
JOURNAL

OF THE

ARNOLD ARBORETUM

VOL. XXIX

JANUARY 1948

NUMBER 1

HYBRID OAKS OF NORTH AMERICA

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THE RECORDED HISTORY of American hybrid oaks begins with the publication (36) of a description of \times *Quercus heterophylla* by François André Michaux in 1812. The short Latin description and notes and the excellent colored plate in his *Silva* give a very good idea of the general characters of the plant. It was believed by Michaux to be a distinct species, but he made the significant statement that it was known only from a single stock on the banks of the Schuylkill River in a field belonging to Mr. Bartram. The plant was later propagated by seeds and cuttings from the original tree and so found its way into a number of botanic and private gardens. There was much debate among early botanists as to whether it was a species or a hybrid, and there has been some difference of opinion as to the identity of the parent species among those who regarded it as a hybrid. All writers seem to have agreed that the willow-oak was one of the parents, but the northern red oak, the black oak, scarlet oak, pin-oak, and Spanish oak (*Quercus falcata*) have all been suggested as the other parent. It is now generally regarded as a cross between the willow-oak (*Quercus Phellos*) and the northern red oak (*Q. borealis*).

Scattered trees discovered in different parts of the country in recent years have been referred to \times *Quercus heterophylla* on account of a general resemblance in foliage. There is no reason to doubt that many of these hybrids were identical in parentage with Bartram's oak, but some of them were probably of a different hybrid origin. The controversy over this interesting oak was probably due rather to the conservatism of the early botanists and to their philosophical or theological bias in regard to species than to lack of internal evidence in the material.

Thomas Nuttall described \times *Quercus Leana* in 1919 (41), giving a clear description and a good plate as well as a rather full discussion of the tree. He pointed out its similarity to \times *Quercus heterophylla* but concluded from a study of material with mature fruit that it was "either a distinct species or another strange hybrid." Mr. Thomas G. Lea, the discoverer of the tree near Cincinnati, Ohio, expressed the opinion in notes quoted by

Nuttall that it was a hybrid, most likely between *Quercus imbricaria* and *Q. velutina* or *Q. coccinea*. Nuttall expressed a doubt, however, as to whether such mixed races occur spontaneously in nature; and so he rather discounted Lea's shrewd and correct surmise as to its origin and relationship and decided to publish it as a species. This hybrid has since turned up at a number of widely scattered stations and it has been brought into cultivation in botanic gardens both in America and in Europe. It seems to be one of the most frequent of natural hybrids, and it may be looked for wherever the shingle-oak and black oak grow in proximity to each other.

In 1863 Dr. Albert K. Kellogg, a keen amateur botanist of California, published a description of \times *Quercus Mohreus* (31). This tree was also believed to be a distinct species by the author; but it has since been shown that it is without much doubt a hybrid between *Quercus Kelloggii* and *Q. Wislizeni*.

Dr. George Engelmann was the first American botanist to pay particular attention to spontaneous hybrids among the oaks and to publish notes on them. In a paper presented to the Academy of Science of St. Louis in 1876 (24) he enumerated ten hybrids that he considered well authenticated. Englemann did not propose any strictly new names for the hybrid oaks, but he recognized the hybrid character of \times *Quercus heterophylla* and \times *Q. Leana*, and he believed *Quercus sinuata* Walter¹ to be a hybrid between the species now known as *Quercus laevis* and *Q. nigra*. He also adopted the name \times *Quercus tridentata* for the cross between *Q. imbricaria* and *Q. marilandica*. This was based on *Quercus nigra* (*marilandica*) *tridentata* A. DC. Only the names of the supposed parent species were given in discussing the other six hybrids. Three of the hybrids recognized by Engelmann were between white oak species and seven between black oaks.

Several interesting points were brought out by Engelmann in the general discussion. He mentioned the difficulty of dealing with the question of hybridity in plants when the character of sterility fails, as it was stated, is the case with the oaks where the seeds "come true" and do not revert to the parent forms. White and black oaks, he observed, are too distinct to be crossed; among the white oaks, hybrids appear to be much rarer than among the black oaks — or it may be that they are merely more difficult to recognize; the seeds appear to be as fertile as in true species, but at the same time they do not seem to propagate themselves or to spread in their native woods.

After the publication of Engelmann's paper it began to be recognized among American botanists that natural hybrids do occur between certain species of oaks.

In 1882 Dr. N. L. Britton described \times *Quercus Rudkinii* (10) from specimens collected near Keyport, N. J. This was regarded as a hybrid

¹ The name \times *Quercus Walteriana* was later proposed by Ashe (5) for this hybrid on the ground that *Q. sinuata* Walt. was, in his opinion, the earliest name for the species described by Small in 1903 as *Quercus austrina*.

between *Quercus marilandica* and *Q. Phellos*. Other trees supposed to be of the same mixed parentage have since been discovered on Staten Island, N. Y., and at a number of other stations from North Carolina and Florida to Texas. Several other hybrid oaks were discovered during the next quarter of a century and some of them were given binomials by authors who either recognized their hybrid character or regarded them as new species.

Dr. William Trelease entered the field in 1917 with a paper on naming hybrid oaks (64). In the introduction he called attention to the fact that two methods of designating plant hybrids were approved by the Botanical Congresses of Vienna and Brussels — one by giving the names of the parent species separated by the conventional \times sign; the other by using a binomial preceded by the same sign. In discussing the desirability of giving binomials to recognized hybrids he suggested that such names rest upon a different basis from those of real species that are distinguished by constant morphological differences; and that since they must be applied to a variable group of plants having a common mixed parentage, they are merely a phase of nomenclature rather than of taxonomy. Some of the difficulties of using the first method were shown and examples were given of the complications that arise when a new name is taken up for one or both of the parent species. A list of the hybrid binomials previously published was given in this paper and 25 new ones were proposed. Type specimens were designated and brief descriptions accompanied by plates were given for two of the newly named hybrids. These were \times *Quercus paleolithicola* and \times *Q. Schuettei*. For the other hybrids only the supposed parentage was given, except for brief explanatory notes on a few of them.

A second and fuller treatment of the recognized hybrids was incorporated by Trelease in his monographic work, *The American oaks*, published in 1925. In that work 55 hybrids were named, six of them under new binomials, and another, \times *Quercus Byersii*, was credited to Sudworth in lit. Several previously published names were treated as synonyms. Brief descriptions were given of the newly recognized hybrids as well as of some of those named in the earlier publication, and bibliographical references were supplied for all of them.

Although most of Trelease's monograph was devoted to descriptions of the oaks of Mexico, it is a curious and perhaps a significant fact that no hybrids were recognized in that region. Fuller evidence will in all probability show that they are at least as abundant relatively south of the Rio Grande as in the United States, and it is not unlikely that a number of species recently described from Mexico will prove to be of hybrid origin.

In the interval between the appearance of Trelease's two publications Professor C. S. Sargent contributed a paper (53) in which 11 new hybrids were named and described and a variety was proposed for one of those named by Trelease, (\times *Quercus subfalcata* var. *microcarpa*). Type specimens and other collections were cited by Sargent for his newly proposed

hybrids. A description was also given of \times *Quercus Millechampii* Trelease, and an amplified description of \times *Q. dubia* Ashe. The latter was held to be a cross between *Quercus cinerea* and *Q. laurifolia*, and \times *Q. atlantica* Ashe and \times *Q. sublaurifolia* Trelease were given as synonyms.

Several new hybrids have been named and described since the publication of the papers by Trelease and Sargent, and a number of references to hybrids or supposed hybrids among the oaks have appeared in botanical papers and plant lists without binomials having been proposed for them.

A large amount of material of known or suspected oak hybrids has been brought together in the herbarium of the Arnold Arboretum and many of the hybrids have been grown here both from grafts and from seeds taken from the native trees. This paper is based largely on a study of the herbarium and living material in the Arboretum and on observations and notes made on native trees in many parts of the United States. A few specimens have also been examined in the Gray Herbarium and in the herbarium of the New England Botanical Club. Only a beginning has as yet been made in the study of oak hybrids, and much more field work and experimental work will be necessary before many doubtful questions can be resolved. Some hybrids are so well authenticated by ample material and by the obvious intermediate characters of the plants that there can be little or no reasonable doubt as to their identity. Other identifications must be regarded as merely hypothetical, and in some cases it is very doubtful whether the parentage that has been imputed to them is the correct one or whether they are really hybrids. Some cases of doubtful identity are discussed in this paper after an examination of the material and evidence available, but it is not possible to decide definitely on all of them. But since hybrids are likely to be found in our native woods wherever two or more species of oak of the same section or subgenus grow together, and since they are a source of perplexity to most students, it may serve a useful purpose to bring together a list of those that have been named or that can be recognized with some degree of certainty, and to review briefly the evidence on the subject.

The doubts entertained by the early botanists as to the occurrence of "spontaneous mixed races in nature," as expressed by Nuttall, are understandable when the views generally held at that time as to the origin and nature of species are taken into account. But in view of the accumulating evidence, it is scarcely to be believed that any competent observer would today question the existence of natural plant hybrids or that he could fail to find examples of them in the field, if he keep his eyes open. Hybrids among the oaks are probably much commoner than they were believed to be by most botanists even a few decades ago, and it seems probable that most if not all of the species within the sections of the annual-fruited (*Leucobalani*) and the biennial-fruited (*Erythrobalani*) are inter-fertile under the right conditions. But while this is true, it must not be inferred that individual trees of hybrid origin are relatively abundant in nature. A keen observer with a general knowledge of the native species is likely

to find hybrids by careful searching in any region where compatible species grow in close proximity; but he will probably encounter hundreds of thousands or even millions of trees of the different species for every hybrid. It is more than thirty years since the writer became interested in hybrid oaks, and for many years he has been on the outlook for them while collecting in many parts of the United States. It is perhaps not claiming too much to say that a certain skill and understanding of the problem has been developed. But in all this time and over so wide a territory probably not more than a few hundred trees of unquestionable hybrid origin have been encountered.

The greatest care and caution are necessary in studying hybrid oaks both in the field and in the herbarium. Observations and field notes on the compatible species growing in the vicinity of the supposed hybrid are most important in determining the parentage, and this often limits the possibilities very narrowly. There is no way of determining definitely which parent species was the sire and which the mother tree, although, as will be shown later, it may in some cases be inferred with considerable probability. It is the conventional practice to write the names of the supposed parents of a natural hybrid in alphabetical order, as *Quercus alba* \times *bicolor*, and not the reverse.

It must not be assumed that all aberrant forms are to be explained as hybrids. Adventitious shoots, sterile branches and juvenile growth often produce leaves of abnormal types or texture in many of the oaks. Sometimes after a period of drought followed by abundant rain trees will put out new growth with leaves very different from the normal ones of the species. The same thing may happen if the tree is defoliated by insects and a second growth of leaves develops. In some cases these and other monstrous forms of leaves have some resemblance to the leaves of hybrids, and the uncautious or inexperienced student is likely to be deceived by them. Without full material and a careful study of the living plants the identification of spontaneous hybrids can sometimes be only tentative and hypothetical. The fact of hybrid origin and the parentage of the cross must be inferred from certain stigmata and from the intermediate character of the leaves, fruit and other parts of the plant. In a hybrid these marks run through the entire plant and are not confined to certain shoots or branches, as is often the case in abnormal growth resulting from injury or arrested growth, and they differ also in character from monstrous forms, in which the leaves of entire plants sometimes become flabellate, lacinate, crisped or otherwise distorted.

It may be assumed that the ideal hybrid of the first generation would be exactly intermediate in characters between the parent species, but it is quite unlikely that any such perfectly balanced individual could be found in nature. There is wide variability in different parts within every species of oak, as in most other plants, and in a hybrid the different, variable characters of the parents may be combined in various ways or any of them may be predominant or subordinate in different degrees. Latent char-

acters or tendencies in the parent species may also be brought out or may be accentuated. Examples of this may be seen in the extremely large winter-buds of some hybrids, in strange and exaggerated leaf patterns and in an accelerated rate of growth.

The most obvious and easily detected hybrids are those between species in which the leaves are narrow and nearly or quite entire, as in the willow-oak, shingle-oak, laurel-oak or live oak, and species with broad and deeply cut leaves. Hybrids of this character were the first to attract attention, and their parentage can sometimes be determined from the leaves alone or with the aid of field observation. The leaves of such hybrids are generally extremely variable in outline and they are often bilaterally asymmetrical. Some of them may be unlobed, as in the entire-leaved parent species; in others the margins may be irregularly undulate, or there may be one or more rounded or sharp pointed lobes on one side or on both sides of the blade. In rare cases the lobes on vigorous shoots may be prolonged or exaggerated beyond anything found in the parent species. It is as if the growing plant had become bewildered between the two leaf-patterns and the cells did not know which direction to take or how to arrange themselves.

In some hybrids in the white oak section, such as those between the chestnut-oaks and species with deeply cut leaves, symmetry of outline is usually preserved but the lobes are almost always simple and intermediate in length between those of the parents. In many species of *Quercus* the fruit is less variable and is of greater diagnostic value than the leaves. This is equally true in hybrids, and in many cases mature acorns should be seen before definite conclusions are reached as to the parentage. Unfortunately, many hybrid oaks are without fruit, either because they are found as juvenile plants or because of a real tendency to sterility. The latter may be true in some cases, but some hybrid trees produce fruit in great abundance. Hybrids between species in which the acorns differ greatly in size, shape or character of the cup-scales can usually be detected by the intermediate type of fruit; winter-buds and bark may furnish valuable clues, and these are particularly valuable in identifying hybrids between species with similar leaves. In general it may be said that the facility and certainty with which any natural hybrid can be identified is in inverse ratio to the similarity of the parent species.

Among common American oaks there are a number of closely related and similar forms, most of which have been treated as distinct species by some authors and as subspecies, varieties or forms by others. Some examples are *Quercus borealis* and *Q. maxima*; *Q. Shumardii*, *Q. texana* and *Q. Schneekii*; *Q. falcata* and *Q. pagoda*; *Q. laurifolia* and *Q. obtusa*; *Q. virginiana*, *Q. minima* and *Q. geminata*; *Q. macrocarpa* and *Q. mandanensis*; *Q. Muhlenbergii* and *Q. prinoides*; *Q. stellata* and *Q. Margaretta*; and *Q. Durandii*, *Q. breviloba* and *Q. austrina*. A number of others are found in the western and southwestern states. Whatever status is given to such closely related oaks, it may be assumed that hybrids would be at least as likely to arise among them where the different pairs or groups grow in

proximity as between more distantly related species. But in most cases it would be extremely difficult or impossible to recognize or to identify such hybrids on morphological evidence. It is not unlikely that some of the slightly atypical forms that occasionally turn up to confound students and authorities may have originated from such crosses.

Sargent in his description of \times *Quercus Harbisonii* gave the parentage as *Q. stellata* var. *Margaretta* \times *virginiana* var. *geminata*, and this according to Trelease is *Q. geminata* \times *Margaretta*. But plants that appear to be hybrids between the typical forms of *Quercus stellata* and *Q. virginiana* have been found in several places and an artificial hybrid between the species was produced by Ness. The type specimen of \times *Quercus Harbisonii* was labeled *Q. minor (stellata)* \times *virginiana* by the collector, and I can see no convincing evidence in the specimen that it was not a cross between the typical forms of the two species, nor that it differs in any important character from the other specimens believed to be crosses between the post-oak and the live oak. The supposed parentage of \times *Quercus pseudomargaretta* was given by Trelease as *Q. Margaretta* \times *stellata*. According to Sargent *Q. Margaretta* is a variety of *Q. stellata*; so in this case we would have, if we follow Sargent, a cross between two varieties of the same species. But even if the two are held to be distinct species, they are so similar in foliage, fruit and other characters and are so closely connected by intermediate forms that recognizing a hybrid between them would seem to require some faith and imagination. A similar situation exists with reference to other hybrids in which one of the supposed parents is of debatable specific or varietal rank. *Quercus Shumardii* var. *Schneckii* was named as one of the parents of \times *Quercus Shirlingii* Bush and of \times *Q. mutabilis* Palmer & Steyermark, but except on grounds of propinquity, it would have seemed just as probable that the typical form of *Q. Shumardii* was involved. If *Quercus borealis* and *Q. maxima* are regarded as distinct species, it becomes a question which of them was one of the parents in such hybrids as \times *Quercus heterophylla*, \times *Q. Hawkinsii*, and others. According to Trelease, \times *Q. heterophylla* is a cross between *Q. maxima* and *Q. Phellos*. If this is accepted and *Q. borealis* is held to be a distinct species, a cross between it and *Q. Phellos* would be another hybrid and should receive another name. It is not unlikely that both forms of the northern red oak may have hybridized with the willow-oak or with other species at times, but it is scarcely possible that any marked differences between them could be found or recognized in spontaneous plants.

