

EXPERIMENT STATION
OF THE
KANSAS STATE AGRICULTURAL COLLEGE,
MANHATTAN.

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HORTICULTURAL DEPARTMENT.

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THE EXPERIMENTAL APPLE ORCHARD.

THE Experiment Station apple orchard was planted in 1891. The site is a favorable one, sloping to the north and east, but rather steep in some places, being liable to wash unless carefully handled. The soil varies from a fairly good loam in the lower parts to a stiff clay on the higher points.

This orchard is the second one grown on this site. The first grown on this land was one of the first grown in this locality, and was set before the College owned the land. Memories of the men in charge, traditions and printed references represent it as having borne well for many years. The best days of the old orchard were before the establishment of the Experiment Station, and the orchard was used by the College as a means of illustration for classes in horticulture and in practical horticultural work.

The old orchard was grubbed out in the winter of 1889-'90, the ground heavily manured with stable manure, and the following spring planted to corn. The year 1890 was not a corn year, but a large crop of fodder was produced.

Early in the spring of 1891 the ground was plowed deeply and subsoiled to a depth of eighteen to twenty inches, harrowed until in first-class condition, and the trees were set the same spring.

The orchard was set primarily as a test of the varieties, some sixty

varieties being planted. With some of the varieties a comparison of the rate of growth, endurance and general behavior of trees grafted upon the so-called whole roots and ordinary piece-root grafts was planned. Budded trees of fifteen varieties were included in this comparison.

The whole-root grafts, the budded trees and the piece-root grafts of the same varieties were purchased from Stark Brothers' nursery, Louisiana, Mo. Three trees from whole-root grafts and three trees from piece-root grafts of the following varieties were set:

Astrachan.	Isham Sweet.	Rome Beauty.
Arkansas Black.	Kinnaird's Choice.	Scarlet Cranberry.
Babbitt.	Lowell.	Shannon.
Buckingham.	Loy.	Smokehouse.
Celestia.	McIntosh Red.	Stark.
Clayton.	Mammoth Black Twig.	Stuart's Golden.
Duchess of Oldenburg.	Mother.	Stump.
Early Ripe.	Pennsylvania Red Streak.	Walbridge.
Huntsman.	Pewaukee.	

Of the following varieties, four trees were set, two of them from whole-root grafts and two of them from piece-root grafts:

Ben Davis.	Jonathan.	White Winter Pearmain.
Cooper.	Wealthy.	York Imperial.
Grimes's Golden.	Winesap.	

Of the budded trees, the following is the list of varieties:

Arkansas Black.	Gano.	Scarlet Cranberry.
Babbitt.	Kinnaird's Choice.	Stark.
Broadwell Sweet.	Loy.	Stuart's Golden.
Celestia.	Mammoth Black Twig.	Tetofsky.
Crawford.	Mother.	

Piece-root grafts of Crawford and Gano were also set.

From William Cutter & Sons, Junction City, Kan., were obtained trees of the following varieties from piece-root grafts:

Benoni.	Huntsman.	Salome.
Cooper.	Isham Sweet.	Smith's Cider.
Crawford.	Janet.	Winesap.
Fallowater.	Jonathan.	White Winter Pearmain.
Fanny.	Lowell.	Wolf River.
Fink.	Mason's Orange.	Yellow Transparent.
Gano.	Red Bietigheimer.	York Imperial.
Haas.		

Other varieties were obtained from Prof. J. L. Budd, then of the Iowa Agricultural College, from the department of agriculture, Washington, from the Experiment Station nursery, and from B. P. Hanan, Arlington, Kan.

The ground was platted on the quincunx or triangular plan, by

which each tree is thirty-three feet from the four nearest trees. The rows, running north and south, were set double, or sixteen and one-half feet apart, with the intention of removing the extra trees when crowding was evident. Many of the trees used for the temporary places were grown by the horticultural department.

The trees were carefully set and were given the best of treatment. Good growths are recorded for nearly every tree. A few accidents, a sewer ditch through the orchard and washing from heavy rains caused the death of about twenty trees during the first two years. The records of accurate measurements and observations during these two years fail to show any differences of growth or vigor in trees of the same variety propagated in the various ways. The records of ten years of growth show practically the same results.

The average height of the sixty-four trees from whole-root grafts is eleven feet four inches. The maximum diameter at eighteen inches from the ground is seven and one-half inches. The average diameter at eighteen inches from the ground is four and nine-tenths inches.

The average height of the 102 trees from piece-root grafts is twelve feet two inches. The maximum diameter at eighteen inches from the ground is nine inches. The average diameter at eighteen inches from the ground is four and six-tenths inches.

The average height of the thirty trees from buds is twelve feet three inches. The maximum diameter at eighteen inches from the ground is seven and one-half inches. The average diameter at eighteen inches from the ground is four and eight-tenths inches.

These trees were all one year old when set, and have had exactly the same care and as nearly as possible the same soil. The conclusion is inevitable that the manner of propagation seems to count for little after growth commences.

These orchard observations confirm the conclusions of the Experiment Station drawn from nursery work, and published in Bulletin 65, that, while the different methods may have some special value to nurserymen, the orchardist is concerned with the tree as it reaches him ready for setting and not with its method of propagation.

In the eleven seasons of the orchard's growth, careful observations have been made, and notes taken and recorded. In these notes as great variations appear in the growth and vigor of the trees of a given variety propagated in the same way, as in those propagated in the different ways. This has been true as regards rate of growth, foliage, and bearing. No stranger visiting the orchard could tell without consulting the labels which trees had their origin as piece roots, which as whole roots, and which as buds.

During the first few years the spaces between the trees were planted

to vegetables and nursery stock, the space allotted to these crops being narrowed each year as the trees required more room. At no time was the planting so close that the cultivation could injure the trees. Since 1897 no crops have been grown in the orchard. The tree rows were cultivated with the two-horse cultivator and the five-tooth cultivator, the hoe being used to keep down the weeds and to loosen the soil around the trees.

