

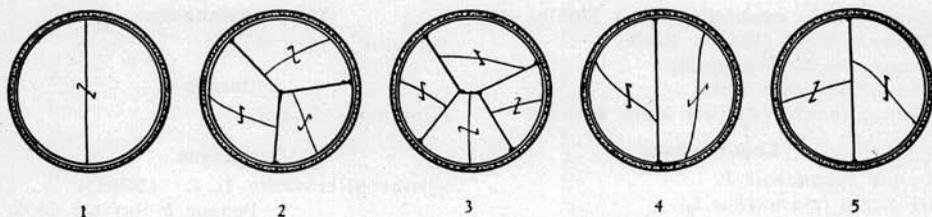
MULTI-SEEDED ACORNS

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At Conway, Arkansas is a large native tree of Southern red oak *Quercus falcata* Michx* which is very unusual in that it bears acorns that contain several seeds each. This tree stands on a corner lot bordered by Bruce Street on the north and by Davis Street on the east. It was originally located in the fall of 1917 as a result of a survey of the acorns falling from hundreds of trees in this section of Conway. Only very rarely was an acorn found elsewhere with more than a single seed. Under this tree and one other, a great majority of the fruits were multi-seeded. The other tree, a much smaller one, was located in a grove about a block or more north and a similar distance west not far from the east bank of a brook, and may have been cut down in the development of this area as a residential section.

The tree at Bruce and Davis streets differs in no obvious particulars from hundreds of other native trees of this variable species. It differs only in the structure of its fruit. The acorns are abnormal in containing several seeds that are crowded into the space usually occupied by a single seed. When these acorns are planted several seedlings emerge from the nut instead of the usual single seedling. I suspect that there are other differences that no one has observed. One may be in its physiological vigor of growth, especially of the acorns. However no claim is advanced that this tree is another species or even a variety. Like several of the synonyms given for the species*, this tree may be a sub-variety or form, and is very likely to represent a mutation, but before the term mutation may be applied, the inheritance

* Given as *Quercus rubra* L. in the writer's pocket manual of the COMMON FOREST TREES OF ARKANSAS (Little Rock 1924). As a result of changes and clarification of the International Rules of Botanical Nomenclature (1930, 1935) the name *Q. rubra* L. does not remain as the legitimate name of any North American species. The name *Q. falcata* Michx. remains the legitimate botanical name of the Southern red oak, also called Spanish oak, and the following are synonyms: *Q. rubra* L. not DuRoi., *Q. triloba* Michx., *Q. digitata* Sudw., *Q. cuneata* Rehd. and *Q. pagodaefolia* Ashe. At least the last named is recognized as a variety: *Q. falcata* var. *pagodaefolia* Elliott and it is likely that other varieties should be recognized. The names of other oaks given by Buchholz and Mattoon (1) remain unchanged by the rules.



DIAGRAMS SHOWING CROSS SECTIONS OF NORMAL AND MULTI-SEEDED ACORNS $\times 2$
 1. Normal acorn with single seed. 2. A 3-seeded acorn. 3. A 4-seeded acorn. 4 and 5. 2-seeded acorns. Pairs of cotyledons belonging to same embryo are connected by a "z".

of this multi-seeded condition would have to be demonstrated.

The structure of flowers in the oak and the development of the fruit was described nearly a century ago by the German botanist Theodor Hartig (5). The subject is treated more briefly by M. Marshall Ward (7) in *The Oak*, one of the Modern Science Series edited by Sir John Lubbock (Lord Avebury). Every female oak flower contains 6 ovules within its compound tricarpellate pistil. Though the ovary has a single cavity these ovules are attached to 3 marginal placentae in pairs, and become, for a time, so crowded and pushed together that it gives the impression of a 3-celled ovary. At the time of pollination the ovules are still very rudimentary and undeveloped, but they become well organized during the first season. In the summer of the second year (for it requires 2 seasons to mature the acorns of oaks belonging to the red oak group) the pistil enlarges very greatly to form the acorn. Usually only one of the six ovules enlarges and matures to form a seed; the embryo which it contains stretches its seed coat out thin as it fills the entire space within the pericarp. The other five ovules become aborted and are carried upward by the intercalary growth of the shell of the nut so that they may be observed only under magnification inside of the shell at the tip of the mature acorn or they may be seen clinging to the apex of the enlarged seed when this is removed from the shell. For some reason this Conway tree matures seeds from more than one of its ovules—as many as five out of a possible six seeds have been found.