The question of varieties of a named hybrid also arises. Can or should forms or varieties of the hybrid "species" be recognized and named? Sargent, as mentioned above, proposed a variety of \times *Quercus subfalcata*, and Baenitz in his description of \times *Q. Benderi* subdivided it into the variety *coccinioides*, with a forma *voluto-annulata*, and variety *rubroides*, indicating which parent species the hybrid resembled more closely. Such subdivisions might be multiplied indefinitely, since it must be expected

that hybrids of identical parentage will be widely variable. To attempt to give distinct botanical names to all such forms would, in my opinion, result in complications that would more than offset any advantages. But in the case of plants of particular ornamental or economic value and of distinct appearance, it might be worth while to give them horticultural names.

Only a single tree of \times *Quercus heterophylla* and of \times *Q. Leana* had been discovered when they were described, and while a number of examples of both of them have since been found, they are both comparatively rare as wild plants. This is true of all hybrids, and it affords some aid in detecting and distinguishing them. But the fact that a form of oak is rare or unique in a locality does not prove it to be a hybrid though it may strongly suggest it; for real species are seldom found so isolated unless the tree is beyond its general range, and in that case it will usually be known to be abundant elsewhere.

Hybrids are most likely to occur in nature along the margins of the range of one of the parent species or where one is locally rare and the other abundant. The reason for this is rather obvious; the chance of the rare plant being pollinated by one of its own kind is small or nonexistent, except in so far as it may be effected by self-pollination. On the other hand, the chance of its pistillate flowers being fertilized by the wind-borne pollen of the dominant species is very great. In the case of a hybrid found under such circumstances it may almost be assumed that the rare species was the mother plant.

It may be stated as a general principle that, other factors being equal, the chance for the production of natural hybrids between compatible species increases in proportion to the numerical inequality of the parent species in the immediate vicinity. Another significant implication of this fact is that in hypothesizing the parentage of a hybrid, especially if it is an old tree, it is not absolutely essential that both species be found growing with it, providing they are natives of the region and are known at no great distance. For if one of the parents was a lone individual it may well have disappeared from the locality.

While collecting in southern Illinois in 1919 and 1920 my attention was first called to this principle as applied to hybrid oaks. The willow-oak (*Quercus Phellos*) barely enters the state from the south near the junction of the Ohio and Mississippi Rivers. A few scattered specimens were found in Alexander, Massac, and Pulaski counties in a region where the pin-oak (*Quercus palustris*) is a common and dominant species. In almost every locality where there was a single large willow-oak — and in some where none was seen — obvious hybrids between this species and the pin-oak were found. Some of the hybrid plants were mere sprouts that probably would not long survive, but several had attained considerable size. Similar evidence has been obtained in regard to other hybrids at different localities. Specimens of \times *Quercus Leana* are often found along the border of the range of the shingle-oak, and of \times *Q. Saulei* where *Q.*

alba is locally dominant and *Q. montana* rare. In the localities where $\times Q. bimundorum$, described in this paper, has appeared the white oak is a common tree and the English oak is known in cultivation in the vicinity, or it may rarely be found as an escape. Obviously, natural hybrids may arise where the parent species are more evenly balanced in numbers, but the chances for them are relatively less.

As may be seen by looking over the literature listed in the bibliography at the end of this paper, most of it deals with accounts and descriptions of hybrids found in nature and with discussions of them. Only a small amount of work has been undertaken so far for the purpose of testing supposed hybrids by growing seedlings on a large scale under experimental conditions, and still less has been done in the controlled production of oak hybrids by cross-pollination.

MacDougall (34) mentioned the generally unreliable and hypothetical character of the evidence as to supposed hybrids in nature and he thought that they should be regarded merely as suggestions to be tested by cultural and experimental methods. He suggested three possible lines of attack on the problem of the hybrid; (1) by synthesizing it from its supposed parents; (2) by making an anatomical examination of the hybrid and the supposed parents; (3) by growing the plants to see whether there will be a separation of the ancestral characters in succeeding generations and a reversion of some plants to the parent species. At the same time he pointed out some of the difficulties and uncertainties as to the results that attend such experiments. Cross-pollination in nature may have taken place under an exceptionally favorable combination of circumstances that can scarcely be reproduced artificially. One or both parent species as ordinarily recognized may in reality have consisted of two or more elementary species which might give quite diverse results in breeding. The characters of the hybrid offspring might be quite different if the roles of the parent species, as to which was the sire and which the mother plant were reversed, as was indicated by experiments with *Oenothera*. After growing a number of seedlings from acorns collected from native trees of $\times Quercus heterophylla$ and $\times Q. Rudkini$, he concluded that the former was without doubt a hybrid between the willow-oak and the northern red oak, but that the evidence was inconclusive as to the hybrid character of $\times Q. Rudkini$.

Allard (3) gave an account of seedlings grown from several individuals of $\times Quercus Saulei$ found in the vicinity of Washington, D. C. About 40 seedlings were grown by him, some of which had attained a height of 15 feet in ten years. The leaves showed considerable variation in outline, with a dominance of *Q. montana* characters in the comparatively shallow, more numerous and uniform lobes and in the presence of more or less whitish pubescence beneath. However, a few individual leaves showed the *Q. alba* influence in the larger, irregular lobes. Different individuals also showed variation in autumn coloring, a number of them assuming the typical red-brown color of the *Q. montana* parent, and others the coppery red of *Q. alba*, while one individual with an obviously *Q. alba* type of

leaves became brilliantly deep-red. In some of the plants the leaves showed a tendency to cling to the branches until late in the season, as in *Q. alba*, while in others they resembled the *Q. montana* parent in being early deciduous. In Allard's paper several other hybrid oaks or supposed hybrids were reported as growing in the vicinity of Washington, and the leaves, fruit, and winter-buds of some of them were figured. One of the most interesting of these was the cross between *Quercus palustris* and *Q. Phellos*, of which two trees were said to be growing in a planting of willow-oaks on Pershing Drive, just east of Glebe Road. The experiments and publications of Gale, MacDougall, and others on hybrid oaks were mentioned, the need for further study and experimental work was suggested.

In 1909 Professor Helge Ness began experiments in the cross-pollination of oaks at the Texas Agricultural Experiment Station, College Station, Texas, and obtained some significant results. The most striking of these was a cross between the overcup oak (*Quercus lyrata*), used as the sire, and the live oak (*Q. virginiana*), as the mother plant. This hybrid has also been found growing spontaneously in several places, and was named \times *Quercus Comptonae* by Sargent.

Ness published a brief account of this hybrid in 1918 (39), and a second paper with a fuller account of work on hybrid oaks appeared in 1937 (40). At the time of the first report four of the hybrid trees planted on the College campus had produced acorns although there had been no male flowers, and the pollen for the fertilization of the female flowers must have come from other trees, probably post-oak (*Quercus stellata*) growing in the vicinity. The hybrids were symmetrical trees of rapid growth and with attractive foliage, intermediate in character between the parent species but with the overcup predominant.

In the second paper it was reported that seven trees of the original cross-pollination had grown to full fruiting size and all of them had within the preceding two years produced a profusion of both male and female flowers, and while six of them had matured crops of acorns, the seventh had remained sterile. The leaves of the second generation plants grown from these acorns showed wide variability ranging from forms quite intermediate between those of the overcup oak and live oak to others that could scarcely be distinguished from one or other of the parents. Mention was also made of plantings of live oaks on the college grounds where the trees began to bear female flowers about five years after they were set out but no male flowers until several years later. Yet the young trees so placed that they could scarcely receive pollen from any of their own species bore crops of acorns. Several hundred seedlings were grown from these, and the leaves ranged in character between those of the post-oak and live oak, with forms that resembled neither. Ness also produced hybrids through artificial pollination between *Quercus stellata* and *Q. virginiana*, and between the latter and *Q. bicolor*, and he mentioned a tree in the same planting that had been grown from seed of a white oak growing beside a post-oak, and that was an evident hybrid of the two species.

S. H. Yarnell (72), and W. S. Flory, Jr. and F. R. Brison (25) have more recently published papers on the Ness hybrids and have added valuable additional information about them. A brief paper by Ernest J. Schreiner and John W. Duffield (56) mentions an artificial cross having been made between the white oak (*Quercus alba*) and the English oak (*Q. robur*). Spontaneous hybrids between these species have also been found and are described later in this paper as \times *Quercus bimundorum*.

While attempts have been made over a number of years to bring as many as possible of the hybrid oaks into cultivation at the Arnold Arboretum, no experimental work has so far been carried on in growing seedlings in quantity under test conditions for scientific study. In some cases a number of seedlings were grown from seeds taken from spontaneous hybrids or from other cultivated trees, but usually only a few specimen plants were selected from them. Other hybrids were propagated by grafts or by transplanting rooted plants. The conclusions that can be drawn from the collection are, therefore, limited but not without interest.

Records show the following hybrids to be in cultivation at the Arboretum or to have been grown here at some time in the past. Several of those on the list did not live long enough to produce fruit or to be of much value for study and, unfortunately, the records of some of the introductions have been lost and other plants have been destroyed or injured by fires or other causes. Those of which specimens were still growing in the collection in 1946 are marked with an asterisk (*); those grown from seed are indicated by S, grafts by G, and where received as rooted plants by P. In a few cases there is no record.

\times <i>Quercus</i> Bebbiana* S, G, P.	\times <i>Quercus</i> macnabiana S.
“ Bushii	“ mutabilis S.
“ Comptonae* S.	“ mutabilis S.
“ Deami* S, P.	“ Rehderi* S, P.
“ exacta* S, G, P.	“ Robbinsii G.
“ Fernowi S.	“ Rudkini* S.
“ filialis* S.	“ runcinata* S, G.
“ garlandensis S, G.	“ Sargentii* S, G.
“ Hastingsii G.	“ Saulei* S, G, P.
“ Hawkinsi* S.	“ Schockiana G.
“ heterophylla*, G. P.	“ stelloides S, G.
“ Hillii*, S, G.	“ vaga
“ humidicola S, G.	“ Walteriana S.
“ Jackiana* S, G.	“ bicolor \times montana(?) S, G.
“ Leana* S, G.	“ aliena var. acutissima
“ ludoviciana	“ \times alba* (?) P.
var. microphylla P.	

Most plants that have been grown at the Arboretum from seeds of the original hybrids found in nature and a few second generation plants from cultivated trees have reproduced the characters of the hybrid parent more or less closely, and in some cases with remarkable fidelity. There seem to be a few exceptions to this, and it is a question whether other aberrant forms or reversions may not have been discarded in selecting plants for the collection. Only in a few cases were enough seedlings kept to afford a basis for comparison.

× *Quercus Comptonae* was grown from seeds sent by Miss Compton from Natchez, Miss. in 1932, and nine plants were set out, of which four or five were living recently. They made slow growth and none of them attained much size, so only the leaves could be studied. These all showed unmistakably the intermediate character of the hybrid with considerable diversity in each individual and slight average variation in width and lobing on the different plants. It is interesting to find that this hybrid offspring of two southern species is hardy in the Arboretum, as the live oak has never survived the New England winters, although the overcup oak has been successfully grown.

× *Quercus Leana* has been grown from seeds from several sources, and the seedlings kept are all examples of this hybrid though with some variations in foliage and fruit. Five plants of one lot from seed collected in southern Illinois were set out, and two of them have produced fruit. The leaves of the different individuals differ considerably in average size and outline. Most of them show some undulation or traces of irregularity or lobing on some of the leaves. But in two of the plants nearly all of the blades are entire and resemble some broad-leaved forms of the shingle-oak. On the other extreme is one tree in which the leaves are nearly all irregularly lobed or undulate. The acorns are intermediate in character between those of the parent species.

Six plants of a culture of × *Quercus Rudkini*, from seeds of a tree found near Fulton, Arkansas, were set out and the leaves were studied before some of them were damaged or destroyed by fire. In all but one of the plants the leaves are mostly narrowly lanceolate and entire, somewhat resembling those of the willow-oak, though somewhat larger and broader than is usual in that species. But they are thicker in texture, strongly veined and pubescent when young on the under side and are sessile or nearly so and often rounded or slightly subcordate at base, all characters indicating the influence of the black jack oak (*Quercus marilandica*). One tree of the lot had much broader, more irregular and mostly lobed leaves. A tree of × *Quercus runcinata* grown from seed of a tree found in southern Illinois in 1919, has made a remarkably rapid growth and in 1945 it was about forty feet in height with a trunk diameter of about fourteen inches. The leaves are broader and more uniform in shape than those of the parent tree and there is some resemblance to a narrow-leaved form of *Quercus borealis*. But some leaves show a tendency toward eccentric lobing and they are covered with a coat of easily-detached pubescence on the under side while young. The acorns, of which there was a large crop in 1945, are somewhat similar in size and shape to those of *Q. borealis*, but with loose scales on the cups suggestive of the *Q. imbricaria* parent. The two large trees of × *Quercus Sargentii*, from seed of the hybrid tree first recognized in cultivation, both show unmistakably the characters of *Q. montana* and *Q. robur*, although differing noticeably from each other in foliage and fruit. Of three lots of × *Quercus Deamii* from seeds of the original tree none resemble the parent

very closely and in the leaves of two of them there is a strong suggestion of *Quercus bicolor*. None has yet produced fruit.

It has been stated that most or all of the species within the two main sections of white oaks and black oaks are interfertile and that in some cases at least they produce viable fruit in abundance. There is also evidence that some of them reproduce themselves with little change, retaining characters intermediate between the parent species. Since several species are often found growing together in the deciduous forests throughout North America, it may be asked, as Englemann asked, why are hybrids not more common and why do they not tend to spread in their native woods and to become dominant in some areas?

Perhaps there are physiological reasons that tend to reduce the fertility of some oak hybrids, but evidence is lacking on this. And without resorting to such an explanation, probably a sufficient answer can be found in the keen competition for survival and reproduction among plants in nature. In a well occupied forest there is little chance for expansion, and reproduction is held to a minimum except where the pressure is relieved by some extraordinary chance or vicissitude, such as an artificial clearing or thinning or a similar result brought about by such natural causes as fire, hurricane, climatic extremes, or disease among some of the competing species. A large oak tree living for perhaps a century or more may produce literally millions of acorns. But in spite of this almost incredible fecundity, very few of them will ordinarily find a chance to germinate and of the seedlings that do spring up perhaps only one or at best only a very small number is likely to survive and to replace the parent as a fully grown tree. Even under the most favorable conditions for hybridization the chance of the fortunate survivor having sprung from an acorn produced by cross-pollination would seem to be extremely small.

In a hybrid found in nature there is of course no way of determining whether it is a cross of the first or of a later generation. But the probability seems to be very great that it is the first. For if the chance for the development and survival of the original hybrid are so small, the odds against its perpetuation in a second generation are infinitely greater. It has been suggested that certain supposed hybrids found in nature represent crosses between more than two species, or in other words, that the bispecific cross has been recrossed with a third species. The isolated hybrid produced by the fertilization of a rare or single mother plant by another and locally common species would in all probability be pollinated by the dominant species. And so in the improbable case of succeeding generations there would be an increasing tendency to revert to the characters of the male parent. It may be possible that under a combination of particularly favorable circumstances a hybrid might be pollinated by a third species and a compound hybrid result. But the chances for it occurring in nature seem so remote as to be almost negligible. It seems probable, therefore, that the great majority of natural hybrids are first-generation crosses between two species.