Since the trees have entirely occupied the ground, clean culture has been given. For some years the ground was plowed and harrowed each spring and the surface kept fine and loose. It was frequently noticed that, even when plowing at a medium depth, some of the roots were cut. The later work of the Station has been to prevent the injury to the roots and at the same time secure all the benefits of cultivation. The behavior of old orchards indicates that the seeding down to clover or other grasses is not the best treatment for Kansas orchards. It seems necessary for the best results that, so far as possible, all the moisture should be conserved for the use of the trees.

During the past season only surface cultivation has been given. The ground has been kept well worked to a depth of three or four inches with a disk. Two patterns of the disk have been used, the Clark Reversible Cutaway and the Ohio Reversible. Both of these disks have extension heads which set the gangs out from the center. The hitch is low, and with the added advantage of the extension head the soil can be worked well under the branches and the danger of "singletree disease" is reduced to a minimum. Both disks did remarkably good work. Where the ground was packed in one of the tree spaces the entire disk responded to weight better than did the cutaway. In slightly loose soil the cutaway seemed to have the lighter draft. When not extended, either disk is a most useful implement for general farm and garden work. Each is reversible, so that in orchards where the cultivation must be done in one direction the ground may be kept level by turning the gangs half-way round, and thus throw the dirt in the opposite direction. Ground that had not been cultivated for several years was put in very fair condition by disking each way very early in the spring, when the ground was somewhat loosened by recent frosts. Part of the orchard had previously been heavily manured and the disks served admirably for working it into the soil. The work in the Experiment Station orchard was done with a two-horse team weighing 2600 pounds.

An Acme harrow was used with very satisfactory results after the soil had been worked with the disks. This also has an extension head for orchard work. It is of light draft and a valuable implement for

keeping the surface well pulverized. Like the disks, it is also a good implement for general farm and garden work.

The Clark's Cutaway Reversible Orchard Extension disk harrow (plate 6) is manufactured by the Clark Cutaway Harrow Company, Higganum, Conn.; E. G. Mendenhall, Kinmundy, Ill., general agent. The Ohio Extension Reversible disk harrow (plate 7) is manufactured by the Ohio Cultivator Company, Bellevue, Ohio; G. A. Plank, Kansas City, Mo., general agent. The Acme harrow (plate 5) is manufactured by Duane H. Nash, Millington, Conn.

Since the orchard has been given up entirely to the trees, cover crops have been sown each fall. The growth of these crops has not seemed detrimental to the development of the late varieties of apples. It is believed that these crops check whatever tendency thoroughly cultivated orchards may have to make too great a growth late in the season. The trees in the Experiment Station orchard have uniformly been in good condition in the fall, and have remained so throughout the winter. The cover crop has protected the soil from washing and blowing, and has, to a considerable extent, served to prevent the drifting of the snow. Both the oats and cow-peas have made heavy growths. The cow-peas have been sown late in August and the oats early in September. Plates 1 and 2 show the growth of a cover crop of oats. Rye and wheat have not made so heavy a growth, and have been somewhat difficult to kill by cultivation in the spring, and consequently are to be considered as less valuable than either oats or cow-peas.

The details of keeping the soil in the best possible condition will vary somewhat for different soils, and for the same soil under different atmospheric conditions. The great principle is that the soil should be stirred as soon after each rain that softens the surface as the ground is in suitable condition. This prevents the formation of a crust and the resulting evaporation. A day too soon, or a few days too late, may give a rough, cloddy surface instead of the valued dust mulch. With the tools mentioned, a given area can be put in the best possible condition much more rapidly and easily, and with less danger to the trees, than with the common cultivator.

The results during the past summer (1901) were very satisfactory. The trees maintained a good condition as to foliage and fruit, and the rate of twig growth was normal in spite of the severe dry weather. In his article, "Some Lessons from the Drought," Prof. J. T. Willard, chemist and director of the Kansas Experiment Station, says, in regard to this orchard: "In the latter part of July a considerable number of fields and plantations at and near the College were tested to a depth of fifteen inches, and determinations of moisture made. Care-

ful notes were also taken as to the condition of the growing crops. It was found that with most cultivated field crops the moisture was reduced to from eight to eleven per cent. In the case of grass lands it was reduced to as low as six per cent. As these samples extended to a depth of fifteen inches, it is obvious that the upper one-half must have been much drier still. The College orchard, which was kept free of weeds and thoroughly cultivated throughout the season, showed over sixteen per cent. of moisture at the close of this period of nearly eight weeks with less than an inch of rain."

When the trees were set the tops were shortened back in order that the leaf surface might, as far as possible, correspond with the shortened root system. Care has been taken to form the trees so that they have a low, symmetrical head, with no interfering branches. Thus, by forming the head while young, very little pruning of large branches has been required. Whenever cutting has been thought necessary, care has been taken that the knife has a sharp, smooth edge. Wounds made with sharp tools heal much more readily than where a rough-edged blade is used. The care taken to form the heads while young has been well repaid. Forks and crotches have been avoided, and, while each tree has been regarded as an individual to be made the most of, it has been borne in mind that the ideal tree exists only in the mind of the orchardist, and that he can only hope to approximate it in the orchard.

The plates show, in some slight degree, the variation in form of some of the varieties. A knowledge of the habit of growth is helpful during the first few years of the life of the orchard, the vital time in the formation of good trees. With varieties that tend to an upright and too dense head, care has been taken to remove the twigs and buds from the inside of the tree, inducing, as much as possible, an outside growth. The trees have all been headed low. With wide-spreading sorts, it has sometimes been necessary to cut away the lower branches after they had served a few years as a protection from sun-scald. With the trees of most varieties, it has not been a difficult task to keep the head low enough to protect the trunk and high enough to allow the cultivation of practically the entire surface soil. We have found it cheaper to rub off watersprouts in the summer than to prune them later, and it is certainly better for the tree.

