

SOME VARIATIONS OF THE FRUIT OF
QUERCUS MACROCARPA

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QUERCUS MACROCARPA

By

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INTRODUCTION

The fruit of Quercus macrocarpa Michx., or Burr Oak, probably shows more variation from tree to tree than does any other species of oak, while variations within a given tree are no greater than might be expected. In this work, the author has endeavored to present material which will facilitate an understanding of the species from an ecological and taxonomical standpoint.

In compiling the material, no indication has been found that any extensive study has been made regarding such variabilities. Sargent (16) states that the fruit is exceedingly variable in size and shape and that the cups bear awns which on trees of northern habitat are short and inconspicuous, but on southern trees are long and very conspicuous. Keeler (12) calls attention to the fruit variabilities and mentions that in the north stature of the trees and size of fruit may be much reduced as compared to those of the south. Other authors of taxonomical and ecological literature state, in general manner, that such variabilities may exist.

The species, Quercus macrocarpa, is found throughout most of Oklahoma except in the panhandle area. It maintains itself upon rich bottomlands near streams or upon moist but well drained soil. The Burr Oak or Mossy Cup Oak, as it is commonly called, does not form pure forest stands as do some of the other oaks. More often one finds it in an area quite well defined or as a single tree in open fields.

The fruit possesses a fringe, a characteristic which is found in no other species of oak in North America. The fringe is formed by the prolonged tips of the bracts of which the cup is composed. These prolonged flexuous tips will be called awns in this discourse. In some cases the bracts may be modified into short robust awns further back from the rim. The awns

tend to incurve or recurve in the cup near the margin in many instances, while in others they remain entirely straight or recurve but very little if at all. The awns of the fringe may be long on some cups and short or nearly lacking on others. The bracts show variation in spacing. Some are closely arranged and others widely spaced. Furthermore, on some cups the bracts are short and tuberculate with the apex clasping the cup or turning in at an abrupt angle. On other cups the bracts are long and non-tuberculate with the apex free. Another noteworthy characteristic of the cup may be found in the stalk. Some are "short stalked", about 1 cm. long; others are "moderately stalked", about 1.5 cm. long, and there are others "long stalked", which are over 1.5 cm. long. Color of the cup is an outstanding feature. Some specimens are dark purplish-brown and others are brown, light brown, or olive colored. Wall thickness of the cup may vary in different specimens. Some are "thin walled", about 3 mm. or less; others are of "moderate" wall thickness, at least 4 mm., and still others are "thick walled", about 5 mm. or more. The cup may tend to incurve near the marginal apex or may remain straight or curve outward. The inside rim diameter of the cup tends to remain fairly constant, but in some instances it is found to vary considerably.

Tendency of the cup to be variable in the quality of retaining the acorn proves to be of importance in a study of this kind. In some instances the acorn is retained for some time after maturity and in others it is released immediately. The mechanism which permits retention of the acorn may be due to a few adaptations which should be mentioned. One such adaptation is seen in a cup where nearly the entire acorn is included in the cup and where the cup is constricted near the apex or rim. Another adaptation is found in which the awns of the cup recurve near the inner rim and form a constrictive pad pinching in on the sides of the acorn. In a third type the awns grow

down over the apex of the acorn and inhibit it from being expelled. Other specimens reveal that the vascular bundles passing from the base of the cup to the base of the acorn do not absciss, and, therefore, the acorn persists in the cup.

The acorn exhibits its share of variation. Some are oblong-ovate and others short-ovate. Still others are much reduced longitudinally and increased in width through the horizontal axis. The color of the acorn at maturity varies through shades of dark purplish-brown, brown, light brown or tan. The amount of the acorn exposed may vary from a third to three-fourths, or more.

METHODS

Collections:

Fruits were collected in Payne and Lincoln counties in the north central part of Oklahoma during the fall and winter of 1948. They were collected from trees which grew along streams upon well drained soil. The species tends to be restricted to this type of habitat, in this area at least, instead of forming stands upon higher and rockier soils, particularly where *Q. marilandica* Muench. and *Q. stellata* Wang. grow in great numbers.

The number of fruits collected from individual trees varied depending upon the productivity of the trees in this particular year. On the average, the number of fruits taken from each tree was about 25 to 30. 95 trees were visited, 91 from which fruit was taken. The other 4 had very little or no fruit available.

Collections were made from seven different areas (Fig. I). Five were of the natural habitat type, one of a natural habitat type with the area given over to grazing of domestic farm animals, and one was of a park type.

Study:

The 91 samples were divided into 16 distinct types on the basis of their gross anatomical features such as size, shape of cup, nature of awns and bracts, wall thickness, length of stalk, the ability of the cup to retain or release the acorn as well as the amount of the acorn enveloped by the cup. The thickness of the cup was determined by cutting the cup longitudinally. To prevent the awns from being broken off in the process of cutting, they were placed in a humidifier until they had become flexuous.

Upon the basis of the characters described above, the following key has been devised.