Several instances of experiments and results in the artificial production of oak hybrids have been referred to above. But comparatively little has so far been done in this field, although it would seem to be a most promising one both from the standpoint of its practical value and its scientific interest.

In several cases the specific names used for one or both of the parent species in the original publication of hybrid binomials have been changed to conform to more recent usage or interpretation. Among examples are *Quercus nigra* L., long used for the black jack oak but now held to apply properly to the water-oak of the southern states, *Quercus falcata* Michx., which has again been taken up for the southern red oak instead of the doubtful *Quercus rubra* L., *Quercus Prinus* L., now used for the basket-oak of the southern coastal plain instead of for the rock-chestnut-oak, which is now called *Quercus montana* Willd., and a number of others. The names originally used are generally shown in parentheses or are explained in the descriptions. Differences of opinion as to the proper use of certain names and in regard to the status of some named species, varieties, and forms still exist among botanical authors. The names currently accepted as valid in the herbarium of the Arnold Arboretum are used in this paper.

The figures in parentheses refer to the numbers of papers listed in the bibliography. Specimens cited that were examined only in the Gray Herbarium are designated by (G); all others are in the herbarium of the Arnold Arboretum.

× *Quercus anceps* hybr. nov. (*Q. falcata* × *imbricaria*).

Arbor foliis obovatis vel oblongo-ellipticis undulatis vel inaequaliter lobatis 9–16 cm. longis 4–10 cm. latis apice acutis mucronatis basi cuneatis vel anguste rotundatis, maturis supra glabris infra fulvo-tomentosis. Fructus ignotus.

The trees from which the type of this hybrid came were found along the margin of upland woods near Rosiclair, Illinois, with both of the supposed parent species growing near by. Other biennially-fruited oaks in the vicinity were *Quercus borealis* var. *maxima*, *Q. marilandica*, and *Q. velutina*. Unfortunately, there were no acorns either on this tree or on another of apparently similar parentage found near Shawneetown, Ill. But the shape, texture and color of the leaves and other characters furnish convincing evidence of the parentage. The narrowly obovate or oblong-elliptic leaves are remarkably variable and many of them are asymmetric in outline. The range of the shingle-oak and of the southern red oak overlap in only a few localities, and the latter was near its northern limit in the locality where the hybrid was found.

ILLINOIS: Rosiclair, Hardin Co., *E. J. Palmer* 15455, June 10. 17031 (TYPE), Oct. 10, 1919; Shawneetown, Gallatin Co., *E. J. Palmer* 15560, June 19, 1919.

× *Quercus Andrewsii* Sargent (*Q. macrocarpa* × *undulata*), Bot. Gaz. 65: 455. 1918.
—Trelease, Mem. Nat. Acad. Sci. 30: 13. 1924.

This was described from a specimen taken from a group of large shrubs spreading by underground stems, found in Dewey County, western Oklahoma. Both of the supposed parents were growing near by. The

leaves are intermediate in size and shape between those of the parent species, the pubescence on the under surface being very much like that of *Quercus macrocarpa*. The single acorn on the type specimen is about 2.5 cm. long including the rounded or slightly turbinate cup which covers nearly half of the nut; cup scales pale pubescent, corky thickened toward base, the tips on upper rows prolonged and forming a short, sparse fringe along the rim.

OKLAHOMA: Seibring, *D. M. Andrews* 69 (TYPE), Aug. 17, 1915.

Although known from only a single collection, there can be little doubt as to the hybrid origin and parentage of this plant.

- × *Quercus Asheana* Little (*Q. incana* × *laevis*), Jour. Washington Acad. Sci. 33: 8. 1943.
- × *Quercus Ashei* Trelease (*nomen nudum*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 13. 1924. Not *Q. Ashei* Sterrett, Jour. Elisha Mitchell Sci. Soc. 37: 178. 1922.
- Quercus cinerea* × *Catesbaei* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 88. 1894. — Small, Bull. Torrey Bot. Club 22: 76, pl. 234-235. 1895.
- Quercus brevifolia* × *Catesbaei* Sudworth, U. S. Dept. Agric., Div. Forestry, Bull. 14: 170. 1897.

Although no description of this hybrid was given by Trelease, the name and the reference to Ashe's report clearly indicate the source. Two forms were described by Ashe: (1) having the bark and general appearance of *Q. cinerea* (*incana*) but with twigs, buds and fruit somewhat resembling the other parent, and (2) with the general appearance of *Q. Catesbaei* (*laevis*), but with acorns generally like those of *Q. incana*. It was stated that ten or twelve of the first form were seen and several of the latter, but no definite locality was mentioned. The following specimens of this hybrid have been seen:

GEORGIA: Traders Hill, *J. K. Small*, June 12-15, 1895; St. Marys, *J. K. Small*, June 13, 1895; Folkstone, *T. G. Harbison* 50, May 15, 1918, 106, Nov. 26, 1919. FLORIDA: Ella, Lake Co., *Geo. V. Nash* 1577, Aug. 1894; Umatilla, Lake Co., *Geo. V. Nash* 1586, Aug., 1894; Zellwood, Orange Co., *C. H. Baker* 491-a-b-c-d-e, April 16, 1918; Orlando, Orange Co., *T. G. Harbison* 23, Dec. 5, 1917, *E. J. Palmer* 38433, April 2, 1931; Jacksonville, *T. G. Harbison* 1, 6, Nov. 9, 29, April 23, 1917; Gainesville, *T. G. Harbison* 54, Nov. 11, 1917, 70, July 25, 1918; Sebring, *T. G. Harbison* 41, July 29, 63, July 30, 1918; Haines City, *T. G. Harbison* 4, Aug. 1, 1918; Lakeland, *T. G. Harbison* 4, 13, Aug. 1, 1918; Brookville, Hernando Co., *J. Kelley* 21, Sept., 1941. MISSISSIPPI: Biloxi, *T. G. Harbison* 16, May 6, 1918.

- × *Quercus atlantica* Ashe (*Q. incana* × *obtusa*?), Proc. Soc. Amer. Foresters 11: 88. 1916. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.
- × *Quercus dubia* Sargent, Bot. Gaz. 65: 452. 1918, in part, not Ashe.

Ashe described this as a new species but with the note that, "This tree might be considered a hybrid between *Quercus cinerea* and *Q. laurifolia*, but for the fact that both the fruit and the foliage are larger than in either of those species." But a careful reading of the description and an examination of Ashe's specimens from the type locality and other stations suggest that it is probably a cross between *Quercus incana* and *Q. obtusa*. All three species are found near the type locality. *Quercus obtusa* and *Q. laurifolia* are closely related and very similar species and it is not always

easy to distinguish between them. The same difficulty may be found in trying to identify hybrids in which they are involved, such as \times *Quercus atlantica* and \times *Q. sublaurifolia* discussed later. The best distinguishing characters between the species are that in *Quercus obtusa* the leaves are slightly larger on the average, usually broadened above the middle, rounded or obtuse at the apex, thinner in texture and earlier deciduous than in the laurel-oak; the acorns are also larger.

GEORGIA: Lumber City (Telfair Co.), *W. W. Ashe* 10, 1915 (TOPOTYPE), *T. G. Harbison* 6, May 30 and Dec. 15, 10, 13, May 30, and 15, Dec. 16, 1917; Climax, *T. G. Harbison* 11, Nov. 6, 1917. FLORIDA: near Jacksonville, *A. H. Curtis* (without no. or date), *T. G. Harbison* 4, 5, Dec. 7, 2, 11, 12, Dec. 10, 23, Dec. 3, 1917; Zellwood, *T. G. Harbison* 3, Dec. 4, 1917; Lake City, *T. G. Harbison* 23, June 23, 1917; Gainesville, *T. G. Harbison* 160, 164, Dec. 4, 1917, 202, Sept. 18, 1919.

\times *Quercus Beadlei* Trelease¹ (*Q. alba* \times *Prinus*), *Proc. Amer. Phil. Soc.* 56: 48. 1917; *Mem. Nat. Acad. Sci.* 20: 13. 1924. — Sargent, *Man. Trees N. Amer.* ed. 2, 203. 1922.

Quercus alba \times *Michauxii* Britton and Shafer, *N. Amer. Trees* 203. 1908.

Although no description was given and no type specimen was cited by Trelease, this hybrid was, no doubt, based on a specimen in the Biltmore Herbarium, no. 5723b, May 10 and Oct. 13, 1897. The earlier collection consisted of young leaves and flowers to which mature leaves and acorns were added in autumn. There seems to be no reason for questioning the parentage. The leaves are intermediate in shape between those of the parent species, with 6–12 pairs of rather uniform deeply divided lobes. While young they are coated beneath with pale, loosely attached tomentum, and at maturity they often become nearly glabrous except for tufts of tomentum in the axils and along the principal veins. The acorns of the type specimen and of most of the other fruiting specimens I have seen resemble those of *Quercus alba* in size and in the corky thickening of the scales of the cups, but in a specimen from Jackson Co., Indiana, they are quite similar to those of *Q. Prinus*. In this and another Indiana specimen the mature leaves are unusually pubescent beneath.

NEW JERSEY: near Newtonville, Atlantic Co., *J. W. Adams* 4081, Sept. 24, 1937. DELAWARE: Kiawense Station, near Wilmington (without date or name of collector). VIRGINIA: south of Seatack, *M. L. Fernald & Bayard Long* 3902, July 30, 1934. NORTH CAROLINA: Biltmore, ex Herb. Biltmore, no. 5723b, May 10 and Oct. 13, 1897; swamps near Clarkton, Bladen Co., ex Herb. Biltmore, no. 5723c, June 25, 1897. FLORIDA: rich woods east of Tallahassee, *R. M. Harper*, Dec. 6, 1924. INDIANA: 3 miles east of Mendora, Jackson Co., *C. C. Deam* 19037, Sept. 13, 1915; near Bedford, *R. M. Kriebel*, 1934. TEXAS: near Cleveland, San Jacinto Co., *C. H. Muller* 3938, July 11, 1941.

\times *Quercus beaumontiana* Sargent (*Q. falcata* \times *obtusa*), *Bot. Gaz.* 65: 451. 1918, (as *Q. rhombica* \times *rubra*); *Man. Trees N. Amer.* ed. 2, 262. 1922. — Trelease, *Mem. Nat. Acad. Sci.* 20: 13. 1924, (as *Q. [laurifolia] rhombica* \times *rubra*).

The type specimen of this hybrid was collected from a tree growing in low, native woods, in close association with the supposed parent species,

¹ Arbor foliis obovatis vel oblongo-obovatis plerumque satis profunde 13–25-lobatis maturis supra glabris infra pubescentibus interdum solum ad venulas.

and not from a street tree as stated in the description. The intermediate character of the generally slightly asymmetrically lobed leaves suggest the parentage.

TEXAS: Beaumont, C. S. Sargent, April 11, 1915 (planted along street), E. J. Palmer 12748 (TYPE), Sept. 14, 1917, 13081, March 16, 1918; Sauer Lake, Hardin Co., E. J. Palmer 13109, March 18, 1918.

× *Quercus Bebbiana* Schneider (*Q. alba* × *macrocarpa*), Ill. Handb. Laubh. 1: 201. 1904. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.

Quercus alba × *macrocarpa* Engelmann, Trans. Acad. Sci. St. Louis 3: 398. 1877. — Sargent, Silva 8: 18, pl. 360. 1894.

Specimens showing various degrees of transition between the parent species afford convincing evidence as to the hybrid origin and relationship of this plant.

CANADA: Ste. Anne de Bellevue, Que., S. Baril, Oct. 8, 1939. VERMONT: Charlotte, C. G. Pringle, Sept. 29, 1879. OHIO: Kenton, Hardin Co., R. E. Horsey 720, Sept. 27, 1918. INDIANA: Bedford, R. M. Kriebel, Oct. 1, 1932. MISSOURI: Hannibal, J. Davis 3629, Oct. 19, 1914; Swope Park (Kansas City), B. F. Bush 9313, 9314, Oct. 19, 1914, E. J. Palmer 22323, 22324, Oct. 21, 1922.

Also cultivated at the Arnold Arboretum and at Mt. Desert Nurseries, Bar. Harbor, Me. According to Schneider, this hybrid was first found by M. S. Bebb, near Fountaindale, Ill., but I have not seen the specimen.

(?) × *Quercus Benderi* Baenitz (*Q. borealis* × *coccinea*), Allg. Bot. Zeit. 9: 84. 1903, (as *Q. coccinea rubra*). — Sargent, Man. Trees N. Amer. ed 2, 248. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 13. 1924.

Believed to have originated spontaneously in cultivation. The hybrid origin of the plant is indicated, according to Baenitz, not only by the intermediate morphological characters and the yellow color of the autumn foliage, but also by a microscopic examination of the stamens and by the fact that the acorns are often sterile. A hybrid between two such similar species as the northern red oak and the scarlet oak would, obviously, be obscure and difficult to distinguish. An examination of the specimens distributed by Dr. Baenitz rather suggests *Quercus ellipsoidalis* E. J. Hill, a tree that was scarcely known as a distinct species in Europe at the time × *Q. Benderi* was published, although it might very well have found its way into cultivation without having been recognized. The small acorns with the nut half or more enclosed in the narrow, turbinate cup are very similar to those of the jack oak, and the leaves of both forms come within the range of variability shown in that species.

Besides the specimens collected by Baenitz in Scheitniger Park, Breslau, Silesia, in 1902, showing a seedling and mature leaves and acorns of the varieties and form, I have seen others with nearly fully grown leaves, collected by C. K. Schneider from the original trees, May 24–28, 1904. There is also a sheet in the Arnold Arboretum herbarium collected by A. Rehder, Blue Hills, near Boston, Mass., Sept. 22, 1900, and doubtfully referred to this hybrid. The specimen is sterile and the leaves look much like those of *Quercus borealis*. Hybrids between *Quercus borealis* and

Q. coccinea are not unlikely to be found where the two species grow in proximity, but I am somewhat doubtful as to whether \times *Quercus Benderi* represents such a cross. It is perhaps best to leave the question open until fuller evidence is available.

\times *Quercus bernardensis* W. Wolf (*Q. montana* \times *stellata*), *Torreyia* 18: 161. 1918.

Several trees of this apparent hybrid were found by Brother Wolf in the vicinity of Saint Bernard College, in Cullman County, northern Alabama, and they were believed by him to represent a new species. In the description he stated that *Quercus Prinus (montana)*, its principal associate, was confined to the rocky slopes and cliffs, while \times *Q. bernardensis* was found in a strip of lowland below the cliff. Other oaks mentioned as common in the vicinity were *Quercus alba*, *Q. stellata*, and *Q. velutina*. Trelease considered it a hybrid between *Quercus alba* and *Q. stellata* and therefore a synonym of \times *Q. Fernowi*. The leaves are clearly intermediate in shape between those of the chestnut-oak and the post-oak, and the acorn in the one specimen in which they have been seen also indicate this relationship.

DISTRICT OF COLUMBIA: near Rock Creek, ex U. S. Nat. Herb., May 9, 1884. ALABAMA: St. Bernard, Cullman Co., *W. Wolf A*, April 28, May 14, May 24, and Oct. 26, 1918, *B*, Sept. 14, 1918, *D*, May 14, 1918, *F*, June 4, 1918; Cullman Co., *T. G. Harbison 4, 6*, Nov. 3, 1919; Valleyhead, *T. G. Harbison 26*, June 26, 1918; between Maud and Trio, Bibb Co., *R. M. Harper*, June 11, 1924.

\times *Quercus bimundorum* hybr. nov. (*Q. alba* \times *robur*).

Arbor ad 10–12 m. alt., foliis obovatis, profunde incisus lobis 7–9 obtusis apice obtusis basi leviter contractis subcordatis vel auriculatis; petiolis 5–10 mm. longis. Fructus ovatus 1.5–2 cm. longus pedunculatus; squamis cupulae rotundae paulis crassis.