The growth and general conditions of the orchard have been such as to encourage the observers. The trees on the higher parts of the orchard, where the soil is thin and poor, do not compare well with trees growing in reasonably good soil. Few localities in Kansas could furnish a more unfavorable situation than the poorer parts of the Experiment Station orchard. The ground is old, has matured one orchard,

and has at times washed quite badly. In spite of this a fair measure of success has been attained. In the lower and better soil the Experiment Station orchard compares very favorably with other orchards in this locality planted on newer land.

More time will be required to determine the value of some of the slower maturing varieties; but the varieties that have come to be regarded as the standards in Kansas orchards are the ones that have succeeded best. The records of the old orchards and the behavior of these varieties in the new one seems to warrant their being recommended. Early Harvest, Benoni and Late Strawberry have been the best of the early varieties. Cooper and Maiden's Blush follow these. Fameuse, Grimes's Golden and Jonathan have been the best of the later fall varieties. York Imperial and Pennsylvania Red Streak have ripened earlier than a winter apple should. It may be well to state here that nearly all the varieties have usually ripened a month or more earlier than they are reported as ripening in the Eastern states. The past season, 1901, has been a notable exception; the drought seemed to delay the ripening process so much that many varieties were six weeks later in ripening than in former years. Pennsylvania Red Streak has fallen prematurely in the Station orchard.

Winesap, Missouri Pippin, Gano and Ben Davis have been the best of the winter varieties. Janet has been undersized. Huntsman has a fairly good record as a bearer and is of fine quality. White Winter Pearmain has done well the past two seasons. Mammoth Black Twig is a hardy, vigorous tree and promises well. It is worthy of trial in specially trying localities. The fruit as grown here is not handsome but is of fair quality and keeps well.

Few apples were borne before 1897, when the following varieties bore light crops:

Arkansas Black.	Gano.	Rome Beauty.
Babbitt.	Grimes's Golden.	Salome.
Ben Davis.	Jonathan.	Smith's Cider.
Broadwell Sweet.	Kinnaird's Choice.	Smokehouse.
Buckingham.	Keswick Codlin.	Stark.
Cooper.	Loy.	Stuart's Golden.
Cullen's Keeper.	Mammoth Black Twig.	Tetofsky.
Fink.	Pennsylvania Red Streak.	Winesap.

Observations have been made as to the date of blossoming and investigations of the problems of pollination begun. The varieties that bloom at practically the same time have been grouped together. The dates vary somewhat with the season, and there is sometimes a difference in the date of blossoming in trees of the same varieties, but the relative dates are fairly constant. The following varieties

were beginning to bloom April 23, 1900, and April 27, 1901; were in full bloom April 29, 1900, and May 2, 1901:

Ben Davis.	Fanny.	Pennsylvania Red Streak.
Benoni.	Gano.	Smith's Cider.
Cooper.	Isham Sweet.	Winesap.
Crawford.	Jonathan.	Wolf River.
Fallowater.	Kinnaird's Choice.	

The following varieties were beginning to bloom April 26, 1900, and April 30, 1901, and were in full bloom April 30, 1900, and May 5, 1901:

Arkansas Black.	Keswick Codlin.	Rome Beauty.
Cullen's Keeper.	Loy.	Stuart's Golden.
Celestia.	Mammoth Black Twig.	Stump.
Huntsman.	Okabena.	Swaar.
Janet.	Park's Keeper.	

TREE DESCRIPTIONS.

Arkansas Black. Tree upright, with an open, round head; vigorous and thrifty; a fair bearer, though not to be compared with the Winesap, which the apple resembles; foliage dark green, of medium density; bark of trunk rough, dark gray; branches long, slender, upright, straight; twigs smooth, dark brown; leaves small, lanceolate.

Astrachan. Upright, with a low head; vigorous and thrifty; a good bearer; foliage dark green, dense; bark on trunk dark olive-green; branches upright, straight, stout; twigs smooth, very dark brown; leaves very large, pyriform or obovate.

Ben Davis. Tree upright, spreading; hardy and vigorous; an excellent bearer; foliage dark green and comparatively dense; bark on trunk light brown, rough; branches slender and zigzagging; twigs pubescent to a slight degree, dark brown; leaves medium, broadly lanceolate.

Benoni. Tree upright, with close top; vigorous and hardy; usually a good bearer; foliage dark green, dense; bark on trunk dark brown, very rough; branches medium to slender, straight; twigs smooth, reddish brown; leaves of medium size, ovate.

Bluemont Pippin. Tree upright, spreading and thrifty; very vigorous, making notably long growths; it is liable to be a shy bearer; foliage dark green, dense; bark on trunk grayish brown, rough; branches long, slender, straight; twigs pubescent, dark brown; leaves broadly ovate, large.

Babbitt. Tree upright, top spreading; vigorous and thrifty; a moderate bearer; bark on trunk dark gray; foliage dark green, dense; branches slender, straight, upright; twigs smooth, brown; leaves smooth, obovate.

Boiken. Tree low, spreading, with numerous branches; rather thrifty and hardy; only a fair bearer; foliage rather light than dark, thin, furnishing little shade; bark on trunk a light green, slightly rough; branches slender and somewhat willowy, and rather straight; twigs smooth or slightly pubescent; leaves lanceolate, medium to small.

Broadwell Sweet. Tree spreading; healthful, vigorous, and thrifty; a fairly good bearer; bark on trunk light brown; foliage dark green, medium to dense; twigs smooth, dark reddish brown; branches pendulous, medium, stiff; leaves large, oblong-ovate.

Buckingham. Tree upright, the top of grown tree being but a few feet across; a thrifty grower, though not very hardy; a shy bearer; foliage dark green, dense; bark on trunk light brown; branches slender, straight; twigs pubescent, light brown; leaves pyriform or ovate.

