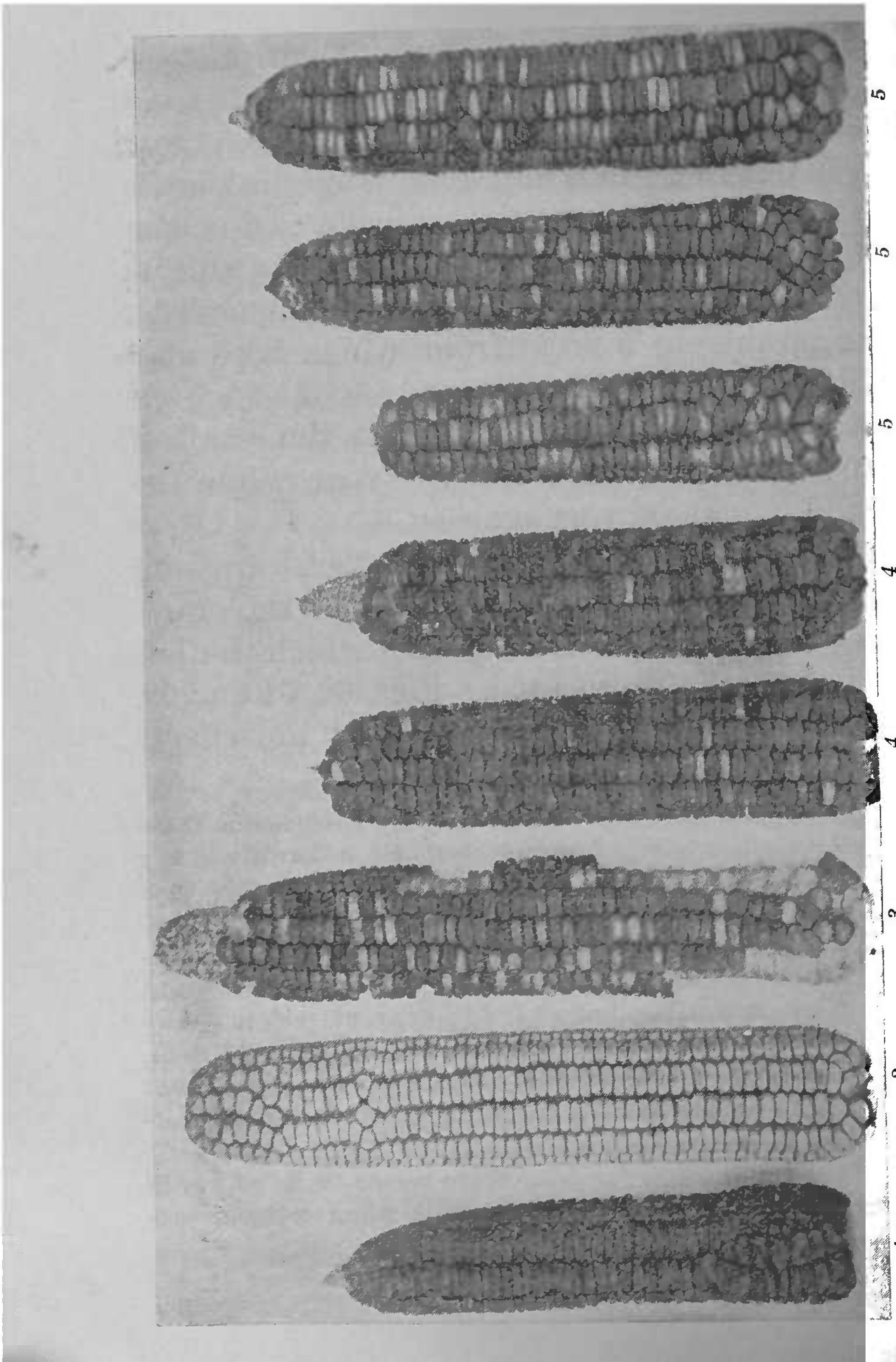


FIG. 60.—BLACK MEXICAN CROSSED WITH WHITE DENT. Ear 1 is the type of the variety used as male parent; 2, of female. 3 shows immediate result of the cross, corn from which was planted to produce 4 and 5. No. 4 is grown from wrinkled or sweet kernels of No. 3. No. 5 is corn grown from dent kernels of No. 3.