A small tree that is apparently a spontaneous hybrid between the white oak and the English oak was found by C. H. L. Gebfert on a wooded hillside on the west side of Centre Street, Jamaica Plain, Mass. This tree was fruiting abundantly. Two trees of the same hybrid were discovered by J. C. Swartley on the farm of Charles Mann, near Horsham, Pennsylvania, and a specimen of one of them with mature leaves and fruit was sent to the Arnold Arboretum. According to information furnished by Mr. Mann and transmitted by Mr. Swartley, the trees were grown from seeds collected from a tree near a farmhouse on an extension of the Easton Highway, not far from Ivy Hill Cemetery. A large English oak was also found near the road and both the white oak and swamp white oak were growing in the vicinity. The name Syndenham Oak was proposed by Mr. Mann for these trees, in honor of some of his family connections. Another specimen collected in 1917 from a tree growing in the Harvard Botanical Garden at Cambridge, Mass., appears to belong to the same hybrid.

MASSACHUSETTS: Jamaica Plain, *C. H. L. Gebfert*, Sept. 3, 1923 (TYPE); Cambridge, Botanical Garden (cult.), *J. G. Jack*, Sept. 13, 1917. PENNSYLVANIA: near Horsham, Montgomery Co. (cult.), *J. C. Swartley S-858*, Oct. 10, 1936.

Mention was also made in the introduction of the cross having been made artificially (56).

- × *Quercus blufftonensis* Trelease (*Q. falcata* × *laevis*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 254, 1922.

The type of this is a sheet in the U. S. Nat. Herb., collected by J. H. Mellichamp at Bluffton, S. Car., Aug. and Oct., 1893. According to Trelease, it is very like × *Q. Mellichampii* except for its larger and thinner leaves. I have not seen the specimen nor any other material of this hybrid.

- × *Quercus Brittoni* W. T. Davis (*Q. ilicifolia* × *marilandica*), Bull. Torrey Bot. Club 19: 301. 1892. — Sargent, Man. Trees N. Amer. ed. 2, 225. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

Quercus nigra × *ilicifolia* W. T. Davis, Scientific American, Sept. 3, 1892; Proc. Nat. Sci. Assoc. Staten Isl., Sept. 10, 1892.

According to the author, a number of trees of this hybrid were found growing in sandy soil at Watchogue, on Staten Island, where both *Quercus ilicifolia* and *Q. marilandica* were abundant. Examination of material from the type locality and from several other stations furnishes convincing evidence of the validity of this hybrid.

NEW YORK: Watchogue, Staten Island, W. T. Davis, May 10 (and autumn), 1894. PENNSYLVANIA: Reading, Berks Co., E. J. Palmer 36321, Sept. 11, 1929; David Berkheimer 4412, Oct. 10, 1943. NEW JERSEY: Ocean Grove, J. K. Hayward, Sept., 1890.

- (?) × *Quercus burnetensis* Little (*Q. macrocarpa* × *virginiana*), Jour. Washington Acad. Sci. 33: 9. 1943.

- × *Quercus coloradensis* Ashe, Bull. Torrey Bot. Club 49: 268. 1922. Not Lesquereaux. 1888 (fossil).

The description of × *Quercus coloradensis* Ashe clearly indicates that the live oak is one of the parents, but there is little to suggest the bur-oak in any of the characters mentioned. I have not seen the type specimen nor any other material that can be referred to it. The type was collected along the Colorado River above Marble Falls, Texas.

- × *Quercus Bushii* Sargent (*Q. marilandica* × *velutina*), Bot. Gaz. 65: 453. 1918; Man. Trees N. Amer. ed. 2, 259. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 14. 1924.

- × *Quercus incomita* Palmer (as *Q. marilandica* × *rubra* [*falcata*]), Jour. Arnold Arb. 7: 120. 1926.

The type of × *Quercus Bushii* was collected near Sapulpa, Okla., and it has since been found at a number of other stations from Pennsylvania to South Carolina and westward to eastern Nebraska, eastern Kansas, and Mississippi. The intermediate characters of the leaves and fruit in the many specimens clearly indicate the parentage. In some specimens the young shoots are extremely vigorous and the winter-buds are larger than in either of the parent species. A further study of material from the type tree of × *Q. incomita* makes it seem probable that it may be of the same hybrid origin as × *Q. Bushii*, and it is accordingly treated as a synonym here.

PENNSYLVANIA: Reading, Berks Co., E. J. Palmer 36308, 36309, Sept. 11, 1929, David Berkheimer 4365, Sept. 25, 1943, 5700, Sept. 18, 1944. MARYLAND: near Lenham, Prince George Co., W. R. Maxon 6009, Aug. 31, 1914; 2 miles north of Harrisonville, Baltimore Co., C. H. Muller 4963, 4965, 4966, Oct. 12, 1941. NORTH

CAROLINA: Durham, *D. S. Correll 6896a*, Oct. 8, 1936. SOUTH CAROLINA: Spartansburg, ex Herb. Biltmore, no. 5723e, Oct. 5, 1897. GEORGIA: Climax, *T. G. Harbison 7*, Nov. 6, 1917; Danielsville, Madison Co., *K. M. Wiegand & W. E. Manning 1045*, Aug. 18, 1921. NEBRASKA: Table Rock, Pawnee Co., *Thos. Howe*, Sept. 25, 1920. IOWA: Soap Creek, Davis Co., *Ada Hayden 9836*, June 26, 1939. INDIANA: Decker, Knox Co., *C. C. Deam 54322*, Aug. 19, 1933, *54689*, Oct. 8, 1933, *R. M. Tryon 4262*, Sept. 3, 1939. ILLINOIS: southwest of Elbow, Richland Co., *Robt. Ridgway 3067*, July 22, 1928. TENNESSEE: Roan Co., *D. M. Coffman*, Oct. 3, 1889. MISSOURI: Buckner, *B. F. Bush 9706*, Oct. 3, 1921, *E. J. Palmer 22335*, Oct. 22, 1922; Holmes Park (Kansas City), *B. F. Bush 10368*, Oct. 22, 1924; Allenton, *G. W. Letterman*, July 28, 1911; Pertle Springs, Warrensburg, *E. J. Palmer 36747*, June 23, 1930; Prosperity, Jasper Co., *E. J. Palmer 15852*, Aug. 15, 1919; Joplin, Jasper Co., *E. J. Palmer 22735*, May 21, 1923. ARKANSAS: Eureka Springs, *E. J. Palmer 20509*, Sept. 17, 1921; Fayetteville, *E. J. Palmer 23950*, Oct. 1, 1923. KANSAS: Neodesha, Wilson Co., *E. J. Palmer 21379*, May 23, 1922. OKLAHOMA: Sapulpa, *B. F. Bush 1328* (TYPE), Sept. 20, 1895. MISSISSIPPI: Oxford, *T. G. Harbison 16*, Oct. 16, 1915.

× *Quercus Byersi* Sudworth ex Trelease (*Q. macrocarpa* × *Prinus*), Mem. Nat. Acad. Sci. 20: 14. 1924.

Quercus Michauxii × *macrocarpa* Sudworth, U. S. Dept. Agric., Div. Forestry, Bull. 14: 158. 1897.

The type was found near Covington, Tipton Co., Tennessee, associated with the bur-oak and the basket-oak, both of which are species of low or alluvial woods. I have not seen any specimens of this hybrid, but from the description and notes given by Sudworth there seems to be no reason to question the parentage.

× *Quercus caduca* Trelease (*Q. incana* × *nigra*), Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus cinerea × *aquatica* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 90. 1894.

Ashe stated that several trees of this hybrid were found, all near the coast, but no definite locality was given. I have not seen any of the original material; but there are a number of specimens in the herbarium of the Arnold Arboretum that have been referred to it. It is often difficult to distinguish between this hybrid and × *Quercus atlantica*, although there is a greater tendency for the leaves to be lobed or toothed near the apex than in the latter.

VIRGINIA: Cape Henry, Princess Anne Co., *M. L. Fernald & Bayard Long 4863*, Sept. 12, 1935. GEORGIA: Dorchester, *T. G. Harbison 23*, June 21, 1917; Folkston, *T. G. Harbison 71*, July 16, 90, July 17, 1918; Lumber City, *T. G. Harbison 1*, May 30, Nov. 14, Dec. 16, 1917. FLORIDA: Gainesville, *T. G. Harbison 69*, 75, July 25, 1918; Alachua County, *T. G. Harbison 101*, June 20, 1919; Sebring, *T. G. Harbison 62*, July 30, 1918. ALABAMA: Cottondale, *T. G. Harbison 41*, 44, May 19, 1917. MISSISSIPPI: Mississippi City, *T. G. Harbison 8*, Oct. 28, 1917. TEXAS: Milano, Milam Co., *E. J. Palmer 11712*, April 27, 1917; Jacksonville, Cherokee Co., *E. J. Palmer 8597*, Sept. 21, 1915; Bryan, Brazos Co., *E. J. Palmer 10731*, 10748, Sept. 17, 1916, 13474, 13476, April 27, 1918; Huntsville, Walker Co., *V. L. Cory 19524*, Sept. 11, 1936.

× *Quercus Capesii* W. Wolf (*Q. nigra* × *Phellos*), Castanea 10: 91, 120. 1945.

The description of this hybrid was based on variants that appeared in a planting of seedlings grown from acorns of a cultivated tree of *Quercus Phellos* growing in an assemblage of *Q. nigra* specimens at St. Bernard

College, Alabama. The two species grow together over most of their wide range in the southern states and what appear to be spontaneous hybrids between them have been found in several places. Hybridization seems also to have taken place among cultivated trees at other stations. The hybrid may be a relatively frequent one, but it is usually difficult to recognize it with certainty because of similarities of extreme forms of the parent species, especially in the leaves of shoots and juvenile specimens, which are often eccentrically lobed and quite similar in both, and they may sometimes be mistaken for hybrids.

NEW JERSEY: Cape May Co., *Bayard Long* 7943, Oct. 29, 1912. SOUTH CAROLINA: Calhoun Falls, *T. G. Harbison* 19, May 20, 1918. CULTIVATED: Hort. C. S. Mann, Hartsboro, Penn., C. S. Sargent, Sept. 13, 1914; Borde Hill, Sussex, England, *Stephensen R. Clarke*, May 18, 1933; La Maulevrie, Angers, France, *Antoine de Cugnac*, Sept., 1922.

(?) \times *Quercus Cocksii* Sargent (*Q. obtusa* \times *velutina*), Bot. Gaz. 65:459. 1918; Man. Trees N. Amer. ed. 2, 262. 1922. — Trelease, Mem. Nat. Acad. Sci. 20:14. 1924.

The only material that I have seen of this hybrid is the type collection of two sheets, *R. S. Cocks* 4702, Pineville, La., April 18, 1917.

The specimens have young but nearly fully grown leaves and pistillate flowers. The leaves are mostly 7 to 15 cm. long and 2 to 6 cm. broad, lanceolate or rhombic in outline, with nearly entire, undulate or eccentrically lobed margins. There is no doubt that the plant is a hybrid, and the shape of the leaves indicates *Quercus obtusa* as one of the parents; but the character of the pubescence on the under surface of the leaves rather suggests *Q. falcata* as the other parent, and if that is the case, it would be a synonym of \times *Q. beaumontiana*. But in the absence of fruit it is perhaps best to leave it among the doubtfully authenticated hybrids.

\times *Quercus Comptonae* Sargent (*Q. lyrata* \times *virginiana*), Bot. Gaz. 65:456. 1918; Man. Trees N. Amer. ed. 2, 293. 1922. — Trelease, Mem. Nat. Acad. Sci. 20:14. 1924.

Quercus lyrata \times *virginiana* H. Ness, Jour. Heredity 9:265, fig. 6-8. 1918. — Yarnell, Jour. Arnold Arb. 14:68. 1933.

This is one of the most interesting of the hybrid oaks both on account of its striking characters derived from the very distinct parent species, and because of the fact that it has been found growing spontaneously at several stations and has also been produced artificially under conditions that have permitted careful study. It is a handsome and ornamental tree of rapid growth and should be valuable in cultivation. Although the live oak is not hardy in this latitude and the overcup oak though hardy is far north of its native range, several seedlings of the hybrid grown from acorns sent by Miss Compton from Mississippi grew for several years in the Arboretum until lost by fire injury.

VIRGINIA: Williamsburg (planted on Courthouse Green, but transplanted from Virginia Beach where it was found spontaneous), *J. T. Baldwin, Jr.* 5612, Jan. 20, 1947. ALABAMA: Selma, ("at old house on plantation"), *T. G. Harbison* 10, April 20 and Oct. 21, 1915. MISSISSIPPI: Natchez, *Miss C. C. Compton*, many collections under nos. 12, 16, 18, 19, 26, 27, 28, 29, 32, 33, 34, 35, 38, 39, 43, 44, 45, and 47, in

1915 and 1916, *C. S. Sargent*, April 17, 1915, April 16, 1916. LOUISIANA: New Orleans, *R. S. Cocks*, Oct., 1911, *C. S. Sargent*, Audubon Park, March 31, 1917. TEXAS: along Payson's Creek, Matagorda Co., *C. H. Mohr* 96, Dec. 18, 1880.

A number of specimens from cultivated plants are also in the herbarium of the Arnold Arboretum, including several of the Ness hybrids grown at College Station, Texas, others grown here from acorns sent by Professor Ness and Miss Compton, and one from a small tree on the campus of the University of Kentucky, Lexington, Ky., that is said to have come originally from western Louisiana.

× *Quercus cravenensis* Little (*Q. incana* × *marilandica*), Jour. Washington Acad. Sci. 33: 9. 1943.

× *Quercus carolinensis* Trelease, Proc. Amer. Phil. Soc. 56: 48. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922. Not. *Q. carolinensis* Muench. 1770.

Quercus cinerea × *nigra* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 91. 1894.

Trelease gave no description and did not cite a type specimen when the name × *Quercus carolinensis* was published. But Ashe's notes on the plants and collections on which it was evidently based give a good idea of the hybrid. He stated that perhaps ten trees were seen, all in the neighborhood of the coast. I have not seen the original material, but several specimens in the herbarium of the Arnold Arboretum seem clearly to represent it. In typical specimens the pubescence and veining of the leaves show the relationship to *Quercus marilandica* and some of them have the subcordate base and short petioles characteristic of that species. The branchlets are generally stout and stiff, which is also a character of the black jack oak; but in other specimens the branchlets are more slender and the general shape of the leaves with long petioles and cuneate bases more nearly resembles the other parent.

VIRGINIA: south of Franklin, Southampton Co., *M. L. Fernald & Bayard Long* 8242, June 19, 1938 (G). NORTH CAROLINA: Carolina Beach, New Hanover Co., *R. H. Gorfry* 6241, Aug. 28, 1938 (G); New Berne, *T. G. Harbison* 27, 48, Oct. 9, 1917. SOUTH CAROLINA: Seneca, *T. G. Harbison* 6083, April 29, 1922; Myrtle Beach, *Ludlow Griscom* 16513, April 24, 1932. GEORGIA: Lumber City, *T. G. Harbison* 3, May 29, 4, May 8, and 1, Nov. 15, 1917; Climax, *T. G. Harbison* 3, May 29, 8, 10, Nov. 6, 1917. ALABAMA: Spring Hill, *T. G. Harbison* 5861, March 27, 1920. TEXAS: Fletcher, Hardin Co., *E. J. Palmer* 12741, Sept. 12, 1917.

(?) × *Quercus Deami* Trelease (*Q. alba* × *Muhlenbergii*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922. — Deam, Fl. Indiana 384. 1940.

Quercus alba × *Muhlenbergii* Deam, Rept. Ind. Bd. Forestry, Bull. 2: 127. 1912.

In proposing the name × *Quercus Deami* for this hybrid Trelease referred to Deam's description and plate (22). The fine original tree on which it was based is now preserved as a state monument near Bluffton, Ind. It was believed to be a hybrid between *Quercus alba* and *Q. Muhlenbergii*, and was so determined by G. B. Sudworth. The leaves have more resemblance to those of *Quercus alba* in outline than to those of the other supposed parent, and they are pale and finely pubescent on the under surface. Some doubt has been thrown on the parentage by the fact that

seedlings raised at the Arnold Arboretum from acorns supposed to have come from the type tree have leaves similar to those of *Quercus bicolor*. Should it be found that the tree is really a cross between *Quercus alba* and *Q. bicolor*, the name would have to be regarded as a synonym of \times *Quercus Jackiana*. But since there may be a possibility of error in the record, it seems best to suspend judgment until there is more evidence. Irrespective of the parentage of the original plant, some of the collections enumerated below are probably crosses between *Quercus alba* and *Q. Muhlenbergii*.