Celestia. Tree very upright, with many branches; the head is dense enough, but, the body being unprotected, is subject to sun-scald. Some of the trees seem to be hardy, though they are not large-growing trees. Prolific for a tree with so little top. Foliage light green, dense; bark on the trunk smooth, gray green; branches slender, upright, straight; twigs smooth, yellowish green; leaves lanceolate-ovate, small.

Clayton. Tree upright, broadening very high; a good grower, though not hardy; bark on the trunk yellowish brown, rough; branches stout, long, straight; twigs pubescent, dark brown; foliage yellowish green, dense; leaves medium to large, obovate-lanceolate.

Cooper (COOPER'S EARLY). Broadly spreading, with an upright tendency; very vigorous and hardy; an unusually heavy bearer; foliage yellowish green, very heavy and dense. The tree seems to need vigorous center pruning. Bark on trunk yellowish green and smooth; branches stubbed, smooth, have a incurving tendency, though many of them hang low; twigs of a brownish-green color; leaves obovate, very large. A very fine, round-headed tree.

Crawford. Tree upright, has a great tendency to branch; some thrifty trees, though not very hardy; a shy bearer; foliage dark green, scant, owing to the mode of branching; bark on trunk light grayish green; branches willowy, slender, and usually straight; twigs pubescent, green; leaves obovate, medium to small, very pubescent.

Cullen's Keeper. Tree upright, with a broadly spreading top; vigorous and hardy; an excellent bearer; foliage light green and very dense; bark smooth, yellowish gray; branches slender and straight; twigs pubescent, light brownish green; leaves very large, oblong-ovate or elliptical.

Duchess of Oldenburg. Tree upright, spreading; vigorous and thrifty; only a fairly good bearer; foliage dark green, dense; bark rough, brown; branches slender, upright, and crooked; twigs smooth, reddish brown; leaves ovate-lanceolate, large.

Early Ripe. Upright, spreading; not very thrifty; a reasonably good bearer; foliage light green, sparse; bark on trunk brown, smooth; branches long, slender, straight; twigs smooth, light brown, almost crimson; leaves ovate-lanceolate, small.

Fallwater. Tree upright, spreading; thrifty, though not very hardy, some of the branches killing back every year; a very shy bearer; foliage bright green, scant; bark on the trunk a brownish green to brown on the older portions of the trunk, rough; branches of medium thickness, straight; leaves ovate or oblong, rather large; twigs smooth, short, dark brown.

Fanny. Tree very upright, with a great tendency to branching; very vigorous, making enormous growth each season; rather a shy bearer; bark on trunk

rough, dark grayish brown; foliage dark green, dense; branches numerous, of medium size, dark olive-green; twigs pubescent, dark brown; leaves large, ovate or cordate; a very handsome tree.

Fink. Tree spreading; hardy, though not a thrifty tree; a very good bearer; foliage dark gray green, scant; branches slender, crooked, and few; twigs pubescent, light brown; leaves pyriform to lanceolate, small.

Gano. Upright, spreading; very thrifty; an excellent bearer; bark on trunk yellowish brown; foliage light green, of medium density; branches numerous, of medium thickness, with yellowish bark; twigs smooth, brown; leaves ovate, of medium size.

Golden Reinette. Tree upright, head very narrow; neither thrifty nor vigorous; a very shy bearer, having not as yet borne a crop of apples; foliage yellowish green, scant; bark on trunk a bright brown, smooth; branches crooked, slender, upright; twigs smooth, glaucous, light brown; leaves broadly ovate or ovate-lanceolate.

Haas. Tree upright, with broad top; vigorous, thrifty; a shy bearer; foliage dark green, dense; bark on trunk light brown, rough; branches slender-straight; twigs smooth, dark brown; leaves large, ovate.

Huntsman (HUNTSMAN'S FAVORITE). Tree upright, thrifty, though not very hardy; a shy bearer; foliage green, not very heavy; bark rough, grayish brown; branches slender, straight; twigs smooth, reddish brown; leaves pyriform, large.

Isham Sweet. Tree upright, spreading; of medium vigor; a good bearer, though falling very badly before thoroughly ripe; bark on trunk grayish brown; foliage yellowish green, of medium density; branches slender, crooked; twigs pubescent, green; leaves large, ovate.

Janet (RAWLE'S JANET). Tree spreading; vigorous, thrifty; a heavy bearer, though the fruit drops very badly before it is ripe; foliage very dark green, dense; bark on trunk smooth, gray; branches long, slender, straight; twigs pubescent, dark brown; leaves medium, obovate.

Jonathan. Tree upright, spreading; thrifty and hardy; good bearer; foliage a dark green and of a good medium density; bark on trunk rather rough, dark brown when older; branches medium, straight; twigs a pea-green, pubescent; leaves broadly lanceolate, deep green, rather large in the more thrifty trees.

Keswick Codlin. Upright, close head; vigorous and thrifty; very prolific and hardy; bark on trunk smooth, yellowish brown; branches slender, upright, straight; twigs pubescent, dark brown; leaves small, lanceolate or pyriform; foliage dense, dark green.

Kinnaird's Choice. Tree tall, spreading, lower limbs bending towards ground; vigorous and thrifty, though not a very heavy bearer; foliage a very dark green, and scant; bark on trunk an olive-green, smooth; branches slender, long, and drooping; twigs pubescent, a dull green; leaves oblong-lanceolate; the trunk has a tendency to be very slender.

Lowell. Tree upright and thrifty, with a slightly bending top; vigorous, though a light bearer; branches heavy, crooked, yellowish brown; twigs light brown, pubescent; leaves large, pyriform to ovate; foliage dark green, dense.