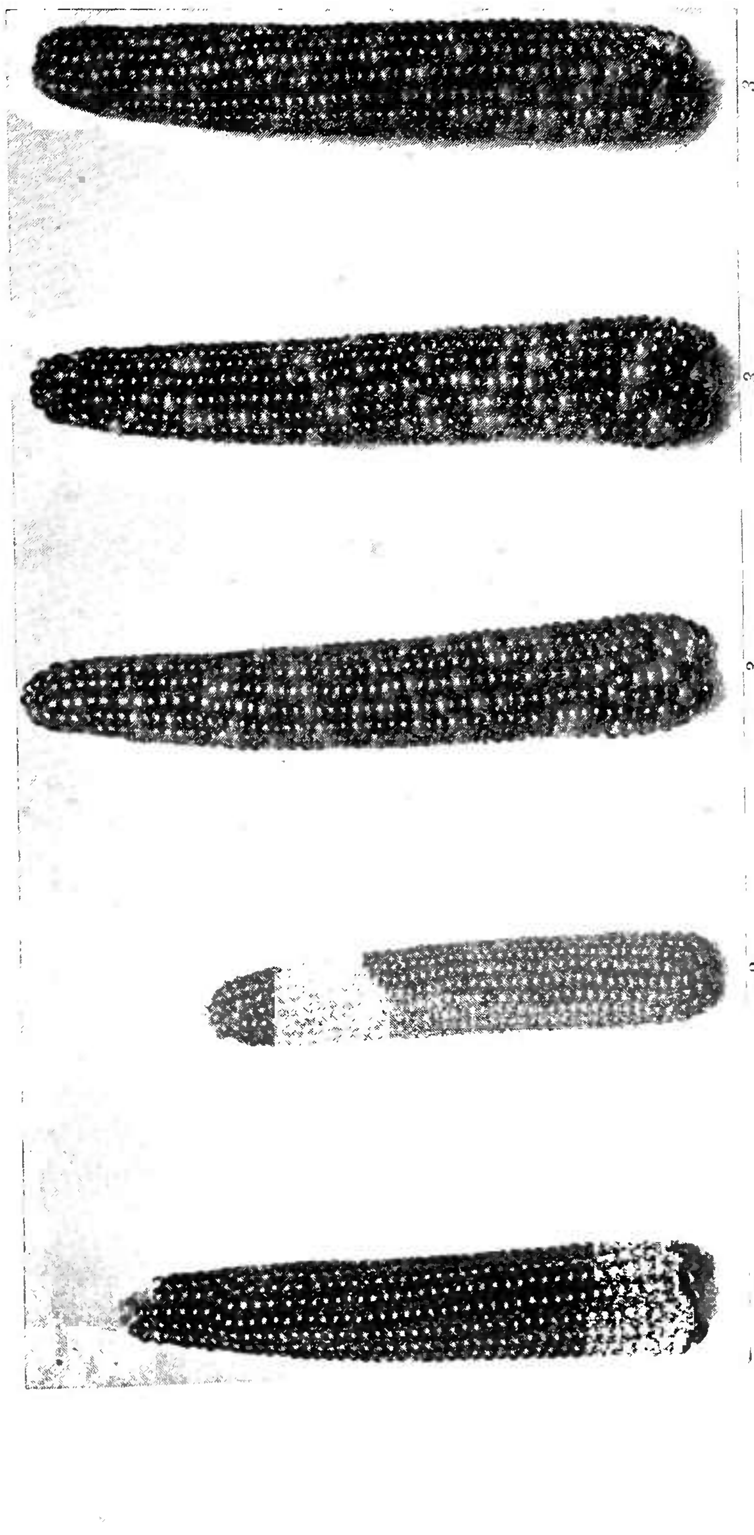


FIG. 61.—QUEEN'S GOLDEN CROSSED WITH COMMON PEARL, showing increase in size of cross-bred ear. No. 1 is type of variety used as male parent; No. 2, of female; No. 3, result of cross. The immediate result of the cross is not shown.