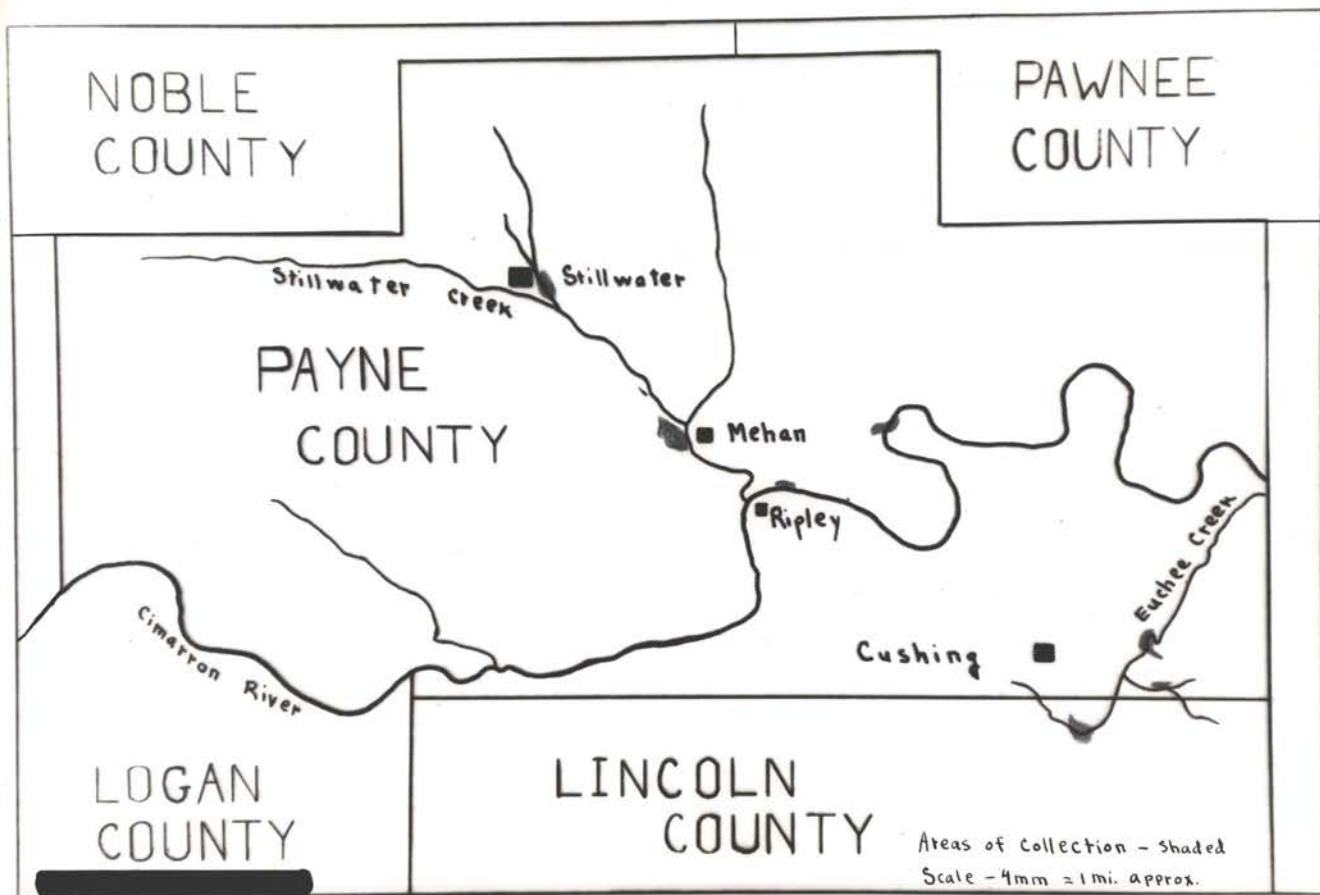


Fig. 1. Areas of collection of *Quercus macrocarpa*

A KEY TO THE REPRESENTATIVE GROUPS

- | | |
|---|---------|
| 1. Cups usually retaining the acorn ----- | 2 |
| Cups not retaining the acorn ----- | 11 |
| 2. Cups with well developed marginal fringe ----- | 3 |
| Cups with short or poorly developed marginal fringe or
with fringe lacking ----- | 7 |
| 3. Cups saucer-shaped or shallow bell-shaped. Fringe very
thick and spreading ----- | Type 1 |
| Cups not shaped as above ----- | 4 |
| 4. Cups very dark. Awns very heavy to the outside ----- | Type 2 |
| Cups not dark. Awns not heavy as above ----- | 5 |
| 5. Cups with long slender awns ----- | 6 |
| Cups with short stubby awns ----- | Type 3 |
| 6. Awns usually recurving in the cup and forming a pad at the
inside margin ----- | Type 4 |
| Awns not recurving in the cup as above ----- | Type 5 |
| 7. Cup margin erose with short and poorly developed fringe;
acorn dark purple ----- | Type 6 |
| Cup margin not erose as above; acorn not dark purple ----- | 8 |
| 8. Cup margin tending to grow up over and nearly include entire
acorn ----- | Type 7 |
| Cup margin not tending to grow up over the acorn ----- | 9 |
| 9. Cups long-stalked, from 2.5 to 4 cm. long; cup wall thin ---- | Type 8 |
| Cups short or moderately-stalked, 1.5 cm. or less; cup wall
thick ----- | 10 |
| 10. Acorn ovate-elliptical. Cup margin usually incurved ----- | Type 9 |
| Acorn flatly ovate, i.e., with the long axis much reduced;
apex greatly blunted ----- | Type 10 |
| 11. Cup saucer-shaped or shallow bell-shaped. Fringe very thick,
long, and spreading ----- | Type 11 |
| Cup not as above ----- | 12 |
| 12. Acorn oblong or barrel-shaped ----- | 13 |
| Acorn ovate ----- | 14 |
| 13. Fringe usually recurving in the cup ----- | Type 12 |
| Fringe not recurving in the cup ----- | Type 13 |
| 14. Cups shallow. Acorn short-ovate ----- | Type 14 |
| Cups deep. Acorn long-ovate ----- | 15 |