Loy. Very low and spreading; thrifty, hardy, and a great bearer, maturing

very large crops of the best of apples; foliage dark green, dense; bark rough, dark gray; branches slender, long, and crooked; twigs pubescent, brown; leaves large, pyriform or obovate; basal end of petiole a deep red.

McIntosh Red. Upright, spreading; very thrifty, vigorous, and hardy; usually bears a fair crop; foliage a dark green, dense; bark on trunk grayish brown, rough; branches long, slender, straight; twigs smooth, very dark brown; leaves broadly lanceolate, medium to small.

Mammoth Black Twig. Tree spreading, with a very strong leader; a vigorous, thrifty grower; only fairly prolific; foliage a very dark green, scant; bark on trunk smooth, dark gray; branches slender, crooked; twigs pubescent, reddish brown; leaves obovate-lanceolate, with stiff petioles, medium; base of petioles red.

Mason's Orange. Tree spreading; vigorous; bearing qualities questionable; bark on trunk rough, dark gray; branches numerous, slender, crooked, olive-green; twigs smooth, greenish yellow; leaves oblong-lanceolate; foliage dark green, heavy.

Missouri Pippin. Tree upright, spreading, hardy, thrifty; one of the best of bearers; foliage dark green, of medium density; bark on trunk grayish brown, rough; branches slender and nearly straight; twigs slightly pubescent, reddish brown; leaves medium, ovate; petioles red at base.

Mother. Tree spreading; vigorous and thrifty; a good bearer; foliage very dark, somewhat scant; bark on trunk smooth, dark gray; branches long, pendulous, and crooked; twigs pubescent, deep brown; leaves small, lanceolate or obovate.

Okabena. Tree upright, spreading; vigorous and thrifty; a good bearer; foliage dark green, of medium density; bark on trunk smooth, light brown; branches short and crooked; twigs smooth, dark brown; leaves large, obovate-lanceolate.

Park's Keeper. Tree low, spreading; vigorous and thrifty; a fair bearer; badly affected with rust; foliage very dark, rather dense; bark on trunk smooth, light brown; branches long, slender, and crooked; twigs pubescent and brown; leaves lanceolate, small.

Pennsylvania Red Streak (WINE). Tree spreading, with an upright tendency; thrifty, rather hardy; only a fair bearer; grows good crops of apples some years; fruit with a tendency to drop before ripe; foliage dark green, rather scant; bark on trunk a medium dark brown; branches slender and rather zig-zaging; twigs slightly pubescent, light brown; leaves large, lanceolate in the smaller ones.

Pewaukee. Low, spreading; vigorous and thrifty; has not as yet borne; foliage very dark green, dense; bark on trunk rough, on limbs smooth, olive green; branches very crooked; twigs smooth, very dark brown; leaves long, lanceolate.

Red Bietigheimer. Tree spreading, slightly upright; almost a total failure as far as fruit is concerned; not a vigorous grower; bark green to brown, rough; foliage scant, light green; branches stout, crooked, with yellowish-green bark; twigs pubescent, green; leaves very large, oblong-ovate.

Red Eisen. Tree spreading, upright, vigorous, and thrifty; bark on trunk

a bright brown, smooth; foliage dark green, dense; branches olive to brown, slender and straight; twigs smooth, red; leaves acuminate, large; not an extra good bearer.

Rome Beauty. Tree upright, with a very heavy, broad head; very thrifty and fairly hardy; only a fair bearer; foliage dark gray green, and sufficient for shading the inside of the tree; bark on trunk dark gray, and smooth; branches short, stout, and crooked; twigs smooth, reddish brown; leaves broadly lanceolate, medium to large; the tree has a great tendency towards branching.

Salome. Tree upright, spreading; not very thrifty, nor is it hardy; rather a good bearer for the small size of the tree, which is not as large as a five-year apple tree should be; foliage a deep green, rather scant; bark on trunk a pea-green, rather rough; branches rather slender and straight; twigs smooth, greenish brown; leaves medium, obovate.

Cranberry (SCARLET CRANBERRY) .Tree scarcely upright, though not spreading; a light bearer; foliage yellowish green, rather scant; bark on trunk very rough, gray; branches slender, straight; twigs pubescent, deep brown; leaves obovate-lanceolate, large.

Shannon. Tree upright, spreading; vigorous, but a slow grower; has not as yet borne any fruit; bark on trunk light gray; foliage yellowish green, scant; branches stout, straight; twigs smooth, light brown; leaves elliptical, very large, giving the tree a look of density.

Smith's Cider. Tree upright, spreading; rather thrifty and vigorous, hardy; a light bearer; bark rough, grayish brown; branches slender and extremely crooked; twigs yellowish brown, smooth; leaves lanceolate, large.

Smokehouse. A low, spreading, thrifty grower, hardy and vigorous; a good bearer, though the fruit drops badly; bark on trunk smooth, brown; branches long and drooping; twigs pubescent, light brown; leaves broadly ovate or lanceolate.

Stuart's Golden. Tree with a low, spreading, open top; thrifty and hardy; a rather good bearer; foliage light yellowish green, rather scant; bark on trunk rough, grayish brown; branches slender, crooked; twigs deep yellowish brown, smooth; leaves obovate, medium in size.

Stark. Tree spreading and hardy, though a slow grower; not an extra good bearer; foliage light green and dense; bark rough, olive green; branches stout, short, and crooked; twigs pubescent, light brown; leaves very large, obovate, almost elliptic.

Stump. Tree upright in the extreme; has a great tendency towards branching; neither vigorous nor prolific, the tree having never produced an apple; foliage dark green, dense; bark on trunk rough, yellowish brown; branches upright, straight; twigs pubescent, brownish; leaves obovate, small.

Swaar. Tree spreading, and of medium height; vigorous and thrifty; a medium bearer; foliage dark green, dense; bark on trunk rough, grayish brown; branches slender and crooked; twigs pubescent; leaves small and obovate.