PENNSYLVANIA: Waterside, Bedford Co., *David Berkheimer* 5486, Aug. 21, 1944. INDIANA: 3 miles northwest of Bluffton, Wells Co., *C. C. Deam* 14117, Sept. 28, No. 14131, Oct. 5, 1913, No. 22100, Sept. 24, 1916, No. 49948, Sept. 22, 1930 (all from the type tree). ILLINOIS: New Haven, White Co., *E. J. Palmer* 15298, May 28, 1919. KENTUCKY: Litchfield, Grayson Co., *W. W. Eggleston* 5444, Oct. 11, 1909 (G).

\times *Quercus Demarei* Ashe (*Q. nigra* \times *velutina*), Jour. Elisha Mitchell Sci. Soc. 41: 268. 1926.

Quercus nigra \times *velutina*? Palmer, Jour. Arnold Arb. 7: 119. 1926.

I have not seen the type specimen, but several collections in the herbarium of the Arnold Arboretum seem to be hybrids between the water-oak and the black oak.

ARKANSAS: Boto, Pike Co., *D. Demaree* 9395, Sept. 29, 1932; Craighead Co., *D. Demaree* 7180, Sept. 18, 1929; Hot Springs, Garland Co., *E. J. Palmer* 26858, April 22, 27117, May 19, 1925. LOUISIANA: Natchitoches, *E. J. Palmer* 7473, May 3, 1915.

\times *Quercus Egglestoni* Trelease (*Q. imbricaria* \times *Shumardii*), Mem. Nat. Acad. Sci. 20: 14. 1924.

\times *Quercus Shirlingii* Bush ex Palmer & Steyer. (*Q. imbricaria* \times *Shumardii* var. *Schneckii*), Ann. Missouri Bot. Gard. 22: 521. 1935.

Trelease's brief description of \times *Quercus Egglestoni* says: "Very like \times *Q. runcinata* but with thicker leaves, the clay-colored or reddish buds intermediate between those of *maxima* and *Shumardii*." In giving the parentage he placed a question mark after *Q. imbricaria*. In the type specimen the leaves are deeply divided with sharp nearly simple symmetrical lobes, much more like those of *Q. Shumardii* than of the other suggested parent. The acorns are short-ovate to subglobose, 1.5–1.7 cm. long, with shallow cups enclosing about $\frac{1}{4}$ of the nut, and small closely imbricated glabrous scales, and they are somewhat intermediate between those of the suggested parents. If the name is accepted, it would have priority over \times *Q. Shirlingii*, as I do not think it possible to determine which variety of *Q. Shumardii* is involved in such a hybrid.

KENTUCKY: Litchfield, Grayson Co., *W. W. Eggleston* 5444, Oct. 11, 1909 (G). MISSOURI: Oak Grove, *B. F. Bush* 11637, Oct. 22. 1927.

\times *Quercus Eplingi* C. H. Muller (*Q. Douglasii* \times *Garryana*), Amer. Midl. Naturalist 19: 585. 1938.

The type specimen was collected by Epling and Robinson, Lake Co., California, July 27, 1935, and is deposited in the herbarium of the University of California, Los Angeles, Calif. I have not seen any material referable to it.

× *Quercus exacta* Trelease (*Q. imbricaria* × *palustris*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 268. 1922.

Quercus imbricaria × *palustris* Engelm. ex A. Braun, Sitzungsber. Gesellsch. naturf. freunde Dec. 20, 1870: 82. 1871; Bot. Zeit. 29: 202. 1871. — Engelm., Trans. Acad. Sci. St. Louis 3: 400. 1877.

It is sometimes difficult to distinguish sterile specimens of this hybrid from × *Q. runcinata*. As compared with the latter, the leaves are inclined to be somewhat smaller and thinner in texture and to have fewer primary veins and more persistent tomentum in the axils of the veins and along the midrib. But all of these characters are variable and some specimens may be doubtful.

PENNSYLVANIA: Finland, Bucks Co., Bayard Long 18719, May 23, 1918 (G).
INDIANA: near Half Moon Pond, Posey Co., C. C. Deam 29116, Aug. 16, 1919.
ILLINOIS: near Olney, Richland Co., Robt. Ridgway 33, 34, Aug. 18, 1914, 1488, Sept. 29, 1921, C. S. Sargent, Oct. 5, 1913, E. J. Palmer 22625, May 15, 1923; Gentry Creek, Richland Co., Robt. Ridgway 27, Sept. 9, 1918; (East St. Louis?), George Engelm., 1870 (G).

× *Quercus fallax* nom. nov.

Quercus macrocarpa × *Muhlenbergii* Hitchcock, Bot. Gaz. 18: 110–111, pl. 8. 1893.
— Bush, Garden and Forest 8: 32. 1895. — Sargent, Silva 8: 56. 1895.

Arbor foliis obovatis vel lanceolato-obovatis 8–24 cm. longis 4–12 cm. latis dentato-lobatis subtus pallidis plene minute pubescentibus. Fructus oblongo-obovatus 2–3 cm. longus et latus; glande in cupulo rotundo circiter $\frac{1}{2}$ incluso, squamis cupulae acuminatis crassis pubescentibus.

Trelease proposed the name × *Quercus Hillii* for a hybrid that was supposed to have arisen between the two species mentioned above. Although no description was given and no type specimen cited, it is evident from the name and from a reference to a note in Sargent's Silva that it was based on a collection of E. J. Hill, near Roby, Indiana. But an examination of a sheet of Hill's collection in the herbarium of the Arnold Arboretum convinces me that it is really a hybrid between *Quercus bicolor* and *Q. macrocarpa*, a combination that was described later in the same paper by Trelease as × *Quercus Schuettei*. If that is the case, × *Quercus Schuettei* must be regarded as a synonym of the earlier name, and it is necessary to adopt a new name for the real hybrid between *Quercus macrocarpa* and *Q. Muhlenbergii*.

Professor A. S. Hitchcock (28) reported finding this hybrid near Manhattan, Kans., in 1893, and Mr. B. F. Bush (13) gave an account of two trees found near Independence, Mo., in 1895. I have not seen Hitchcock's collection, but the description and the figure that accompanied it show a plant very similar in foliage to *Quercus macrocarpa*. The fruit was described as intermediate between that of the parent species. In the specimen that is taken here as the type of × *Quercus fallax* and in other collections by Bush the leaves are clearly intermediate between those of the bur-oak and the chinquapin-oak. The fruit is nearly as large as the average in the bur-oak.

MISSOURI: Independence, Jackson Co., *B. F. Bush* 621, Sept. 11, 625, Sept. 16, 1894, 626, Oct. 14, and 629 (TYPE), Oct. 7, 1895; Swope Park (Kansas City), *B. F. Bush* 10326, Oct. 6, 1923.

- × *Quercus Faxonii* Trelease (*Q. alba* × *prinoides*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

There seems to be no reason to question the parentage of this hybrid although it may be difficult in some cases to distinguish sterile specimens from forms of × *Quercus Saulei*.

MASSACHUSETTS: East Walpole, *J. G. Jack* 1, Sept. 17, 1914, May 28, 1915, June 1, 1916, May 31, 1926, No. 2952, May 25, 1931. NEW YORK: Albany, *H. D. House* 20137, Sept. 2, 1932 (G).

- × *Quercus Fernaldi* Trelease (*Q. borealis* × *ilicifolia*), Mem. Nat. Acad. Sci. 20: 15. 1924.

The parentage of this hybrid was given by Trelease as *Q. ilicifolia* × *maxima*, but in this writer's opinion, *Q. borealis* and *Q. maxima*, so-called, are only forms of varieties of one species, and it is generally impossible to tell which of them is involved in a hybrid. Sargent proposed the name × *Quercus Lowellii* (53) for a supposed hybrid between *Quercus borealis* and *Q. ilicifolia*. But an examination of the type, which was a sterile shoot, led Trelease to suggest that perhaps it was only an aberrant form of *maxima* or *borealis*; and I believe that he was correct in his opinion and that × *Quercus Lowellii* must therefore be considered a synonym of *Q. borealis*.

MASSACHUSETTS: Sharon, summit of Moose Hill, *J. G. Jack* 3818, 3819, June 20, 1926; East Walpole, *J. G. Jack* 3954, Sept. 13, 3955, Sept. 20, 1931, 1, 2, 3, May 15, 1936. VIRGINIA: Little Stony Mountain, Madison Co., *H. A. Allard*, Sept. 23, 1933 (G).

- × *Quercus Fernowii* Trelease (*Q. alba* × *stellata*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

Quercus alba × *stellata* Engelmann, Trans. Acad. Sci. St. Louis 3: 399. 1877. — Vasey, Bull. Torrey Bot. Club 10: 25, pl. 29–30. 1883. — Sargent (as *alba* × *minor*), Silva 8: 18, pl. 359. 1895.

NEW JERSEY: Browns Mills, Burlington Co., *J. C. Swartley* 429, Aug. 24, 1935. VIRGINIA: Red Clay Creek, *C. S. Sargent*, Oct. 6, 1891; northwest of Suffolk, Nansemond Co., *M. L. Fernald & Bayard Long* 13321, July 23, 1941 (G); Beverley Hill to High Point, Fauquier Co., *H. A. Allard* 9794, Oct. 26, 1941 (G); Bull Run Mountains, Fauquier Co., *H. A. Allard* 9944, May 17, 1942 (G). DELAWARE: Marshallton, *J. P. Otis*, Oct. 1923. MARYLAND: near Beltsville, *L. P. McCollough*, Oct., 1943. INDIANA: southeast of Nashville, Brown Co., *C. C. Deam* 56933, Oct. 10, 1935. MISSOURI: Allenton, *G. W. Letterman*, May 10, 1882, Oct., 1883, April 30, July 10, 1884, Oct., 1890, *C. S. Sargent*, Aug. 26, 1894, *J. H. Kellogg*, Oct. 12, 1907, Oct. 5, 1910, 25978, June 14, 1932. TEXAS: Milano, Milam Co., *E. J. Palmer* 11658, April 24, 1917.

- × *Quercus filialis* Little (*Q. Phellos* × *velutina*), Jour. Washington Acad. Sci. 33: 10. 1943.

× *Quercus inaequalis* Palmer & Steyermark, Ann. Missouri Bot. Gard. 22: 521. 1935. Not *Q. inaequalis* Watelet. 1866 (fossil).

- × *Quercus dubia* Trelease, Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 14. 1924. Not Ashe.

In his first paper on the hybrid oaks (64) Trelease gave the parentage of \times *Quercus dubia* Ashe as *Phellos* \times ?*velutina*, and the same doubtful disposition of it was made in the Monograph of American Oaks, but in the latter work he suggested that *Q. laevis* might be one of the parents, and he also remarked that the type collection is very like the entire leaved form of \times *Q. Rudkini*, which it may represent. Sargent considered \times *Q. dubia* a hybrid between *Q. laevis* (*cinerea*) and *Q. laurifolia* — a wide divergence of opinion —, and it would seem that the name was well chosen. There is a large series of specimens under the name \times *Quercus dubia* in the herbarium of the Arnold Arboretum, including several sheets collected and named by Ashe, as well as others that he called \times *Q. atlantica* and one that was given the manuscript name of \times *Q. bladenensis*. A careful examination of this material leads me to believe that more than one and perhaps three or four hybrids are represented. But none of them suggest a cross between the willow-oak and the black oak. Certainly *Quercus laurifolia* is one of the parents in most cases, and there can be little doubt that *Q. laevis* is involved in many of them. And a few sheets can probably be referred to \times *Q. Rudkini* as suggested by Trelease.

\times *Quercus filialis* has frequently been confused with \times *Q. heterophylla* which it resembles closely in the shape of the variable leaves. It can be distinguished from that hybrid by the more persistent tomentum on the under surface of the leaves, especially along the principal veins and in their axils, and by its generally larger winter-buds with pubescent scales. The acorns when present are distinguishable by the looser pubescent scales of the cups.

NEW JERSEY: Woodbury, *Isaac C. Martindale*, Sept., 1876; Belleplain State Forest, Cape May Co., *H. A. Scribner*, Aug. 2, 1939; Mt. Holly, *S. P. Sharples*, Sept. 6, 1881. DELAWARE: Wilmington, *A. Commons*, Sept. 29, 1876, Sept. 16, 1877 (G). MISSOURI: Poplar Bluff, *E. J. Palmer* 16342 (type of *Q. inaequalis*), Sept. 11, 1919, 20676, Oct. 5, 1921. ARKANSAS: Hardinville, Faulkner Co., *E. J. Palmer* 26505; Conway, Faulkner Co., *D. Demaree* 13812, Oct. 2, 1936; Hot Springs, *E. J. Palmer* 29098, Oct. 10, 1925, 29577, Nov. 5, 1925. LOUISIANA: Plains, East Baton Rouge Parish, *Clair A. Brown* 9904, Oct. 13, 1943. Cultivated in the Arnold Arboretum.

\times *Quercus Ganderi* C. B. Wolf (*Q. agrifolia* \times *Kelloggii*), Proc. Calif. Acad. Sci. ser. 4, 25: 178, pl. 18-19. 1944.

A full description with numerous figures of the leaves and fruit accompanied the publication of this name. There were also notes on a number of trees discovered in San Diego Co., Calif., and on results obtained with seedlings grown from acorns of the type tree. Another collection was mentioned from Monterey County that may be of similar hybrid origin. The formula of parentage given by the author was, *Quercus Kelloggii* Newb. \times *Quercus agrifolia* var. *oxyadenia* (Torr.) J. T. Howell.

CALIFORNIA: between Santa Ysabel and Lake Henshaw, San Diego Co., *C. B. Wolf* 9487, Jan. 24, 1939, *C. B. Wolf* & *P. C. Everett* 9483, Jan. 10, 1939, 9543 (ISOTYPE), Oct. 20, 1939; from Mesa Grande on road to Lake Henshaw, San Diego Co., *C. B. Wolf* 9488, 9489, Jan. 24, 1939; south of Marettis on road to Santa Ysabel, San Diego Co., *C. H. Muller* 4034, Aug. 9, 1941.

- × *Quercus garlandensis* Palmer (*Q. falcata* × *nigra*), Jour. Arnold Arb. 7: 119. 1926 (as *nigra* × *rubra*).

The description of this hybrid was based on material from two trees found near Hot Springs, Ark. Both supposed parents were growing in the immediate vicinity; and the intermediate characters of the foliage, fruit, bark, and winter-buds indicate the relationship. The leaves are extremely variable in shape and size, many of them being asymmetric; and the loose pale or tawny pubescence of the young leaves is significant. A few additional trees have been found in other localities.

ARKANSAS: Hot Springs, *E. J. Palmer* 23139, July 7, 24237, 24328, Oct. 20, 1923, 24455, 24456, April 22, 1924, 26856, 26857, April 22, 29223, Oct. 14, 29573, 29574, Nov. 5, 1925; Langley, Pike Co., *D. Demaree* 9515, Oct. 5, 1932. ALABAMA: Sardis, *R. S. Cocks* 4704, Sept. 25, 1917; Berlin, *R. S. Cocks*, Aug., 1917; Mt. Vernon, *T. G. Harbison* 8, May 19, 1917. LOUISIANA: Pineville, *R. S. Cocks* 4702, Oct. 3, 1917.

- × *Quercus Giffordi* Trelease (*Q. ilicifolia* × *Phellos*), Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Man. Trees. N. Amer. ed. 255. 1922.

An isotype in the herbarium of the Arnold Arboretum consists only of a sterile shoot and several detached leaves. The outlines of the undulate or irregularly lobed leaves and the fine cinereous pubescence on their under surface seem to confirm the suggested parentage. The specimens from Delaware are much better, and some of them have mature fruit.