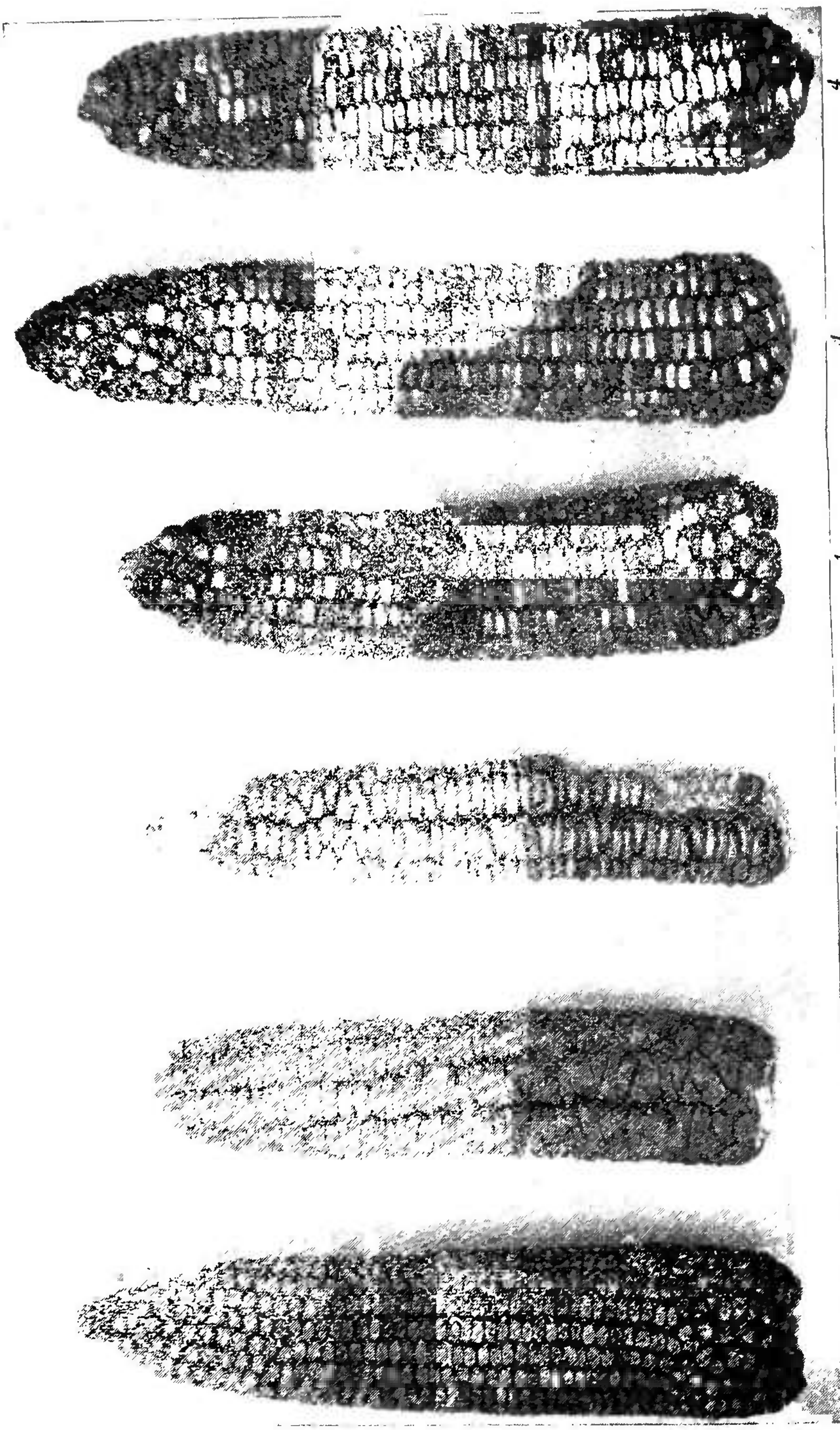


FIG. 63.—LEAMING CROSSED WITH TRIUMPH. No. 1, type of male parent. No. 2, type of female. No. 3 shows immediate result of crossing. No. 4. corn grown from planting No. 3.