Shirk. Tree upright, spreading; stunted and not hardy; has never borne any apples; foliage dark green and of medium density; bark on trunk rough and brown; branches short, stubbed, and crooked; twigs pubescent, light brown; leaves long and lanceolate.

Tetofsky. Tree upright in the extreme; not very thrifty, though hardy, and a great bearer for its size; it can never be of much popularity, as it is a very slow grower, those on the College grounds being, at ten years, no more than eight feet high and not more than three inches in diameter; foliage yellowish green, scant; bark on trunk yellowish brown, smooth; branches upright, straight, and stout; twigs smooth, yellowish brown; leaves very large, oblong.

Wallbridge. Tree upright, with a good head; thrifty and vigorous; a shy bearer; bark on trunk light gray brown, smooth; foliage light green, dense; branches slender, curving upright, yellowish to dark green; leaves lanceolate, small.

Wealthy. Tree upright in the extreme; growth very poor; it bears a few apples and these not of the best quality; foliage deep green; bark on trunk yellowish brown; branches dark green, slender, few, straight, growing upright as soon as free from neighbors; twigs slender, smooth; leaves small, pyriform.

White Winter Pearmain. Tree upright, spreading, with a fine round head; is thrifty and vigorous; a fair bearer; foliage dark green and of medium density; bark on trunk smooth, grayish brown; branches long, slender, straight; twigs smooth, brown; leaves large, lanceolate; petioles crimson at base.

Winesap. A low, spreading head; tree very thrifty, hardy, and vigorous; ranks with the best in bearing; foliage dark green, dense; bark on trunk light brown, and smooth except on very old trees; branches slender, drooping; twigs pubescent, a very dark brown; larger leaves elliptical and smaller leaves lanceolate; petioles red.

Wolf River. Tree very low and spreading, having a squatty appearance; a very thrifty grower, and almost perfectly hardy; tree a good bearer, though it matures very few fruits, as they fall badly before ripe; foliage a good green; bark rough, very light on old branches and trunk; branches long and very crooked, causing so much necessary pruning that the head is apt to be too open; twigs slightly pubescent; leaves extremely large in some cases.

York Imperial. Tree upright, with a very broad head; vigorous and thrifty; bark on trunk olive-green, slightly rough; branches straight, short, and heavy; twigs pubescent and yellowish green; leaves obovate, medium to large; foliage dark green and heavy.

Yellow Transparent. Tree too upright; not very thrifty nor vigorous; a shy bearer; bark on trunk rough, yellowish brown; branches slender, crooked, and bright yellow; twigs a bright yellowish green, smooth; leaves ovate, light green.



PLATE I.



WHOLE-ROOT WINESAP.

PIECE-ROOT WINESAP.

PLATE 2.

WHOLE-ROOT JONATHAN.

(Cross-arm, 9 ft. 8 in.)

PIECE-ROOT JONATHAN.

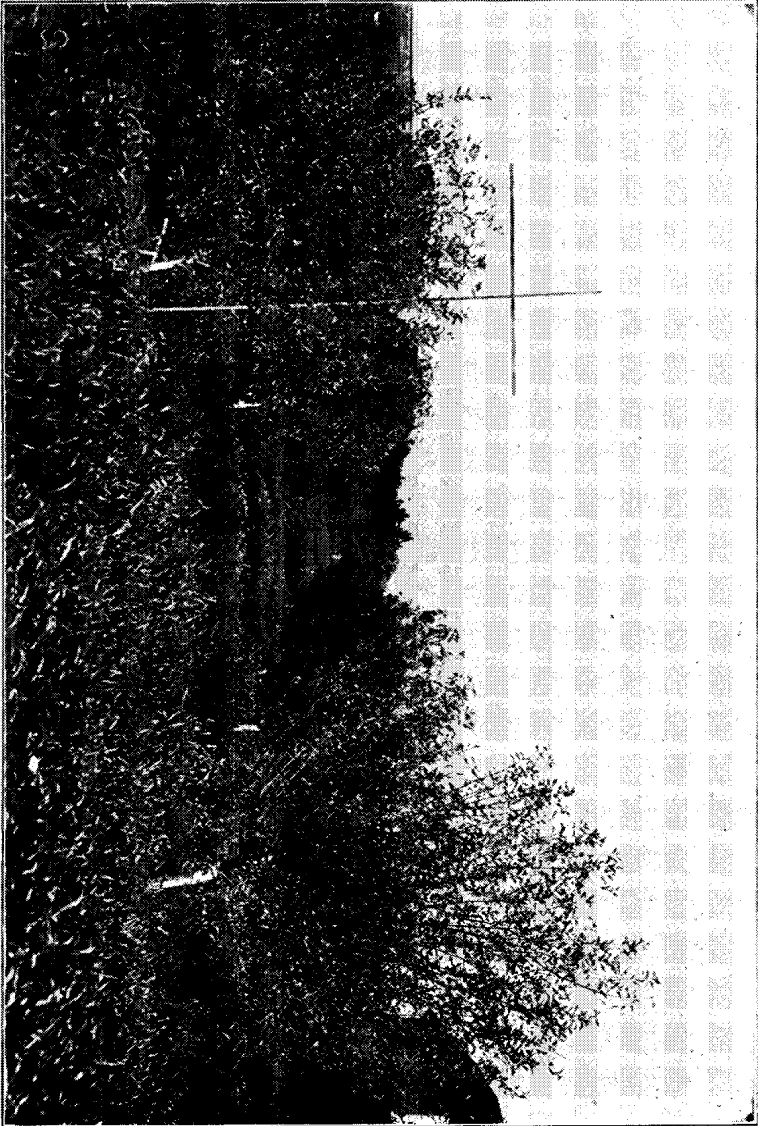
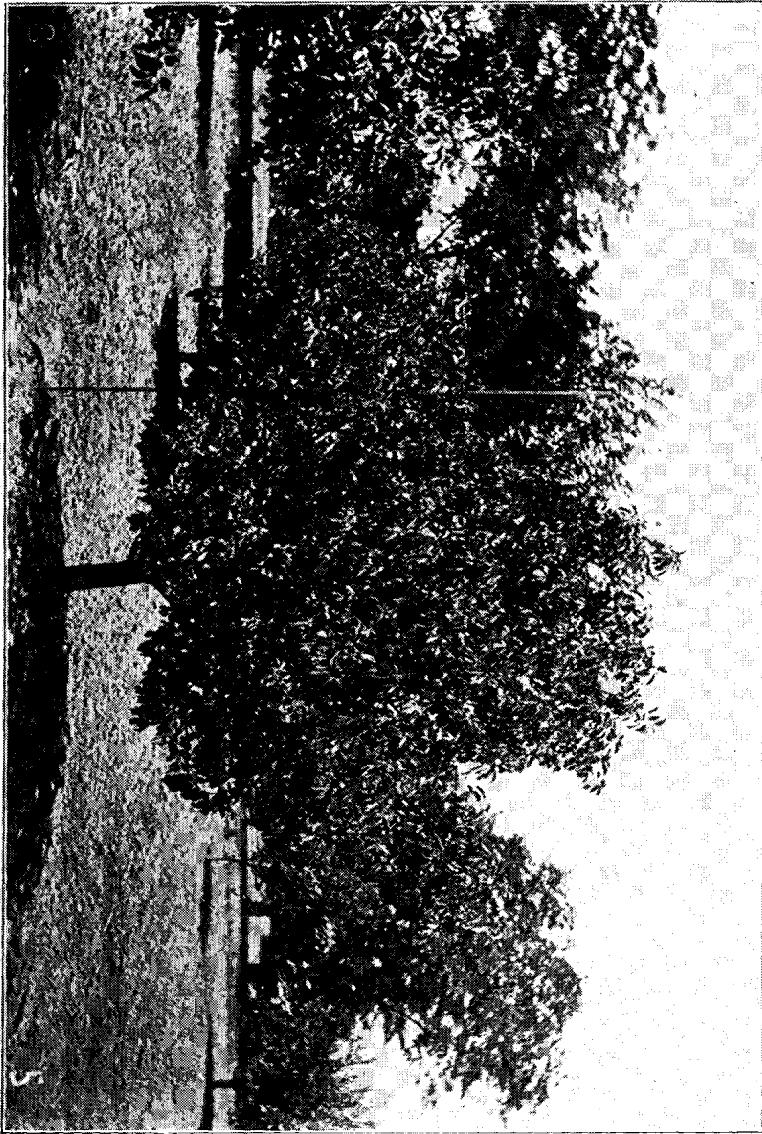