NEW JERSEY: May's Landing, *J. C. Gifford & J. E. Peters*, July 11, 1890 (ISOTYPE). DELAWARE: near Dover, *C. S. Sargent*, Oct. 10, 1922; Wilson Station, *J. T. Otis*, 1922; near Marshallton, *J. T. Otis*, Sept. 18, 1923.

- × *Quercus guadalupensis* Sargent (*Q. macrocarpa* × *stellata*), Bot. Gaz. 65: 454. 1918; Man. Trees N. Amer. ed. 2, 291. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924.

Although only material from the type tree is known, it is so complete and the leaves and fruit are so clearly intermediate between those of the parent species that there can be no doubt as to its origin. Both the bur-oak and the post-oak were found growing near the type tree.

TEXAS: Fredericksburg Junction, Kendall Co., *E. J. Palmer* 10878 (TYPE), Oct. 1, 1916.

- × *Quercus Harbisonii* Sargent (*Q. stellata* × *virginiana*), Bot. Gaz. 65: 458. 1918 (as *stellata* var. *Margaretta* × *virginiana* var. *geminata*); Man. Trees N. Amer. ed. 2, 295. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924 (as *geminata* × *Margaretta*).

- × *Quercus neo-tharpii* A. Camus (as *Durandii* × *virginiana*), Les Chênes 2: 754. Atlas 2: pl. 226, fig. 9-19. 1939.

Although Sargent described × *Quercus Harbisonii* as a hybrid between botanical varieties of the post-oak and live oak, other specimens have been found that show evidences of being crosses between the typical forms of these species, and I can see no way of distinguishing them. If *Quercus geminata* and *Q. Margaretta* were regarded as distinct species, as was held by Trelease and others, the name × *Quercus Harbisonii* would technically have to be restricted to a cross between them and it would be necessary to adopt another name for the *Q. stellata* × *virginiana* hybrid. Besides

several spontaneous specimens of apparent crosses between typical forms of the post-oak and live oak, it has been produced by artificial cross-pollination, as mentioned in the introduction.

Specimens of Tharp's collections from the coast of Texas that were cited and illustrated by Camus as believed to be a hybrid between *Quercus Durandii* and *Q. virginiana* are in the herbarium of the Arnold Arboretum. Except for a superficial resemblance in the shape of some of the leaves, I can see no suggestion of *Quercus Durandii* parentage in them. The fruit closely resembles that of *Q. virginiana*, but it is large and with deep cups even for that species. The scurfy stellate pubescence on the under surface of the mature leaves and on the branchlets suggests *Q. stellata* as the other parent.

FLORIDA: Jacksonville, T. G. Harbison 16, Dec. 3, 1917 (TYPE). TEXAS: Ft. Chadburn, Coke Co., E. J. Palmer 12463, July 9, 1917; Roby (Fisher Co.), B. C. Tharp 4238, Aug. 16, 1926; between Seadrift and Port O'Connor, B. C. Tharp 8768-a, Dec. 1, 1928, 8768-b, March 20, 1930; College Station (artificial hybrids, cultivated), H. Ness, 1922, and W. S. Flory Jr., 1943.

(?) \times *Quercus Hastingsii* Sargent (*Q. marilandica* \times *Shumardii*), Bot. Gaz. 65: 450. 1918; Man. Trees N. Amer. ed. 2, 259. 1922 (as *Q. marilandica texana*).

The leaves of the type, except in their fewer shallow and blunt lobes, are much nearer in appearance to those of *Quercus Shumardii* var. *texana* than to those of the other supposed parent, and Trelease held that it was apparently scarcely more than a form of *Q. texana*. But there are indications of hybrid origin and of the influence of *Q. marilandica* in the stiff branchlets, pubescent through the first year, and in traces of pubescence on the petioles, the under surface of the leaves, cup scales, and scales of the winter-buds. Specimens found at Brownwood, Texas, more nearly resemble *Q. marilandica* var. *Ashei* Sudw. in the shape of the leaves and in the stiff habit and dark rough bark. The supposed hybrids have all been found in the vicinity of *Q. Shumardii* var. *texana* and *Q. marilandica* or the variety *Ashei*, growing under xerophytic conditions. Should hybrids be found between the typical varieties of the two species, they might differ rather widely from \times *Quercus Hastingsii* as found in Texas.

TEXAS: near Bourne, S. H. Hastings 145 (TYPE), Oct., 1910; Brownwood, E. J. Palmer 10364, July 5, 1916, 13056, Oct. 18, 1917, 26818, Nov. 1, 1924, 29547, 29548, Nov. 2, 1925.

\times *Quercus Hawkinsii* Sudworth (*Q. borealis* \times *velutina*), Amer. Forestry 23: 685, fig. 1, 2, 5. 1917.

Quercus Porteri Trelease, Proc. Amer. Phil. Soc. 56: 51. 1917 (*nomen nudum*); Mem. Nat. Acad. Sci. 20: 16. 1924.

In publishing the description of \times *Quercus Hawkinsii* with full notes and figures, Sudworth gave his reasons for believing that it was a hybrid between *Quercus borealis* and *Q. velutina*. But he also suggested the possibility that *Quercus palustris* might be one of the parents. The acorns figured certainly resemble those of the pin-oak, but the leaves and bark are more like those of the black oak. If, as seems probable, the parentage was correctly determined, the name has priority over \times *Quercus Porteri*.

For although Trelease's first publication of the name \times *Quercus Porteri* was a few months earlier, the description of \times *Q. Hawkinsii* appeared first.

Trelease in his Monograph of American Oaks accepted *Quercus borealis* and *Q. maxima* as distinct species, and he gave the parentage of \times *Q. Porteri* as *Q. maxima?* \times *velutina*. He also inserted the name \times *Quercus Hawkinsii* with the parentage, *Q. borealis* (*maxima*) \times *velutina*, but with the note: "Scarcely differs from *maxima* except in its yellow cotyledons."

The leaves of the northern red oak and the black oak are generally quite similar in shape, and a hybrid between them is not outstanding or easily distinguished in foliage specimens. The only notable distinction between the typical form of *Quercus borealis* and the variety *maxima* is in the shape of the acorn cups, and, in my opinion, it would generally be impossible to determine which variety is involved in a hybrid. The best characters for distinguishing \times *Quercus Hawkinsii* from *Q. borealis* are found in the somewhat pubescent scales of the winter-buds and in the more persistent tomentum on the under surface of the leaves. If acorns are available, they are likely to show characters of the black oak in the shape of the cup or in the pubescence of its inner surface and scales.

MAINE: Lyman, York Co., *F. Hyland* 162, July 24, 1934. MASSACHUSETTS: Jamaica Plain, *J. G. Jack* 3803, Nov. 2, 1925; Dedham, *J. G. Jack* 3839, Oct. 15, 1926. NEW YORK: Durand-Eastman Park, Rochester, *B. H. Slavin* 6, Oct. 12, 1918. PENNSYLVANIA: Easton, *Thos. C. Porter*, Sept. 30, 1893, May 12, 1894. OHIO: Lakeside, Ottawa Co., *W. A. Kellerman* 63, May 17 and Sept. 16, 1900. MISSOURI: Swope Park (Kansas City), *Kendall Laughlin*, 1938; Holmes Park (Kansas City), *B. F. Bush* 9944, Oct. 9, 1922, *E. J. Palmer* 22327, Oct. 21, 1922; Dumas, Clark Co., *E. J. Palmer* 21904, Sept. 8, 1922, *B. F. Bush* 9528, Aug. 29, 1921; Crowleys Ridge, Dunklin Co., *J. H. Kellogg* 26043, Aug. 7, 1932. This hybrid is also in cultivation in the Arnold Arboretum, and specimens grown from seeds have retained the intermediate characters.

\times *Quercus heterophylla* Michx. f. (*Q. borealis* \times *Phellos*), Hist. Arb. Amer. Sept. 2: 87, pl. 16. 1812; N. Amer. Silva (English ed.) 1: 75, pl. 18. 1819. — Gale, Proc. Nat. Inst. 1875: 70, fig. 1. 1875. — Sargent, Silva 8: 456, pl. 436. 1895; Man. Trees N. Amer. ed. 2, 263, fig. 241. 1922. — Trelease, Proc. Amer. Phil. Soc. 56: 49. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924.

This classic example of a spontaneous hybrid oak has been figured and described many times. A discussion will be found in the introduction to this paper.

NEW YORK: Tottenville, Staten Island, *Arthur Hollick*, Sept. 2, 1888, *J. K. Small*, Aug. 2, 1890, *C. S. Sargent*, Aug. 6, 1894. PENNSYLVANIA: Hatboro, *C. S. Mann*, Oct., 1918; Upper Darby, *Joseph Crawford*, Aug. 30, 1909; Finland, *W. A. Kline*, July and Nov. 3, 1917. NEW JERSEY: Mickleton, Gloucester Co., *B. Heritage*, Oct. 22, 1895; Gloucester Co., *C. A. Gaskell*, Aug. 1914; State Game Farm, Ocean Co., *Hollis Koster*, June 30, 1937; Buss River State Forest, Burlington Co., *Hollis Koster*, May 13 and Oct. 3, 1934; Westville, *J. W. Adams* 4186, Nov. 2, 1937; South Westville, *J. W. Adams* 4562, Oct. 21, 1938; Mullica Hill, Gloucester Co., *J. W. Adams* 4853, Oct. 10, 1939. DELAWARE: Hazletville, *J. P. Otis*, 1922; Marshallton, *J. P. Otis*, Sept. 18, 1923. MISSOURI: northwest of Wappapelo, Wayne Co., *Julian A. Steyermark* 6428, Sept. 2, 1938; Crowleys Ridge, Dunklin Co., *J. H. Kellogg* 26039, Aug. 7, 1932. ARKANSAS: Corning, *G. W. Letterman* 4, Oct. 1882. OKLAHOMA: Page, Le

Flore Co., *E. J. Palmer* 20901, April 22, 21597, May 30, 22232 Oct. 7, 1922. Specimens have also been examined from trees cultivated in the Arnold Arboretum and in a number of other botanic gardens and parks, including seedling plants grown from cuttings from the original tree.

× *Quercus Hillii* Trelease (*Q. bicolor* × *macrocarpa*), Proc. Amer. Phil. Soc. 56: 49. 1917 (as *macrocarpa* × *Muhlenbergii*); Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Silva 8: 56. 1895; Man. Trees N. Amer. ed. 2, 292. 1922. — Deam, Fl. Indiana, 384. 1940.

× *Quercus Schuettei* Trelease, Proc. Amer. Phil. Soc. 56: 51, pl. 2-3. 1917.

The synonymy was discussed under description of × *Quercus fallax*. × *Quercus Hillii*, as here understood, seems to be a relatively abundant and widely distributed hybrid, since the parent species are rather closely related and grow together in similar habitats over a large area. The leaves of both species are quite variable in shape, but those of the bur-oak (*Q. macrocarpa*) are usually larger, more deeply lobed and with a looser less persistent pubescence than in *Q. bicolor*. Leaves of the hybrid show intermediate characters, but fruit may be necessary to make determination certain in some cases.

CANADA: Montreal, near Rockfield, *J. G. Jack*, Aug. 17, 1894; Chateaugay, *J. G. Jack*, Sept. 16, 1911, Aug. 15, 1895, Sept. 7, 1896; Longueuil, *M. Victorin* 16477, Sept., 1922. NEW YORK: Golah (Monroe Co.), *J. Dunbar*, Sept. 28, 1915, Sept. 23, 1922; Mumford, Monroe Co., *B. H. Slavin* 47, Sept. 27, 1922. INDIANA: Roby, (Lake Co.), *E. J. Hill*, May 12 and 27, June 27, 1892 (TYPE). Cultivated, Arnold Arboretum, Municipal Parks, Rochester, N. Y., and elsewhere in America and Europe.

× *Quercus humidicola* Palmer (*Q. bicolor* × *lyrata*), Jour. Arnold Arb. 18: 140. 1937.

The swamp white oak and the overcup oak, both trees of low wet woods, are often found growing together in regions where their ranges overlap. The leaves and fruit of the two species are quite different, and hybrids are rather easily recognizable by their intermediate characters.

ILLINOIS: Mounds, Pulaski Co., *E. J. Palmer* 16634, Oct. 1, 1919, 19546, Oct. 16, 1920; Mound City, Pulaski Co., *E. J. Palmer* 16642, Oct. 1, 1919, 19549, 19550, Oct. 16, 1920; northwest of Wynoose, Richland Co., *Robt. Ridgway* 777, Aug. 27 and Sept. 7, 1919; Little Wabash River, s. e. corner Clay Co., *Robt. Ridgway* 1557, Oct. 12, 1921. MISSOURI: Campbell, (Dunklin Co.), *B. F. Bush* 6365 (TYPE), Oct. 6, 1910.

× *Quercus inconstans* Palmer (*Q. Emoryi* × *hypoleucoides*), Jour. Arnold Arb. 10: 34. 1929.

× *Quercus livermorensis* Muller, Amer. Midl. Naturalist 19: 585. 1938.

Two shrubby plants believed to be this hybrid were found near the head of a rocky ravine east of Livermore peak, in the Davis Mountains, at an altitude of about 2000 meters. Both supposed parent species were growing near by. The intermediate characters of the leaves indicate the hybrid origin of the plant, as well as the association and its rarity. The leaves are oblong-elliptic to oblanceolate in outline, mostly 4-8 cm. long and 2-4 cm. wide, with 2-3 or rarely 4 pairs of pungent, bristle-tipped teeth, coriaceous or subcoriaceous, with slightly revolute margins, green and thinly stellate-pubescent above, coated beneath with thick, pale, rather easily detached tomentum: veins slightly impressed above, prominent

beneath; petioles 6–10 mm. long. The pistillate flowers are borne on short hairy peduncles or are nearly sessile. No acorns were found. The leaves resemble those of *Quercus Emoryi* in the toothed margins, but they are mostly cuneate or narrowed and rounded at the base, as in *Q. hypoleucoides*. They also resemble the latter in the pale felty tomentose under surface. The fact that the tomentum is loosely attached and can be rubbed off with the finger is particularly significant, as this is often the case in hybrids between a glabrous and a strongly pubescent species.

TEXAS: Davis Mountains, Jeff Davis Co., *E. J. Palmer* 30934 and 30935 (TYPE), June 15, 1926; Davis Mountains, near Mt. Livermore, *L. C. Hinckley*, May 1, 1937 (G).

× *Quercus Jackiana* Schneider (*Q. alba* × *bicolor*), Ill. Handb. Laubh. 1: 202. 1904. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

The type tree of this hybrid was discovered by Professor J. G. Jack in Franklin Park, Boston, Mass., growing in native woods. It has since been found at several other stations in this and other states. The leaves are more or less intermediate in outline between those of the parent species, but generally have more resemblance to those of the white oak, with deep nearly simple lobes or with the middle or upper pairs sometimes slightly broadened and indented at the apex, and with the under surface of the blades covered with a more or less dense tomentum, similar to that of *Quercus bicolor*. The fruit is sometimes nearly sessile, resembling large-fruited forms of the white oak except for the deeper cups, or it may be peduncled as in the swamp white oak.

MASSACHUSETTS: Franklin Park, Boston, *J. G. Jack*, Sept. 12, 1895, Sept. 14, 1902, Sept. 18, 1904, Sept. 20, 1916, Jan. 21, 1926, *C. E. Faxon*, Sept. 20, 1916; East Walpole, *J. G. Jack* 3924, Sept. 25, 1929; between Jamaica Plain and Dedham, *H. J. Koehler*, Aug. 18, 1925. RHODE ISLAND: near Diamond Hill, Providence Co., *E. J. Palmer* 46915, Sept. 11, 1943. NEW YORK: Black Rock Forest, Cornwall on Hudson, *H. H. Tryon* 1, 2, 1903. INDIANA: northeast of Onward, Cass Co., *C. C. Deam* 51066, Sept. 18, 1931. ILLINOIS: Coulterville, Randolph Co., *E. J. Palmer* 17090, Oct. 24, 1919. This hybrid is also in cultivation in the Arnold Arboretum.

× *Quercus jolonensis* Sargent (*Q. Douglasii* × *lobata*), Bot. Gaz. 65: 456. 1918; Man. Trees N. Amer. ed. 2, 248, 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 15. 1924.