15. Bract apex conspicuously long. Acorn averaging 3.5 cm. in
length ----- Type 15
Bract apex short; prominently tuberculate. Acorn averaging
4 cm. in length ----- Type 16

A DESCRIPTION OF THE REPRESENTATIVE GROUPS

Type 1. Cup with long, slender awns forming a spreading fringe.

Awns usually recurve in the cup and then turn out constricting the inside rim. The recurving of the awns in extreme cases may be as much as 1.5 cm. or more. The acorn is retained by the cup due to the constriction of the awns and the incurving margin of the rim. Awns are robust to the extreme outside and back from the rim of the cup. The cup is saucer-shaped or shallow bell-shaped; short-stalked, about 1 cm. long. Bracts are free at apex. The inside rim diameter of the cup is about 3 cm. The wall is 6 mm. or more thick. Acorn ovoid or short-ovate, about 3 cm. long and 2.7 cm. wide, about three-fourths included in the cup exclusive of awns and nearly the entire length including the awns.

Type 2. Cup with heavy dark awns which recurve in the cup and form a padded ridge near the inside rim. Inner awns usually curve outward and become more robust; stalks are short and robust. Bracts are heavy and tuberculate. The cup is very dark colored with the inside rim diameter about 3 cm.; wall 6 mm. or more thick. The cup retains the acorn. Acorn very much reduced through the longitudinal axis making it wider than long and nearly elliptical, about 2.3 cm. long and 3.3 cm. wide, entirely included in the cup and awns.

Type 3. Cup with short awns which usually recurve in the cup. Rim of the cup curves inward and retains the acorn. Cup very deep and heavy; short-stalked, about 1 cm. long. Bracts with long acuminate tips and free at the apex. The inside rim diameter is from 2.5 cm. to 3 cm. The wall is



Type 1.



Type 2.

6 mm. or more thick. Acorn ovate-oblong, about 3 cm. long and 2 to 2.7 cm. wide, about three-fourths or more included in the cup.

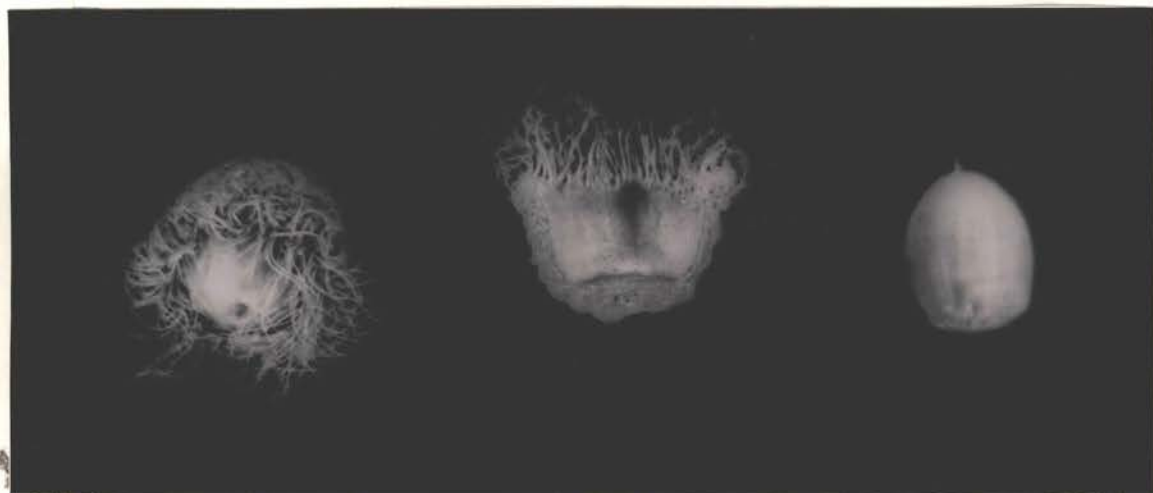
Type 4. Cup with long slender and delicate awns which may or may not be spreading. Awns recurve for a short distance in the cup and form a constriction near the inside rim, which enables the cup to retain the acorn. A slight thickening on the outside near the rim gives the cup a deep bell shape; short to moderately stalked. Bracts are small and tuberculate, free at the apex and turned up. The inside rim diameter of the cup is about 2.5 cm. The wall is usually thick. Acorn elliptical-ovate, about 2.8 to 3 cm. long and 2.4 cm. wide, more than three-fourths included in the cup.