seldom be desirable to cross two varieties that are very widely different from each other. It is probable that, on the whole, selection with occasional partial changes of seed will give more permanent as well as more satisfactory results for the general farmer than would the continual crossing and breaking up of well-fixed types."

Measuring corn in the crib.—Multiply the length, breadth and height of the crib together in feet to obtain the cubic feet of space it contains. Multiply this product by four, strike off the right hand figure and the result will be the number of shelled bushels. This measure is not absolutely correct, but nearly so.

White vs. yellow corn.—The question of the relative merits of white and yellow corn has been discussed in the agricultural press and before farmers' meetings at frequent intervals. From the chemical standpoint the color seems to have no special significance. Upon the question of relative productiveness opinions have been rather evenly divided. Tracy and Lloyd of the Mississippi station made a special investigation of this subject, upon which they rendered an interesting report.* Of the tests made at seven agricultural experiment stations six report greater yields with white than yellow varieties. The following table by Tracy and Lloyd gives a summary of their investigations on this subject:

*Bulletin 33, Mississippi agricultural experiment station, March, 1895.

STATION TESTING.	*White.*		*Yellow.*		*Excess yield.*	
	Number varieties tested.	*Yield per acre.*	*Number varieties tested.*	*Yield per acre.*	*White.*	*Yellow.*
Arkansas........	14	36.7 bu.	14	36.6 bu.	0.1 bu.	....
Illinois..........	54	63.1 bu.	101	62.0 bu.	1.1 bu.	....
Indiana..........	16	54.8 bu.	28	56.3 bu.	....	1.5 bu.
Kansas..........	53	54.2 bu.	67	53.1 bu.	1.1 bu.	....
Louisiana.......	30	47.5 bu.	9	39.7 bu.	7.8 bu.	....
Mississippi	25	43.0 bu.	20	38.7 bu.	4.3 bu.	....
Ohio........	25	55.4 bu.	34	51.3 bu.	4.1 bu.	....
Total..........	217	....	273	....	....	....
Average......	...	50.7 bu.	...	48.2 bu.	2.5 bu.	....

It does not follow, however, from this table that all white varieties yield more than all yellow ones. Numerous yellow varieties are fully as productive as many white ones. It is worthy of note that this table shows a yield in favor of white varieties, especially in the South, where yellow corn is grown much less than in the North. If the best varieties of white and yellow were compared the relative difference would probably be slight.

Corn palaces.—Much beautiful decorative work of a temporary character has been done with Indian corn. This work has been most extensively done in Sioux City, Ia., where for several years so-called corn palaces have been erected. This was first attempted in 1887 at Sioux City, where the idea originated. A corn palace, says the *Pacific Rural Press*, is covered and embellished, as with tapestry, outside and inside, with products of the field, corn predominating, ingeniously and fancifully arranged. In building the palace a large structure is first erected of lumber, of a shape that will carry and show to advantage the multiform decorations with which it is to be adorned. It is in form lofty, with broken lines, pinnacles, buttresses, bridges, gables, ornamental windows, etc. Over every inch of this wooden surface are laid corn and kindred plants in architectural harmony, in a multiplicity of designs. The corn is used in the stalk, ear, kernel, and even the husk has its decorative uses. The walls are covered on the outside with ears of corn, cut lengthwise or crosswise, and nailed on in geometrical figures or other designs. The various colors of the cereal permit of a wide range of shading and coloring.

The Sioux City corn palace in 1887 was 100x 210 feet, with dome and spire over 100 feet high, and of Moorish style of architecture. The outside was a blending of corn of various colors arranged in many designs. It is said 25,000 bushels of ears were used in decorating this palace and city.