With leaves smaller and usually less deeply divided than in *Quercus lobata*.

CALIFORNIA: between King City and Jolon, *A. Eastwood* 44, Sept. 17, 155, 156, 163, Sept. 18, 1894, 164 TYPE, 165, Sept. 22, 1894.

× *Quercus Joorii* Trelease (*Q. falcata* × *Shumardii*), Mem. Nat. Acad. Sci. 20: 15. 1924.

I have not seen the type specimen nor any material that can be referred to this hybrid. *Quercus Shumardii* was questioned as one of the parents in the original publication, but the characters given in the brief description seem to indicate that it was correctly placed. The parent species grow together over a wide range, and it is to be expected that hybrids would appear. The type specimen was collected by Joor at Galveston, Texas, Sept. 25, 1884, according to Trelease.

- × *Quercus Leana* Nuttall (*Q. imbricaria* × *velutina*), Sylva N. Amer. 1: 13, pl. 5 bis. 1819. — Sargent, Silva 8: 176, pl. 434. 1895; Man. Trees N. Amer. ed. 2, 268. 1922. — Trelease, Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 15. 1924.

The history and characters of this widely distributed hybrid were discussed in the introduction. In many cases it appears to come true to type in seedlings.

PENNSYLVANIA: Hyndman, Bedford Co., *J. K. Small*, Aug. 19–23, 1890. MARYLAND: Burnt Mills, *H. W. Henshaw*, Aug. 31, 1887 and May 6, 1888. DISTRICT OF COLUMBIA: Carroll Estate, *H. W. Henshaw*, June 21, 1886; Washington, *Lester F. Ward*, Sept., 1888, *George Vasey*, 1876. NORTH CAROLINA: near Biltmore, ex Herb. Biltmore, no. 821, April 25, Aug. 6 and Oct., 1896, no. 421-b, April 30, Sept. 11 and Oct. 11, 1897; Franklin, *C. S. Sargent*, Sept. 25, 1885, *F. E. Boynton*, 1893; Charleston, Swaine Co., *C. S. Sargent*, 1885. MICHIGAN: northwest of Ann Arbor, *J. H. Eihlers* 3597, Oct. 16, 1927. OHIO: Cedar Point, Erie Co., *W. A. Kellerman*, July 19, 1899; Youngstown, Mahoning Co., *R. E. Horsey* 669, Sept. 28, 1917, Oct. 2, 1918. INDIANA: south of Bedford, Lawrence Co., *Ralph M. Kriebel* 1443, Oct. 18, 1933; near Bedford, *C. C. Deam* 10240, Oct. 14, 1911; Crown Point, Lake Co., *C. C. Deam* 18088, Aug. 23, 1911; southwest of Mt. Vernon, Posey Co., *C. C. Deam* 56919, Oct. 7, 1935; northwest of Mt. Summit, Henry Co., *J. L. Kirling* 4069, Sept. 18, 1936. ILLINOIS: Willow Springs, *E. J. Hill*, July 16, 1890, Oct. 16, 1891, May 23, 1892; near Olney, Richland Co., *Robt. Ridgway* 1321, Oct. 8, 1920; Marion Township, Richland Co., *Robt. Ridgway* 3068, July 22, 1928; Simpson, Johnson Co., *E. J. Palmer* 16670, Oct. 3, 1919, 19580, Oct. 23, 1920; Peters Creek, Hardin Co., *E. J. Palmer* 15467, June 10, 1919, 17035, Oct. 12, 1919, 19590, Oct. 27, 1920. KENTUCKY: Bowling Green, *S. F. Price*, 1902. MISSOURI: Independence, Jackson Co., *B. F. Bush* 94, Nov. 6, 1894; Swope Park (Kansas City), *B. F. Bush* 10243, Nov. 6, 1923, *E. J. Palmer* 24377, Nov. 5, 1923; Greenwood (Jackson Co.), *B. F. Bush* 10331, 10331-a, Sept. 5, 1924, *E. J. Palmer* 26033, Sept. 5, 1924; Washington Co., *G. W. Letterman*, Aug., 1877; Hog Hollow, Jefferson Co., *J. H. Kellogg* 25980, June 14, 1932; Hannibal, Marion Co., *E. J. Palmer* 20393, Sept. 7, 1921; Arcadia, Iron Co., *E. J. Palmer* 30232, May 21, 1926; Mine La Motte, Madison Co., *E. J. Palmer* 31574, Sept. 6, 1926; Greenfield, Dade Co., *E. J. Palmer* 10573, Aug. 5, 1916; between Fairport and Maysville, DeKalb Co., *Palmer & Steyermark* 41389. Cultivated in the Arnold Arboretum and in other botanical gardens and parks in America and Europe.

- × *Quercus ludoviciana* Sargent (*Q. falcata* × *Phellos*), Trees and Shrubs 2: 222. 1913; Man. Trees N. Amer. ed. 2, 264. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

- × *Quercus falcata* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 94. 1898. Not Michaux. 1801.

- × *Quercus subfalcata* Trelease, Proc. Amer. Phil. Soc. 56: 52. 1917.

- × *Quercus ludoviciana* var. *subfalcata* Rehder, Jour. Arnold Arb. 7: 240. 1926.

The parentage of this hybrid was given in the original description as *Quercus pagodaefolia* × *Phellos*. But in later publications *Quercus pagodaefolia* was held by Sargent to be a variety of *Q. falcata*. If this disposition is correct, as in my opinion it is, only one inter-specific hybrid can be recognized. Rehder proposed, as cited above, to restrict the name to the cross between *Q. falcata* var. *pagodaefolia* and *Q. Phellos*. But an examination of a series of specimens does not show any satisfactory way of determining which variety of the southern red oak was involved in the type specimens or in other collections.

GEORGIA: Traders Hill, Charlton Co., *J. K. Small*, June 12–15, 1895. KENTUCKY: Wickliffe, Ballard Co., *E. J. Palmer* 16507, Sept. 20, 1919. MISSOURI: Campbell,

(Dunklin Co.), *B. F. Bush* 610-b, July 28, 1895. ARKANSAS: near Little Rock, *Geo. M. Merrill* 1413, Nov. 2, 1938; Piggott, Clay Co., *Delzie Demaree* 4154, April 11, 1927; Brinkley, Monroe Co., *Delzie Demaree* 10873, Aug. 30, 1934; banks of Little Missouri River, Pike Co., *Delzie Demaree* 9397, Sept. 29, 1932; near Conway, Faulkner Co., *Delzie Demaree* 10093, 10097, Nov. 4, 1932; McNab, Hempstead Co., *E. J. Palmer* 22466, April 25, 1923, 24013, Oct. 4, 1923, 29437, Oct. 28, 1925; Fulton, *B. F. Bush* 5693, March 23, 5833, June 11, 1909. MISSISSIPPI: Bay St. Louis, *R. S. Cocks*, Sept. 1923. LOUISIANA: Peterville, w. of Opeleusas, *C. S. Sargent*, April 4, Oct. 10, 1913 (TYPE); Lafayette, *Clair A. Brown* 9795, Aug. 30, 1943. ALABAMA: near Sardis, *R. S. Cocks* 814, July 30, 938, Sept. 17, 1915. TEXAS: Houston, *E. J. Palmer* 12754, Sept. 15, 12769, Sept. 16, 12774, Sept. 17, 1917. This hybrid has not proved hardy at the Arnold Arboretum.

(?) \times *Quercus ludoviciana* var. *microcarpa* (Dippel) Rehder, Jour. Arnold Arb. 7: 239. 1926.

Quercus Phellos microcarpa Dippel, Handb. Laubh. 108, fig. 49, 1892.

\times *Quercus subfalcata* var. *microcarpa* Sargent, Bot. Gaz. 65: 454. 1918.

Sargent's description of this ambiguous hybrid and the notes on it by Rehder under the name accepted here were based on trees cultivated in the Arnold Arboretum and obtained from the nurseries of Wezelburg and Sons, Hazerswaoude, Holland, in 1903, under the name of *Quercus chinensis microcarpa*. It appears to have been in cultivation in European gardens for many years under this name or as *Q. microcarpa*, *Q. robur microcarpa*, or *Q. Phellos microcarpa*. The origin of the plant is unknown and its relationship seems to be very doubtful. *Quercus Phellos* appears to be one of the parents, but there is little to suggest any known form of *Q. falcata*. The leaves are mostly linear-lanceolate or oblong-lanceolate in outline, of approximately the size and relative length and breadth of those of the willow-oak, but nearly all of them are toothed or lobed on the margins with sharp or obscure bristle-tipped projections. On some blades the lobes or teeth are symmetric and paired and on others they are very irregular. The young branchlets and the under surface of the young leaves are covered with a pale, easily detachable pubescence, but they become quite glabrous late in the season. The acorns are similar in shape to those of the willow-oak, but are smaller than the average for that tree. It is possible that the plant may have arisen as a cross between *Quercus incana* and *Q. Phellos*. But as the leaves in typical forms of both of these species are entire, it would not be expected that a hybrid between them would have toothed or lobed leaves. It may also be noted that *Quercus incana* has not been successfully grown at the Arnold Arboretum, but the hybrid appears to be perfectly hardy, as is also the willow-oak. While it seems to me to be quite unlikely that this supposed hybrid originated from a cross in which any form of *Quercus falcata* was involved, it is perhaps best in the absence of any positive evidence to leave it under its present name. The trees in the Arboretum often produce good crops of acorns, and it is possible that if a series of seedlings was grown from them, some significant results might be obtained.

\times *Quercus macnabiana* Sudworth (*Q. Durandii* \times *stellata*), Check List Forest Trees U. S. 103. 1927.

Quercus Durandii \times *stellata* Palmer, Jour. Arnold Arb. 4: 21. 1923.

Quercus Mahloni Palmer (as *Q. breviloba* × *stellata*), Jour. Arnold Arb. 18: 139. (correction p. 361). 1937.

Two trees of × *Q. macnabiana* were found growing with the supposed parent species; and a series of specimens with young and mature leaves, flowers, and fruit clearly indicates the parentage. The name × *Quercus Mahloni* was proposed for a hybrid between the shrubby variety of *Q. Durandii* and *Q. stellata*, collected in the Arbuckle Mountains, Oklahoma, by George Mahlon Merrill. The typical variety of *Quercus Durandii* is not found in the region, and there can be no doubt that one of the parents was *Q. Durandii* var. *breviloba* (Sarg.) Palmer. But there are no clear characters except the shrubby habit and smaller size of the leaves to distinguish it from × *Quercus macnabiana*, and it may consistently be placed under the earlier name.

ARKANSAS: McNab, Hempstead Co., *E. J. Palmer* 8965, Oct. 10, 1915, 12659, 12662, Sept. 6, 1917, 20645, Sept. 26, 1921, 20715, April 6, 1922, 29442, Oct. 28, 1925. OKLAHOMA: Platt National Park, Murray Co., *G. M. Merrill* 1634, Oct. 28, 1935. TEXAS: Strawn, Paolo Pinto Co., *E. J. Palmer* 14267, June 27, 1918; Brownwood, Brown Co., *E. J. Palmer* 29501, Nov. 1, 1925.

× *Quercus Mellichampi* Trelease (*Q. laevis* × *laurifolia*), Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Bot. Gaz. 65: 451. 1918; Man. Trees N. Amer. ed 2, 254. 1922.

Quercus Catesbaei × *laurifolia* Engelmann, Trans. Acad. Sci. St. Louis 3: 539. 1877.

The leaves in this hybrid are extremely variable and often eccentrically lobed.

SOUTH CAROLINA: Bluffton, *J. H. Mellichamp*, April 13 and Nov. 19, 1895, *C. S. Sargent*, Oct. 4, 1894; Port Royal, *T. G. Harbison* 15, Dec. 8, 1917. FLORIDA: Jacksonville, *T. G. Harbison* 28, Dec. 3, 1917, *A. D. Jackson*, Dec., 1923; Eustis, *T. G. Harbison* 12, June 22, 1919; San Mateo, *T. G. Harbison* 35, Dec. 6, 1917; near Gainesville, *W. A. Murrill*, Jan. 22, 1940; Orlando, *C. H. Baker* 2, April 5, 1915; Plymouth, *T. G. Harbison* 23, 24, Nov. 26, 1916; Zellwood, *T. G. Harbison* 25, 26, 27, 28, 29, Nov. 26, 1916; 2, Dec. 4, 1917.

× *Quercus Morehus* Kellogg (*Q. Kelloggii* × *Wislezni*), Proc. Calif. Acad. Sci. 2: 36. 1863. — Greene, W. Amer. Oaks 3, 47, 49, pl. 2. 1889. — Sargent, Silva 8: 120, pl. 407. 1895; Man. Trees. N. Amer. ed. 2, 271. 1922.

× *Quercus moreha* Trelease, Proc. Amer. Phil. Soc. 56: 50. 1917.

CALIFORNIA: Newcastle (Placer Co.), *T. S. Brandegee*, Sept., 1886, July 5 and 21, 1889, *Alice Eastwood*, Sept. 9, 1894, 142, Sept. 12, 1894; Auburn, *Engelmann & Sargent*, Oct. 10, 1880, *Mary E. P. Ames*, Feb. 1894; San Bruno Hills, San Mateo Co., *G. Ward*, April 12, 1941; Mt. Tamalpas (Marin Co.) *A. Eastwood* 139, 140, Sept. 15, 1894, *Rimo Bacigalupi*, Nov. 12, 1922; Sausalito (Marin Co.), *A. Eastwood* 141, Sept. 15, 1894, 278, June 9, 1912, April, 1920, April 1, 1921, *Lewis S. Rose* 33072, April 12, 1933; Clinton, Amador Co., *Geo. Hansen* 916, April 29, 1892, Sept. 15, 1895; Middle Fork, Amador Co., *Geo. Hansen* 1197, April 27, 1892, 1231, Aug. 17, 1895; Pine Grove, Amador Co., *Geo. Hansen* 914, April 2, 1894, Irishtown, Amador Co., *Geo. Hansen* 915, Aug. 12, 1895; Hetch Hetchy Valley, Toulumne Co., *C. M. Belshaw* 25, Aug. 2, 1935; between Auburn and Folsom, Sacramento Co., *C. B. Wolf & B. D. Stark* 5485, Sept. 24, 1933, *C. B. Wolf* 8341, March 30, 1937; west of Laytonville, Mendocino Co., *Joseph P. Tracy* 15198, Oct. 11, 1936; Ukiah, Mendocino Co., *Alice Eastwood* 3279, June 13, 1913; between Oathill and Mt. Sanhedrin, Lake Co., *Alice Eastwood* 12951, May 25, 1925; 12 miles north of Sacramento, *Wm. Vortriede*, Oct., 1927; Doane Valley, Palomar Mt., San Diego Co., *C. H. Muller* 4026, Aug. 9, 1941; summit of Palomar Mt., *C. H. Muller* 4031, Aug. 9, 1941.

× *Quercus moultonensis* Ashe (*Q. Phellos* × *Shumardii*), *Rhodora* 24: 78. 1922.

The two species given as parents of this hybrid are often found growing together throughout their common range in the coastal plain and the lower Mississippi Valley. Ashe's description was based upon specimens from the Moulton Valley, of the Tennessee River in Lawrence Co., Tennessee. I have not seen the type material, but several specimens in the herbarium of the Arnold Arboretum appear to belong here.

VIRGINIA: Suffolk, *Alfred Rehder*, Aug. 21, 1908. ARKANSAS: Bayou Bartholomew, Jefferson Co., *Delzie Demaree* 13939, Oct. 11, 1936; Newport, Jackson Co., *Delzie Demaree* 20385, Aug. 26, 1939; Rowland, Pulaski Co., *Delzie Demaree* 8833, Oct. 30, 1931; Conway, Faulkner Co., *Delzie Demaree* 10086, Nov. 4, 1932.

× *Quercus mutabilis* Palmer & Steyermark (*Q. palustris* × *Shumardii*), *Ann. Mo. Bot. Gard.* 22: 521. 1935.