Type 5. Cup with long thread-like awns which do not recurve in the cup. Cup deep with nearly parallel sides. The inside of the cup is dark-rusty colored; usually moderately stalked. Bracts are small, shield-shaped, free at the apex and turned up. The inside rim diameter is about 3 cm. The wall is usually thin, about 3 mm. The cup retains the acorn. Acorn ovate, about 3.5 cm. long and 2.8 to 3 cm. wide, three-fourths included in the cup.

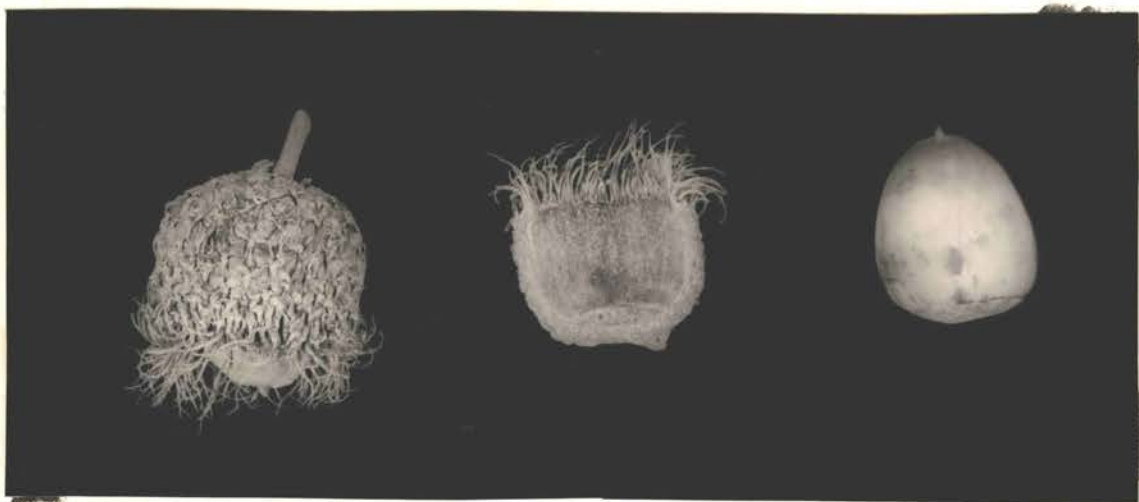
Type 6. Cup with short and very sparse awns. The margin of the cup is erose and uneven; short-stalked. The cup is moderately deep and very dark brownish-purple in color. Bracts are widely spaced and tuberculate with the apex free. The inside rim diameter is about 3 cm. The wall is thin to moderately thick, from 3 to 4 mm. The cup usually retains the acorn. Acorn ovate-elliptical, very dark brown or dark brownish-purple in color, about 3.3 to 3.5 cm. long and 2.5 cm. wide, about one-half included in the cup.



Type 3.



Type 4.



Type 5.



Type 6.

Type 7. Cup with very short or nearly lacking awns which recurve in the cup forming a pad-like lining near the inner rim. The cup is deep and usually grows down over the apex of the acorn; rather long-stalked, as much as 2.5 cm. or more long. Bracts are tuberculate and free at the apex. The inside rim diameter varies from 1.5 to 2.5 cm. The wall is usually moderately thick, from 3 to 4 mm. Acorn ovate, from 3 to 3.7 cm. long and 2.3 to 3 cm. wide, usually more than three-fourths included in the cup.

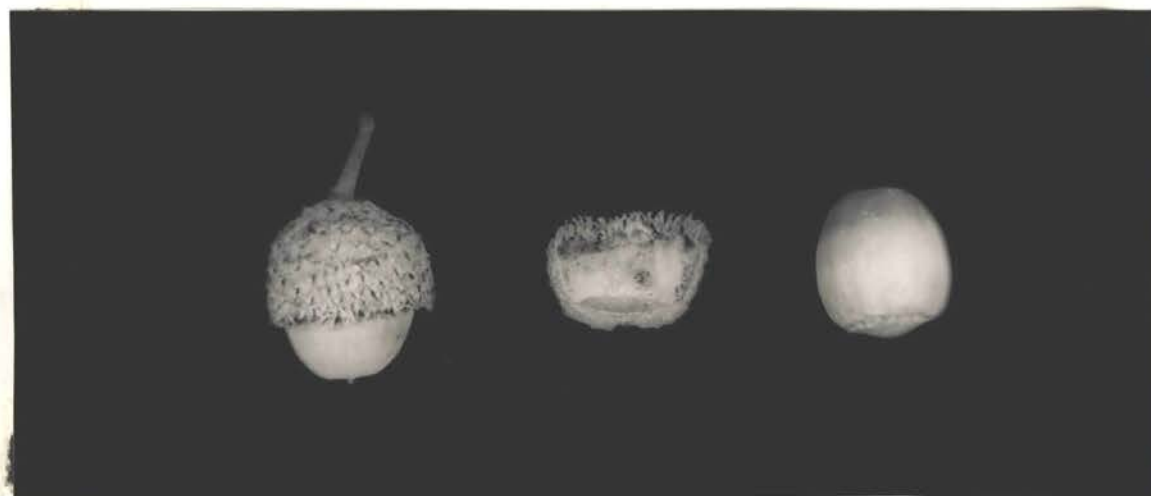
Type 8. Cup with very short awns which in some instances recurve in the cup slightly. Cup small, about 1.5 cm. deep; stalk 2.5 cm. or more long. Bracts are quite delicate and free at the apex. The inside rim diameter from 2.5 to 3 cm. The wall is thin, about 2 mm. The cup retains the acorn. Acorn short-ovate, about 2.8 cm. long and 2.5 cm. wide, about half included in the cup.