In 1889 the decorations were of great merit. From the kernel pictures illustrating farm scenes, legendary and nursery tales, etc., were made on the walls. Frescoes and flowers, figures of persons and animals, draperies, and numerous surprising and beautiful things were also worked out.

In 1890 a building 264 feet square, with a central part and dome 172 feet high, was erected. The main building was in the form of an octagon 166 feet across. A central space 78 feet in diameter was unobstructed by pillar or post. The decorations in this building were

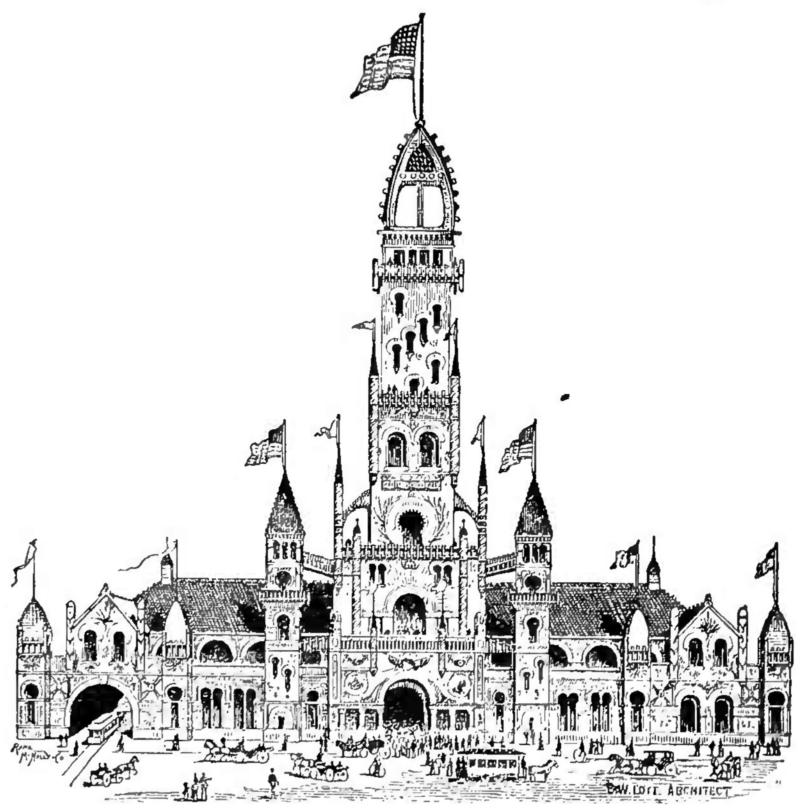


FIG. 63.—THE SIOUX CITY CORN PALACE OF 1889.

very remarkable and included among other things a miniature Niagara Falls.

At the World's Columbian Exposition the Iowa building was very beautifully decorated all over the inside with Indian corn in many unique designs.

Number of days required to mature varieties—The following data is abstracted from an interesting article on the subject by Prof. W C. Latta.* Excessive rain in late seasons often delays planting in spring. This was the case in Indiana and Illinois in 1892. The bulk of the crop was not planted before June 1.

Can the varieties commonly grown in Indiana be matured when planted as late as June 10? The following table is the result of experiments at Purdue University, and shows the number of days required for varieties to mature:

	Number days to mature in.			*Average No. days for three years.*
	1889.	*1890.*	*1891.*	
Boone Co. White	139	121	124	128
Munn's Early	....	105	118	111
Riley's Favorite	138	116	124	126
White Prolific	138	121	126	128
Yellow Nonesuch	....	121	125	123
Hartman's White	....	116	122	119
Early Yellow Dent	....	111	114	112
Yellow Dent	....	116	116	116
Yellow Speckled Dent	....	112	114	113
Purdue Yellow	....	102	111	114

The cause of this wide range in time for maturing is dependent on season—whether warm or cold, wet or dry, or seasonable.

With average weather conditions any of the above-named varieties would mature in September as far north as Lafayette if planted by June 1. Late-planted corn will mature in five or ten less days, owing to higher temperature as the season advances.