PLATE 3.



WHOLE-ROOT COOPER. (10-foot rod.)

PLATE 4.

PIECE-ROOT COOPER. (10-foot rod.)

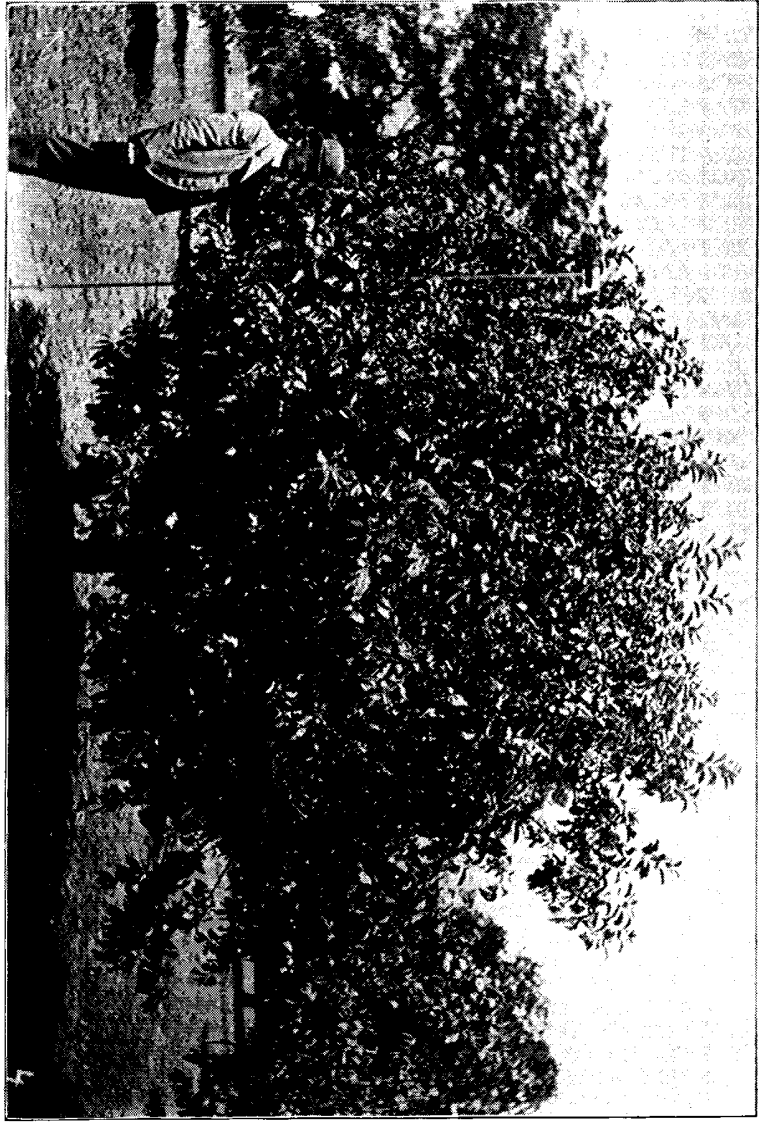
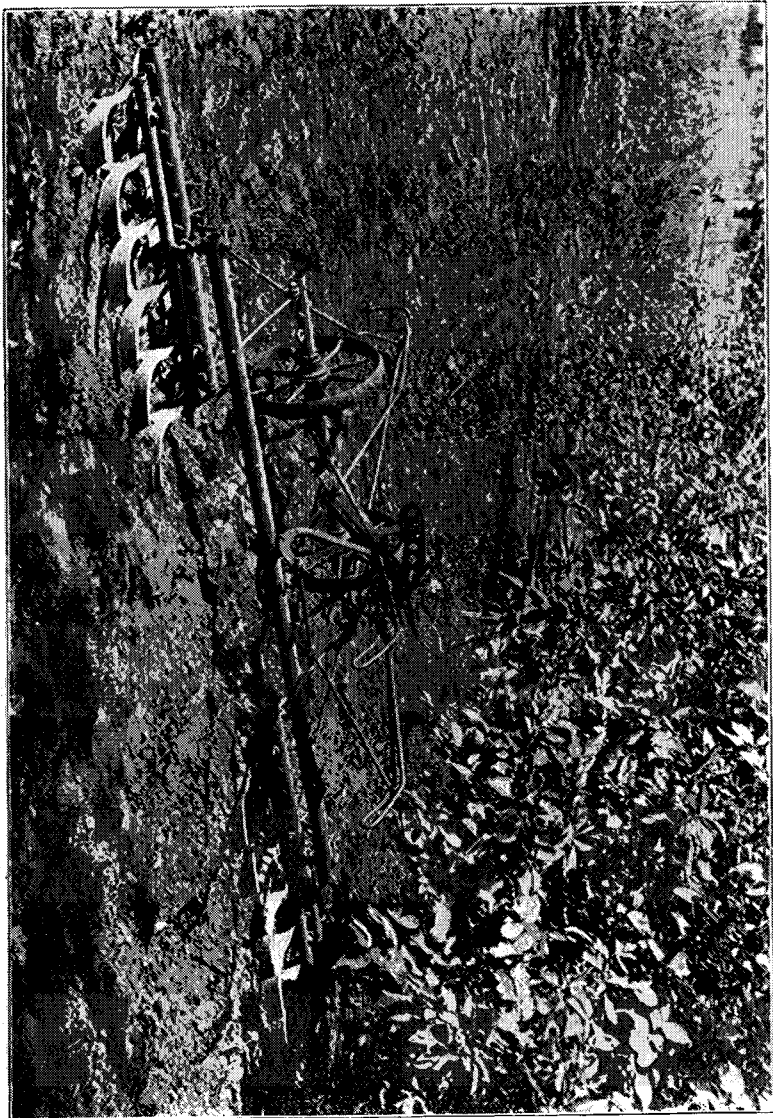