Type 9. Cup usually with short awns which recurve in the cup making a thick pad near the inside rim. The margin greatly incurves and forms a shelf on the inside near the rim which reduced the rim diameter. The cup is bell-shaped, and usually moderately stalked, about 1.5 cm. long. Bracts mostly tuberculate and free at the apex. The inside rim diameter of the cup is about 3 cm. The wall is moderately thick, about 4 mm. The cup usually retains the acorn. Acorn is oval-shaped, about 2.5 to 2.7 cm. long and 2.5 cm. wide, at least one-half included in the cup.

Type 10. Cup with very short awns which slightly recurve in the cup and form a constrictive pad near the inside rim. The rim of the cup curves inward and reduces the rim diameter. The cup is flattened and wide; short



Type 7.



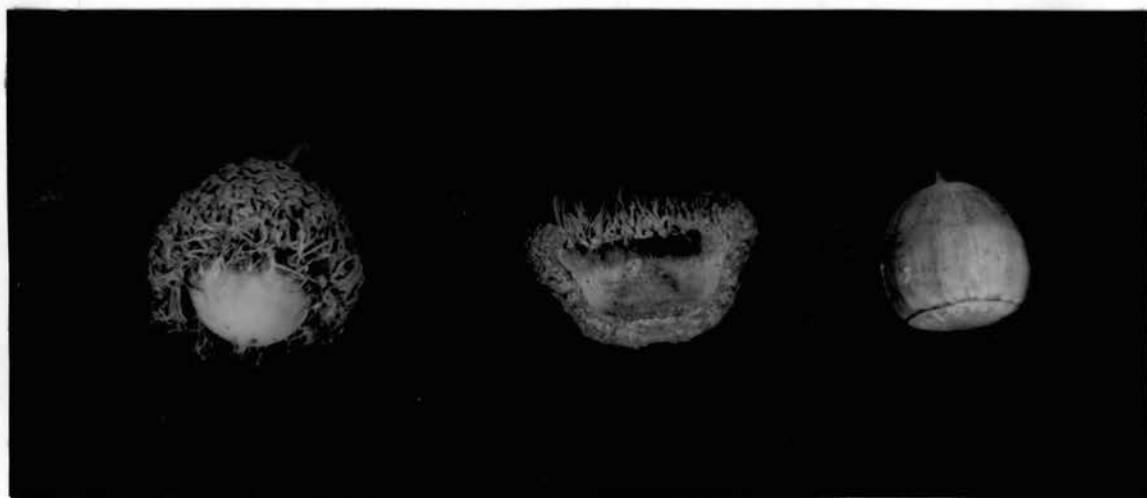
Type 8.

to moderately stalked. Bracts are short and free at the apex. The inside rim diameter of the cup is about 3 cm. The wall is from 4 to 6 mm. thick. The cup usually retains the acorn. Acorn very short-ovate, about 2.3 cm. long and 2.7 cm. wide, from half to three-fourths included in the cup.