* *Indiana Farmer*, May 28, 1892.

CHAPTER XVIII.

LITERATURE ON INDIAN CORN.

Thousands of articles on Indian corn and its culture have been printed in agricultural papers, and numerous addresses on this plant have been published in agricultural and other reports. The bulletins of most of the agricultural experiment stations have published experimental data the result of culture or feeding tests. The stations of Illinois, Indiana, Ohio, New York, Massachusetts, Missouri, Kansas, Wisconsin and Minnesota have given special attention to problems concerning the growing or feeding of this plant. Special chapters on corn have also been published in books devoted to the cereals in general and in cyclopædias and agricultural volumes.

So far as the writer has been able to ascertain, but few books or pamphlets have been published on Indian corn or maize. The following titles, given in sequence of issue, are of those publications in the author's possession. This list probably could be extended some, though not materially:

Parmentier, A. A. Le mais on blè de Turquie, apprécié sous tous ses rapports: Paris, 1812, pp. 303; paper.

Lespés, J. Max Louis. Essai sur le mais on blè de Turquie, considéré sous ses rapports hygiénique et médical: Paris, 1825, pp. 44; paper.

Cobbett, William. A treatise on Cobbett's corn, containing instructions for propagating and cultivating the plant and for harvesting and preserving the crop; and also an account of the several uses to which the produce is applied, with minute directions relative to each mode of application: London, 1828, pp. 290, pl. III; half leather, 7x4½ in.

Bonafous, Matthieu. Histoire naturelle, agricole et économique du mais. Extrait présenté a la société d'agriculture de l'Hérault, par M. Raffenau-Delile. Abstract in Bulletin de la Société de l'Hérault, September, 1836, of contents of large illustrated volume published in 1836 at Paris by Bonafous.

Salisbury, J. H. History and mythology of Indian corn. From Transactions New York State Agricultural Society, 1848, pp. 678–692.

Flint, C. L. An essay on the history and importance of Indian corn as an agricultural product. From Transactions New York State Agricultural Society, 1849, pp. 281–293.

Enfield, Edward. Indian corn; its value, culture and uses. New York: D. Appleton & Co., 1866, pp. 308; cloth, 5x7½ in.

Körnicke, Fr. Vorläufige Mittheilungen äber den mais. (Abstracted from den Sitzungsberichten der Niederrheinischen Gessellschaft für Natur-und Heilkunde.) Bonn, 1872, p. 16.

Sturtevant, M. D., E. Lewis. Indian corn. Paper presented by request at the annual meeting of the Massachusetts State board of agriculture, Jan. 22, 1879, pp. 38.

Godron, D. A. Note sur le mais geant Caragua (*Zea Caragua* Molin). (Extracted from la Revue des Sciences naturelles de Montpellier, June, 1880, pp. 3.)

Sturtevant, E. Lewis. Maize: An attempt at classification. Geneva, N. Y., December, 1883, pp. 9, fig. 21. Rochester, N. Y., Democrat and Chronicle Print, 1884. Printed for private distribution only.

Sturtevant, E. Lewis. Indian corn and the Indian. From the *American Naturalist,* March, 1885, pp. 226–234.

Devol, W. S. A study of the germination of corn. Thesis presented at Ohio State University for the degree of B. Ag., June 23, 1886, pp. 12.

Scott, Mary S. Indian corn as human food. Nevada, Ia.: Payne & Son, 1889, pp. 122; boards, $4\frac{3}{4}$x6 inches.

Murphy, Charles J. American Indian corn (maize) as a cheap, wholesome and nutritious food. Lecture delivered by Charles J. Murphy before the National Agricultural Society of France at the International Congress of Millers, held at Paris in August, 1889. Edinburg, Scotland: R. Grant & Son, 1890, pp. 97; paper.

Ladd, E. F Investigation upon maize. Reprinted from the Journal of the American Chemical Society, Vol. XII, No. 8, pp. 24.