The conditions shown by the acorns may be illustrated by the accompanying diagrams of the cross sections. Fig. 1 shows the cross section of the

normal acorn in which only two cotyledons belonging to a single embryo may be seen. The heavy outer layer is the woody pericarp or shell of the acorn. This contains a seed which consists of a dicotyledonous embryo without endosperm, surrounded by a very thin papery seed coat. In fig. 2 there are three embryos, each of which is surrounded by a similar thin seed coat and the embryo of each seed has two cotyledons. Fig. 3 shows the section of an acorn with four seeds. Figs. 4 and 5 each show acorns having two seeds with embryos, with the lines of separation between the pair of cotyledons placed in various positions, indicating that there is no regularity in the radial orientation of the embryos. Sometimes the cotyledons are very unequally developed so that only one of a pair shows in a section cut through the base of the acorn. Several instances were found in which a cross section cut below the middle of the nut showed only two cotyledons, which upon further dissection proved to have additional seeds with embryos, very much smaller and crowded up toward the apex of the nut. All embryos are oriented with the radicle brought close to the apex of the acorn. When the shell of the acorn is completely removed the individual seeds usually fall apart and show how each embryo is surrounded by an individual seed coat.

77 acorns of the 1940 seed crop collected from beneath this tree were carefully examined during the past winter. 40 of these were normal while 37 contained two or more seeds each. As I recall, in 1917 there were more acorns with abnormal seeds. However if only the larger nuts were sampled in 1917, the proportion of abnormal seeds would have been higher, as I shall show presently. Among the 37 acorns with more than one seed, 14 had 2, 10 had 3, 11

had 4 and 2 had 5 seeds. The 37 abnormal acorns in the 1940 sample contained an average of 3 seeds.

In the summer of 1918, after leaving Conway, the writer received at intervals of 2 weeks during June and July, collections of twigs bearing developing acorns from this tree along with collections made from another red oak tree of similar size nearby and known to bear only normal fruit. These were dissected and compared in similar stages of development. It was obvious from these investigations that in the tree with abnormal acorns more than one of the ovules enlarges and develops to maturity. In the tree with normal fruits the development of five of the six ovules was checked very early in the second season. Another difference was noted: the fruits of the abnormal tree were usually larger at any of these mid-season dates than in the tree that had been chosen as a control. However the mature acorns were not noticeably larger than those of other trees of *Quercus falcata*. Possibly this more precocious growth of the fruit has something to do with the development of several seeds per acorn, in furnishing more room at a critical stage for the enlargement of several ovules to form seeds.

Mr. J. H. Gist who collected the samples of seeds of the 1940 crop informed me that the tree, now nearly 3 feet in diameter, had been pollarded in recent years. All of the 1940 crop of fruits was produced on a dense new growth of slender branches arising from the stubs of large limbs. The acorns were on the whole smaller than the average size for acorns of *Quercus falcata*, as I remember them, and were quite variable in size. Their diameters ranged from 8.5 mm to 12.5 mm; their mean diameter was 10.5 mm. Among 33 acorns which measured more than 10.5 mm in diameter there were 24 (77%) with 2 or more seeds; among 44 acorns 10.5 mm in diameter or less, only 13 (30%) had 2 or more seeds. In the larger group of acorns the mean number of seeds per fruit was 2.5; in the smaller group of 44 the mean was 1.5 seeds per fruit. It is possible, therefore, that the impression gained in 1917 of a

greater prevalence of the multi-seeded condition was correct, but was based on seed samples which included larger seeds.

There are some records in the literature of this condition, based upon observations of the germination of more than a single seedling from an acorn. Harvey (6) mentioned an example in the white oak (*Quercus alba* L.), which he appears to have misinterpreted as an instance of polyembryony. Similar observations have been reported for other species and described as polyembryony; even Coulter (4) appears to have accepted this interpretation. However, polyembryony, which involves several embryos which are formed within the same seed, would be very difficult to prove for the oak. It could certainly not be proved in the later stages represented by germinating acorns. Many years ago Coker (2, 3) recognized and described this condition on the basis of germinating acorns. He mentioned a tree of basket oak, *Q. prinus* L., near Baltimore, and a tree of white oak, *Q. alba* L., at Chapel Hill, North Carolina, in both of which many acorns give rise to several seedlings each. He also found a single instance of a multi-seeded acorn in the black oak, *Q. velutina* Lam.

The condition found in the tree at Conway might occur sporadically in any species of oak, for they all have six ovules in the pistil. The explanation that abnormalities similar to the one reported by Harvey are due to multi-seeded acorns is more logical and more natural. The interesting feature which concerns the tree at Conway is the fact that this condition has persisted over a period of 23 years, even after severe pruning of the upper branches.

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3. Coker, W. C. The seedlings of the live oak and the white oak. Jour. Elisha Mitchell Sci. Soc. 28:34-41. 1912.
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6. Harvey, LeRoy H. Polyembryony in *Quercus alba*. Mich. Acad. Sci. Rept. 19:329-331. (1917.)
7. Ward, H. Marshall. The Oak. New York. 1900.