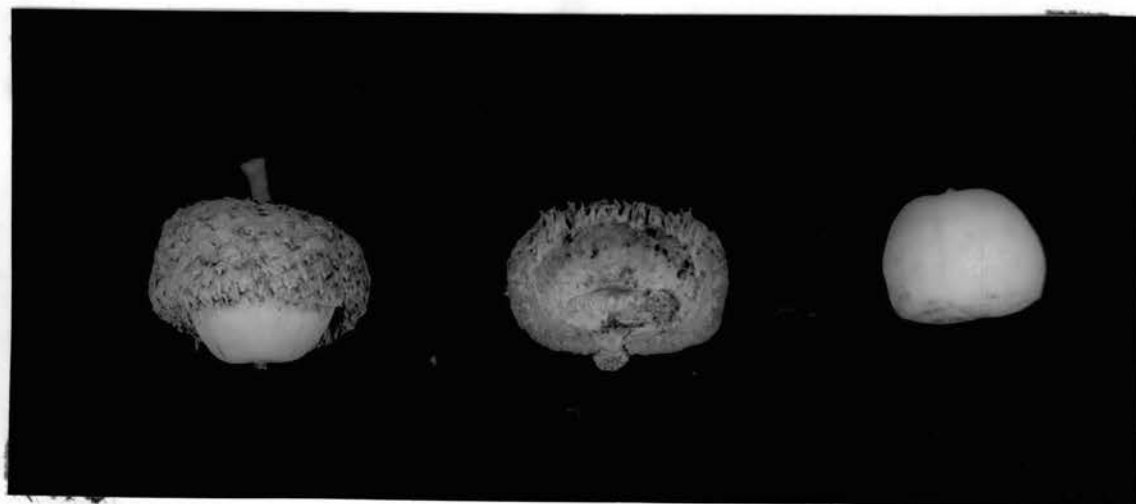
Type 11. Cup with long slender awns forming a wide spreading fringe. The awns recurve in the cup for as much as .5 to 1 cm. forming a soft padding at the edge. A shelf is formed at the inside near the rim. The cup is deep saucer-shaped or shallow bell-shaped; stalk 1.5 to 2 cm. long. Bracts are very dense with the apex free. The inside rim diameter of the cup is about 3 cm. The wall is about 3 mm. The cup usually releases the acorn. Acorn ovate, about 3.2 cm. long and 2.5 cm. wide, one-half or more included in the cup.

Type 12. Cup with well-developed awns which recurve in the cup forming a pad near the rim. The margin of the cup incurves slightly; short to moderately stalked. Bracts are quite thick and heavy with apex turning down and in. The inside rim diameter of the cup is 3 cm. or more. The wall is about 4 mm. thick. The cup usually releases the acorn. Acorn oblong or barrel-shaped, about 3.5 cm. long and 2.5 cm. wide, one-half to three-fourths included in the cup.

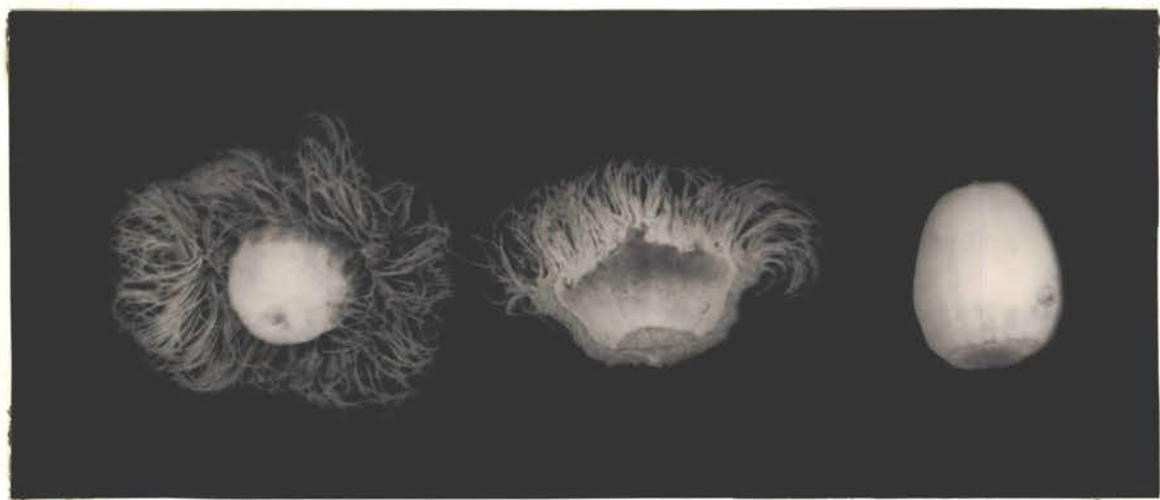
Type 13. Cup with well-developed awns which usually do not recurve in the cup; short-stalked. Bracts are tuberculate and free for a greater part of their length. The inside rim diameter is about 3.5 cm. The wall is 4 to 5 mm. thick. The cup releases the acorn. Acorn nearly barrel-shaped or oblong, about 3.5 cm. long and 3 cm. wide, style with a depression surrounding it, about one-half included in the cup.



Type 9.



Type 10.



Type 11.