Murphy, Wiley & Snow. Report on the use of maize (Indian corn) in Europe, and the possibilities of its extension. United States Department of Agriculture, Washington: Government Printing Office, 1891, pp. 36.

Harshberger, John W Maize: A botanical and economic study. Contributions from the botanical laboratory of the University of Pennsylvania, Vol. I, No. 2, 1893, pp. 75–202, pl. IV; paper.

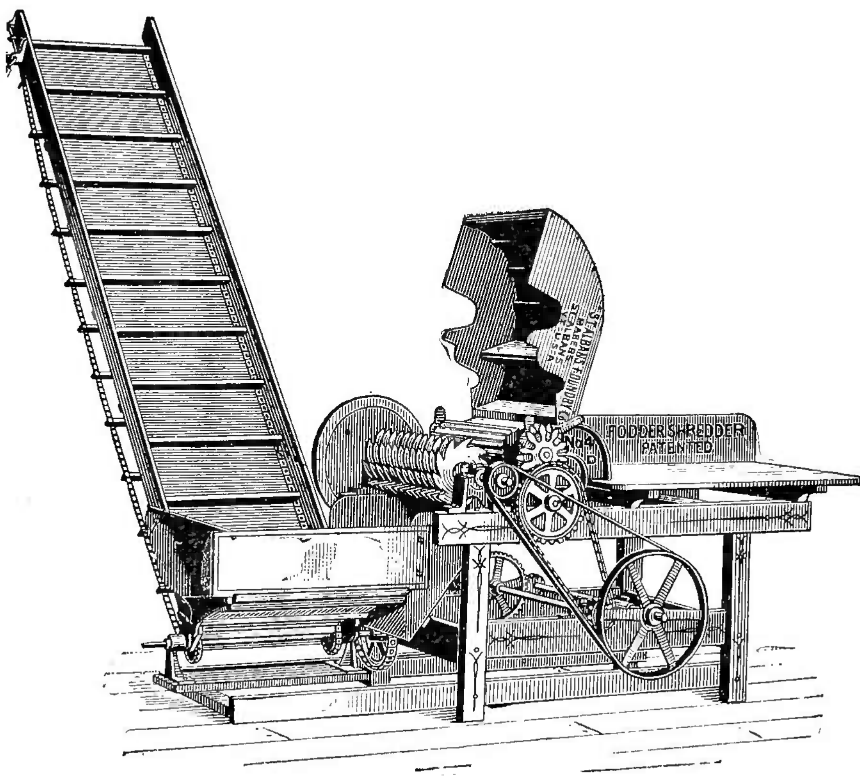
Sturtevant, E. L. Notes on maize. Reprinted from Bulletin Torrey Botanical Club, Vol. XXI, Aug. 20, 1894, pp. 319–343, and Dec. 24, 1894, pp. 503–523.

ACKNOWLEDGEMENTS.

A large number of the illustrations in this book were provided through the kindness of numerous friends of the author, agricultural experiment stations and manufacturers of machinery making loans of electrotypes and engravings. The writer here wishes to express his hearty appreciation for favors of this character to the following:

S. L. Allen & Co., Philadelphia, Pa.; Gale Manufacturing Co., Albion, Mich.; Deere & Co., Moline, Ill.; David Bradley Manufacturing Co., Chicago, Ill.; Emerson, Talcott & Co., Rockford, Ill.; Challenge Corn-Planter Co., Grand Rapids, Mich.; Stoddard Manufacturing Co., Dayton, O.; Richmond Safety Gate Co., Richmond, Ind.; J. D. Tower & Bro., Mendota, Ill.; Rock Island Plow Co., Rock Island, Ill.; Foos Manufacturing Co., Springfield, O.; St. Albans Foundry Co., St. Albans, Vt.; Keystone Manufacturing Co., Sterling, Ill.; Illinois Experiment Station, Champaign, Ill.; Iowa Experiment Station, Ames, Ia.; Indiana Experiment Station, Lafayette, Ind.; Nebraska Experiment Station, Lincoln, Neb., and Prof. F. M. Webster, Wooster, O.

INDEX.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