PLATE 5.



ACME HARROW.

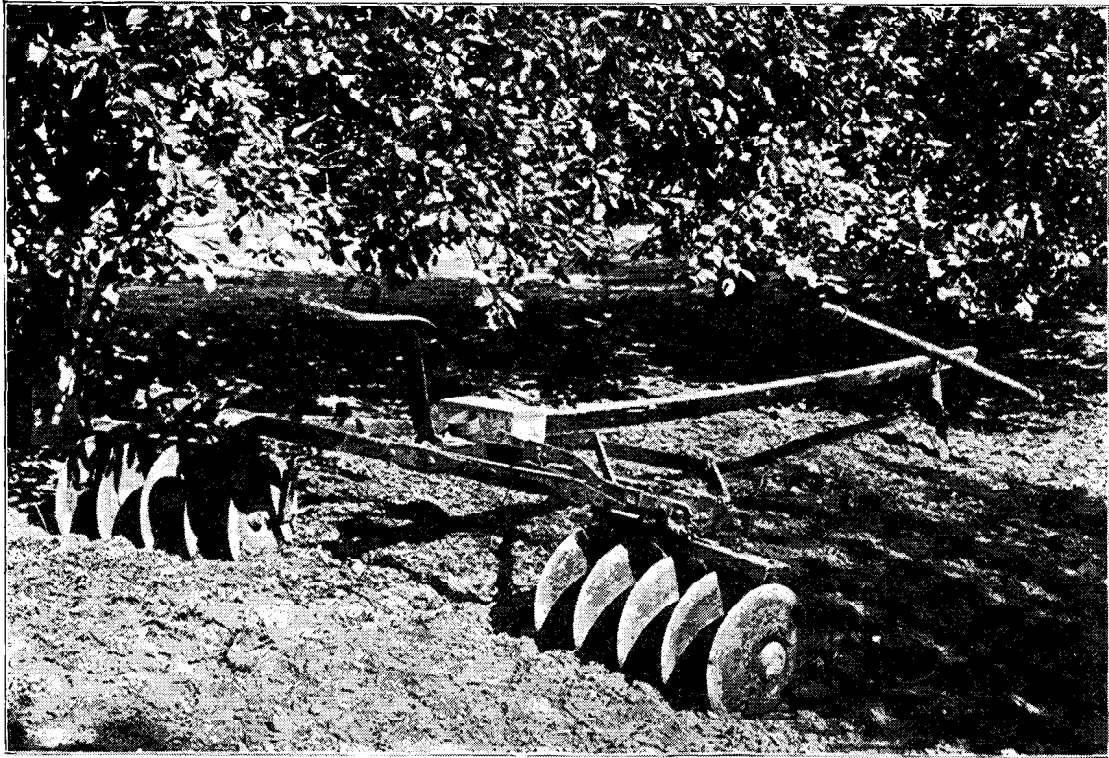
PLATE 6.



CLARK'S CUTAWAY HARROW.

Historical Document
Kansas Agricultural Experiment Station

PLATE 7.



OHIO EXTENSION DISK.