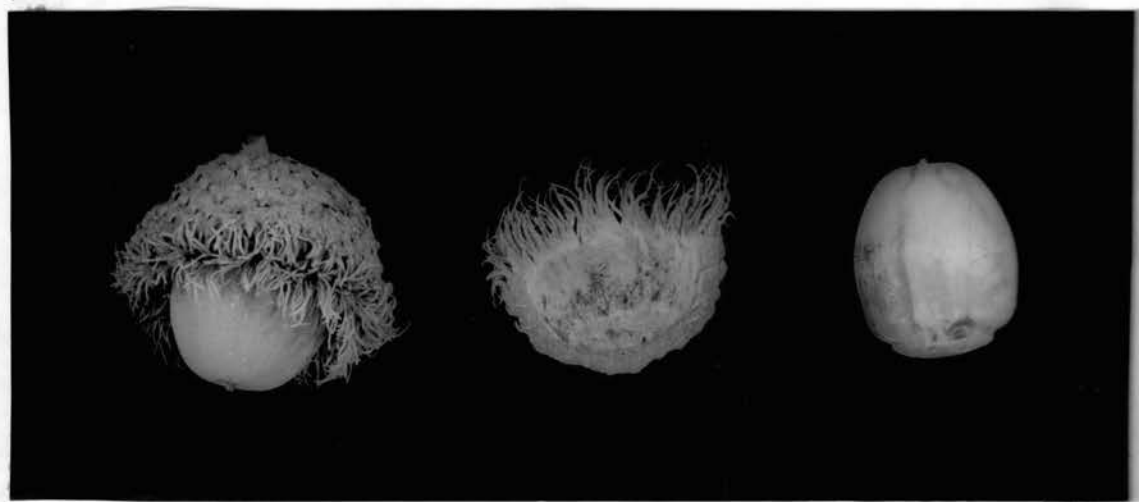


Type 12.

Type 14. Cup possessing well-developed awns which usually recurve in the cup. The margin incurves and the cup is relatively shallow; short and robustly stalked. Bracts are long and usually tuberculate. The inside rim diameter is about 2.7 cm. The wall is 4 to 5 mm. thick. The cup usually releases the acorn. Acorn ovate, about 2.6 cm. long and 2.5 cm. wide, about half included in the cup.

Type 15. Cup with well-developed awns which usually do not recurve. The cup is deep and short stalked. The apex of the bracts are conspicuously long and free. The inside rim diameter of the cup is 2.5 to 3 cm. The wall is about 3 to 4 mm. thick. The cup releases the acorn. Acorn long-ovate, about 3.5 cm. long and 2.2 to 2.5 cm. wide, about one-half included in the cup.

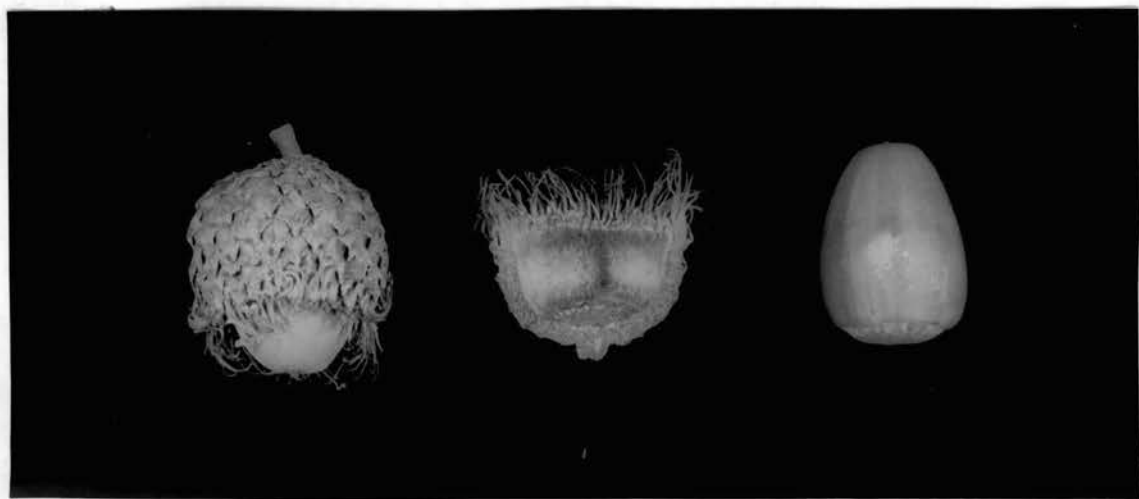
Type 16. Cup with well-developed awns which are delicate and do not recurve. The cup is deep and usually short-stalked. Bracts are prominently tuberculate with inconspicuous apex. The inside rim diameter of the cup is about 3 cm. The wall is about 4 mm. thick. The cup releases the acorn. Acorn long ovate, about 4 cm. long and 2.7 cm. wide, about one-half included in the cup.



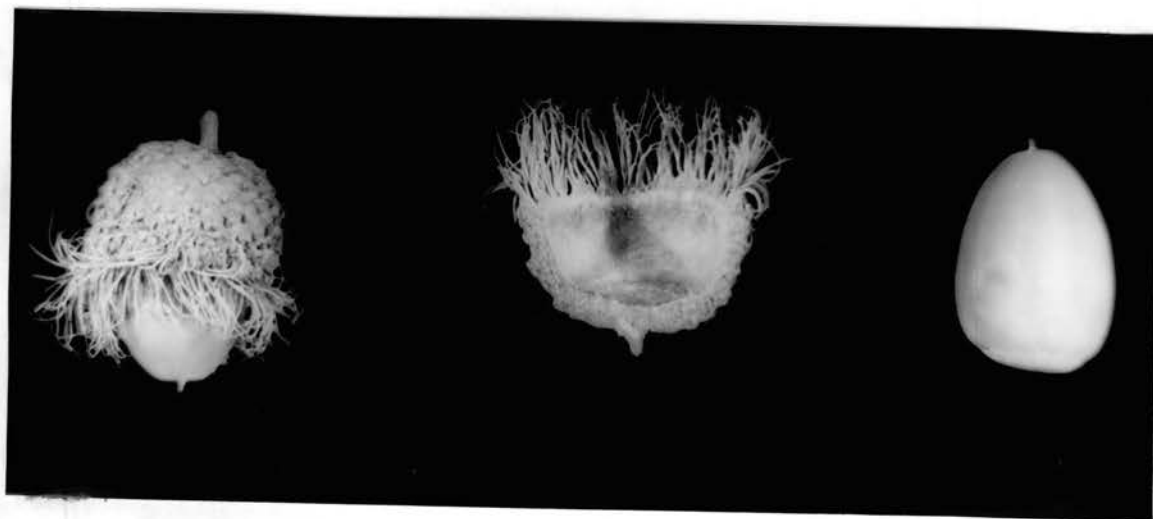
Type 13.



Type 14.



Type 15.



Type 16.

THEORETICAL CAUSE OF VARIATION

The possibility of hybridization cannot be overlooked in the species Q. macrocarpa. Trelease (19) states that there is not a great likelihood that extensive hybridization occurs between black and white oaks, but there are instances where hybrids have been thought to occur between the groups. There have been at least six hybrids described which are crosses with species of white oak and Q. macrocarpa. These hybrids are as follows: X Q. Andrewsii Sarg., believed to be a cross between Q. macrocarpa and Q. undulata Torr.; X Q. Bebbiana Schn., thought to be a cross between Q. macrocarpa and Q. alba L.; X Q. guadalupensis Sarg., a cross between Q. macrocarpa and Q. stellata Wang.; X Q. Hillii Trel., a cross between Q. macrocarpa and Q. muehlenbergii Engelm.; X Q. Byarsii Sud., believed to be a cross between Q. macrocarpa and Q. Prinus L. (Q. Michauxii Nutt.) and X Q. Schuettei Trel., thought to be a cross between Q. macrocarpa and Q. bicolor Willd. Of these there are only two which occur in this area. They are Q. stellata and Q. muehlenbergii. Another species, Q. prinoides Willd., is present in the area, but is not listed as crossing with Q. macrocarpa. In the black oak group there are four species in this area which may be possibilities for hybrids if there actually is crossing between the black and white oaks. These four species are as follows: Q. velutina Lamb., which is rare to the area, but prominent in the eastern part of the state; Q. marilandica Muench. which is quite prominent; Q. borealis Michx., which is not greatly abundant; and Q. palustris Muench., which is present mainly as introduced to the area and used for ornamental purposes.

Question may arise in attempting to reach a decision as to whether

or not one has a hybrid. So far, in the oaks at least, it appears that the only possible clue has been to observe foliage, fruit, seedlings and cytology of wood, and attempt to arrive at some possible parentage by the intermediate characteristics presented.

Mention has previously been made concerning ecological factors as applied to geographical habitat, i.e., trees in the north being of smaller stature, fruits smaller size, and the fringe of the fruit shorter or lacking as compared to those of the south where the trees and fruits are quite large and fringe well developed. It does not seem logical that geographical factors or any ecological factor would apply in this research since the study was carried out in an area which is ecologically constant.

It must be conceded that the species Q. macrocarpa is in a high state of plasticity, at least as shown by the fruits. According to Anderson (2) there is present the possibility of infiltration of germ plasm between unlike species. This may be the case with Q. macrocarpa and other species of Quercus. If we consider the hybrids formed from such an infiltration to be partially or wholly compatible with each other and with Q. macrocarpa there is the possibility of the formation of "hybrid swarms" which may explain the array of variations found. Regardless of what the true explanation may be, the species is in a state wherein there has as yet been no stabilization. It may be a question of time as to when the species will become stabilized as one or more true species that bear uniform fruit. It is the opinion of the author that cytological studies of the somatic and reproductive cells may aid in answering some of the questions arising in investigations of this kind.

SUMMARY

The fruit of Quercus macrocarpa Michx. probably shows more variation from tree to tree than does any other species of oak, while variations within a given tree are no greater than might be expected. Study was made of fruits of trees growing in the north central part of Oklahoma in Payne and Lincoln counties. Variation is found to occur in the size of the cup and acorn, length of the stalk, degree of development of the fringe or awns, aspects of the bracts, quality of the cup in retaining or expelling the acorn, and color of the cup and acorn.

Attempting to explain the cause of variation at present is only theoretical. There seems little possibility of hybridization between the black and white oak groups. In the white oaks there are three species native to this area which could give rise to hybrids, but there is no proof of such.

It does not seem logical that in this area ecological factors would apply since the research was carried out in an area which is ecologically constant.

The species Q. macrocarpa must be conceded as being in a high state of plasticity as characterized by its fruits. A possible explanation of the formation of the variations may be found in the infiltration of germ plasma from another species. The hybrids formed being partially or wholly compatible with Q. macrocarpa and among themselves would give rise to "hybrid swarms" thus explaining the many variations. It may be a question of time as to when the species may become stabilized in its fruit characteristics. The opinion is held by this investigator that a cytological study of somatic and reproductive cells may aid in answering some of the questions arising in a research of this type.

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