The description was based upon specimens from a single tree found growing with *Quercus palustris* and *Q. Shumardii* var. *Schneckii* in western Missouri, and the latter was given as one of the parents. However, as in other cases, it does not seem practicable to distinguish which particular variety of a species is involved in a hybrid. So the name should be considered applicable to hybrids between any varieties of the parent species. The leaves and the fruit resemble more closely those of *Quercus Shumardii* than of the other parent, but the bark and habit of the tree and the thin-shallow cups of the acorns indicate hybridization with *Q. palustris*. The leaves of some of the other specimens cited below have more resemblance to those of *Quercus palustris*.

MISSOURI: Monteith Junction, Bates Co., *E. J. Palmer* 26069 (TYPE), Sept. 10, 1924; Butler Co., *B. F. Bush* 3770, Oct. 19, 1905; Williamsville, Wayne Co., *E. J. Palmer* 19423, Oct. 9, 1920; Cole Camp, Benton Co., *E. J. Palmer* 26358, Oct. 1, 1924.

× *Quercus neopalmeri*¹ Sudworth (*Q. nigra* × *Shumardii*), *Check List Forest Trees U. S.* 92. 1927.

Quercus nigra × *Shumardii* Palmer, *Jour. Arnold Arb.* 4: 21. 1923.

The original specimen was without fruit, and several other sterile specimens have since been found in other places.

GEORGIA: Wilkes Co., *T. G. Harbison* 15, June 15, 1919; Folkston, *T. G. Harbison* 101, Nov. 26, 1919. FLORIDA: Oviedo, *T. G. Harbison* 11, May 28, 1917; Sumner, *T. G. Harbison* 30, June 16, 1917. ARKANSAS: McNab, Hempstead Co., *E. J. Palmer* 22301 (TYPE), Oct. 12, 1922. ALABAMA: Cullman, *T. G. Harbison* 12, Nov. 4, 1919.

× *Quercus Nessiana* hybr. nov. (*Q. bicolor* × *virginiana*).

Arbor foliis tarde deciduis obovatis 5-13-lobatis vel raro incomposite pauci-lobatis vel integris maturis subcoriaciis supra fere glabris infra dense tenuiter pubescentibus.

The hybrid between the swamp white oak and the live oak has not so far been found in the wild state. But the two species were crossed by the late Professor Helge Ness at the Experiment Station of the Texas Agricultural College, College Station, Texas.

¹ Arbor foliis ferme obovatis incomposite lobatis basi cuneatis maturis glabris venulorum axillis barbatis exceptis.

Writing about some of the hybrids in cultivation, Ness stated: "From artificial pollination made April 3, 1918, we have three specimens of *Q. platanoides* (male) and *Q. virginiana* (female) in the Arboretum of the Experiment Station. They were planted in 1920. One of them produced a few acorns in 1923. This year, 1926, all bore heavy crops of acorns, although no male flowers were produced. They are very uniform in character, strongly resembling *Q. platanoides*; the only difference being that the leaves are somewhat smaller, more persistent, firmer, and the crown more densely branched than in *Q. platanoides*."

A specimen sent to the Arnold Arboretum about 1923 consists of two young branches with well developed leaves, resembling those of *Quercus bicolor* in shape and with the other characters mentioned by Ness. Recently Dr. W. S. Flory, Jr. has sent us a series of specimens and photographs showing leaves and fruit. The prevailing type of leaves on the specimens numbered 1 and 3 by Flory is much the same as on the Ness specimen. On no. 2 the leaves are much more variable, relatively narrower, some of them being irregularly lobed or toothed, and a few have blades with entire margins. The lobes and teeth are mucronate tipped, and the under surface of the blades is covered with a dense fine pale stellate pubescence similar to that of *Quercus bicolor*. The peduncled acorns resemble those of *Quercus bicolor* but are smaller and with deeper, more turbinate cups.

× *Quercus organensis* Trelease (*Q. arizonica* × *grisea*), Proc. Amer. Phil. Soc. 56: 50. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924.

Quercus arizonica × *grisea* Wootton & Standley, Contrib. U. S. Nat. Herb. 19: 171. 1915.

A single tree growing with the supposed parent species and believed to be a hybrid between them was found at Van Patten's Camp in the Organ Mountains, according to Wootton and Standley. I have not seen the material.

(?) × *Quercus oviedoensis* Sargent (*Q. incana* × *myrtifolia*), Bot. Gaz. 65: 459. 1918; Man. Trees N. Amer. ed. 2, 266. 1922. — Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

The type specimen of this came from a large shrub found near Oviedo, Seminole Co., Fla., and said to be growing with the supposed parent species. Another specimen from the same locality was described as coming from a small tree. All of the material is sterile and its identity seems rather doubtful.

FLORIDA: Oviedo, T. G. Harbison 19, 20 (TYPE), May 29, 1917.

× *Quercus paleolithicola* Trelease (*Q. ellipsoidalis* × *velutina*), Proc. Amer. Phil. Soc. 56: 50, pl. 1. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924.

Forms of the black oak and of the jack oak approach each other in leaf and fruit characters and hybrids between them are somewhat obscure. The two species often grow in proximity and there is little doubt that they sometimes hybridize. The hybrids can generally be recognized by intermediate characters in the leaves and fruit. The young leaves, branchlets

and winter-buds are more pubescent than in *Quercus ellipsoidalis*, and the cups of the acorns are usually turbinate but with rather loose, pubescent scales.

WISCONSIN: Lake Geneva, C. S. Sargent, April 19, 1916; Sugar Loaf, Columbia Co., Huron H. Smith 8067, Aug. 5, 1922. INDIANA: southwest of Vistula, Elkhart Co., C. C. Deam 61589, Oct. 2, 1941, Ralph M. Kriebel 10048, Oct. 4, 1942; northwest of Shipshewana, Lagrange Co., Ralph M. Kriebel 10044, Oct. 4, 1942. IOWA: Fayette Co., Bruce Fink, 1893; Eldora, L. H. Pammel, Aug. 19, 1930.

× *Quercus pastorensis* C. H. Muller (*Q. clivicola* × *glaucophylla*), Jour. Arnold Arb. 17: 164. 1936.

MEXICO: Puerto de Pastores, southeast of Galena, Sierra Madre Oriental, C. H. & M. T. Muller, 1000, 1005, July 5, 1934, 1296 (TYPE), 1297, Aug. 2, 1934.

× *Quercus podophylla* Trelease (*Q. incana* × *velutina*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 243. 1922.

× *Quercus petiolaris* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 90. 1894. Not. *Q. petiolaris* Benth, 1840.

Ashe gave the parentage of × *Quercus petiolaris* as *Q. cinerea* × *Q. tinctoria*? But his rather detailed description seems to substantiate the suggested parentage. It was stated that five or six trees were seen, the bark of all of them having the general aspect of *cinerea* (*incana*). The locality was not given, but, presumably, they were found in North Carolina. I have not seen any material of this hybrid.

(?) × *QUERCUS PSEUDOMARGARETTA* Trelease, Mem. Nat. Acad. Sci. 20: 16. 1924.

The parentage given by Trelease was *Quercus Margaretta* × *stellata*. The former was regarded by him as a distinct species and not as a variety of *Q. stellata* as held by Sargent and as here considered. Whatever view is taken of this, the two suggested parents approach each other so closely in leaf and fruit characters — especially in forms found in the western part of the coastal plain — that a hybrid between them would be very obscure and difficult to detect. I have not seen the type specimen (*Fisher 5116*, Houston, Tex.), but Trelease stated that it closely resembled *Margaretta*, and from his brief description and from what I have seen of the post-oak in the part of the country from which it came, I think it is probably identical with *Quercus stellata* var. *araniosa* Sargent.

× *Quercus Rehderi* Trelease (*Q. ilicifolia* × *velutina*), Proc. Amer. Phil. Soc. 56: 51. 1917; Trans. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees. N. Amer. ed. 2, 255. 1922.

Quercus ilicifolia × *velutina* Rehder, Rhodora 3: 133, pl. 24, fig. 1-2. 1903.

This hybrid seems to be comparatively frequent where the bear-oak and the black oak grow together. The leaves of the two species are quite different from each other in character and in the hybrids they are obviously intermediate. Most of the specimens observed in the field are shrubby, although sometimes stouter and more tree-like than is usual in *Quercus ilicifolia*.

MASSACHUSETTS: Blue Hills, near Boston, A. Rehder, Sept. 18 & 22, 1900, March 13, 1901; South Blue Hill Ave., near Boston, E. J. Palmer 20190, 20192, June 17, 1921; near Boston, Rufus N. Carr, Oct. 19, 1927; Norwood, J. G. Jack, June 25,

1904; Lynn Woods, *A. Rehder*, Oct. 3, 1903; West Peabody, *J. Robinson*, Sept. 12, 1880; Marthas Vinyard, *Sidney Harris*, May 30, 1901; Chilmark, Marthas Vinyard, *Sidney Harris*, May 30, June 12, 1902, Aug. 31, 1903. RHODE ISLAND: Slatersville, Providence Co., *E. J. Palmer* 43296, July 17, 1927. PENNSYLVANIA: Reading, Berks Co., *E. J. Palmer* 36306, Sept. 11, 1929; near White Bear, Berks Co., *David Berkheimer* 4379, Sept. 26, 1943.

(?) \times *QUERCUS RICHTERI* Baenitz, Allg. Bot. Zeitschr. 9: 85. 1903.

This name was proposed for a supposed hybrid between *Quercus borealis* (*rubra*) and *Q. palustris* and was based on a tree growing in Scheitniger Park, Breslau, Silesia. Specimens from the type tree collected and distributed by Baenitz and others are in the herbarium of the Arnold Arboretum. Croizat (18) after studying the material concluded that there was nothing to distinguish it from *Quercus coccinea* Muenchh. And on the evidence, I am inclined to agree with him that \times *Quercus Richteri* should be considered a synonym of that species. Several specimens from native trees in different parts of the United States are also in the Arboretum herbarium that suggest hybrids between the red oak and the pin-oak, but since all of them seem to be slightly questionable and since the name proposed by Baenitz is invalid, it is perhaps best to leave them unnamed for the present.

\times *Quercus Robbinsii* Trelease (*Q. coccinea* \times *ilicifolia*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 16. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 248. 1922.

Quercus coccinea \times *ilicifolia* Gray, Man. Bot., ed. 5, 454. 1867. — Robbins ex Engelmann (as *ilicifolia* \times *coccinea*), Trans. Acad. Sci. St. Louis 3: 542. 1877.

Specimens of this hybrid may be difficult to distinguish from \times *Quercus Rehderi*. The leaves and branchlets are less pubescent and the cups of the acorns are deeper.

MASSACHUSETTS: Uxbridge, *J. W. Robbins* (without date), (G); North Easton, *J. S. Ames* 1912, Sept. 17, 1917; Framingham, *A. J. Eames*, Sept. 6, 1909 (G). PENNSYLVANIA: Wilkes Barre, Luzerne Co., *E. J. Palmer* 36289, Sept. 9, 1929.

\times *Quercus Rudkini* Britton (*Q. marilandica* \times *Phellos*), Bull. Torrey Bot. Club 9: 13, pl. 10-12, fig. 3-5. 1888. — Sargent, Silva 8: 181, pl. 437. 1895; Man. Trees N. Amer. ed. 2, 259. 1922. — Trelease, Mem. Nat. Acad. Sci. 22: 16. 1924.

\times *Quercus dubia* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 93. 1894.

Trees that appear to be hybrids between the black jack oak and the willow-oak have been found widely scattered through the common range of the two species. The foliage is extremely variable and ranges between the leaf types of the two species and with some eccentric forms. In describing \times *Quercus dubia*, Ashe expressed the opinion that it was a hybrid between *Quercus coccinea* and *Q. Phellos*, although he was in doubt about it. Sargent (53) considered it a synonym of \times *Q. atlantica* Ashe, which he held to be a cross between *Q. incana* and *Q. laurifolia*. An isotype in the herbarium of the Arnold Arboretum shows it to be an anomalous form with large entire, oblong-elliptic leaves, and it appears to me to be an extreme form of \times *Quercus Rudkini*.

NEW YORK: Tottenville, Staten Island, *Arthur Hollick* 4, 5, 15, Sept. 2, 1888. NEW JERSEY: Keyport, *W. T. Davis* 146, Nov. 13, 1910; Bennett, Cape May Co.,

Bayard Long 7947, Oct. 29, 1912. DELAWARE: Stanton, *J. P. Otis*, 1920. VIRGINIA: South Arlington, *E. S. Steele*, Aug. 8, 1899. NORTH CAROLINA: Falls of Yadkin River, Stanley Co., *J. K. Small*, Aug. 18, 1893; Blondin Co., *W. W. Ashe* 247, June and Nov., 1895; Raleigh, *W. W. Ashe*, March and Oct.; Chapel Hill, *T. G. Harbison* 25, May 30, 1919; Abbottsburg, Bladen Co., *T. G. Harbison* 11, 1916, Oct. 5, 1917, *J. S. Holmes*, May 9, 1918. SOUTH CAROLINA: Charleston, *T. G. Harbison* 30, May 1, 1917. GEORGIA: Wilkes Co., *T. G. Harbison* 48, June 15, 1919. FLORIDA: Gainesville, *T. G. Harbison* 46, June 17, 1917. ARKANSAS: Fulton, Hempstead Co., *B. F. Bush* 1093, Oct. 17, 1901, 5946, Oct. 5, 1909, *E. J. Palmer* 10504, July 17, 1916, 10580, Sept. 4, 1916, 22276, Oct. 12, 1922, 22465, April 25, 23999, Oct. 4, 1923. LOUISIANA: west of Bogalusa, Washington Parish, *Clair A. Brown* 7721, June 4, 1939; Chestnut, Natchitoches Parish, *E. J. Palmer* 9471, April 17, 1916. Cultivated at Arnold Arboretum, Brooklyn Botanic Garden, and University of North Carolina.

× *Quercus runcinata* (A. DC.) Engelm (Q. *borealis* × *imbricaria*), Oaks of U. S. 20. 1876 — Sargent, Man. Trees N. Amer. ed. 2, 243. 1922.

Quercus rubra β *runcinata* A. de Candolle, Prodr. 16(2): 60. 1864. — Gray, Man. Bot. ed. 5, 454. 1868.

Engelmann stated that he collected the type material of this in the bottomlands of the Mississippi River opposite St. Louis, growing with *rubra*, *imbricaria*, and *palustris*. He believed it to be a hybrid between the first two, and sent a specimen under the name × *Quercus runcinata* to A. de Candolle, who regarded it as merely a form of the red oak and so published a description under the combination shown above. Engelmann in his notes (24) in which he published the name × *Quercus runcinata* for the first time expressed himself as willing to defer to Candolle's opinion. However, there can be little doubt that Engelmann's plant and numerous later discoveries are really hybrids of the parentage he first suggested.

PENNSYLVANIA: Westmoreland Co., *Henry Chisman*, 1936; near Ambler, *James R. Gilpin*, Sept. 19, 1934. MARYLAND: Ammendale, *F. S. C.* —, Oct. 13, 1928. OHIO: near Akron, *Fred H. Gleny*, 1938; West Union, *Conrad Roth*, Oct., 1931; Columbus, *W. A. Kellerman* (without date). INDIANA: near Bedford, *Ralph M. Kriebel* 2767, 2768, Oct. 1934; near Oakland City, Gibson Co., *Ralph M. Kriebel*, 1939. ILLINOIS: near Sannon Bridge, Wayne Co., *Robt. Ridgway* 91, Oct. 21, 1914; near mouth of Turkey Creek, Richland Co., *Robt. Ridgway* 26, Aug. 12, 1917; 10 miles northeast of Olney, Richland Co., *Robt. Ridgway* 2687, Sept. 19, 1926; East St. Louis, *Geo. Engelmann*, Sept. 28, 1849; Tunnel Hill, Johnson Co., *E. J. Palmer* 19579, Oct. 23, 1920; Simpson, Johnson Co., *E. J. Palmer* 16666, Oct. 4, 1919. KENTUCKY: Sparta, *Donaldson*, 1935. MISSOURI: Allenton, St. Louis Co., *G. W. Letterman* 2, 1880, 3, July, 1878, 5, May 10, 1891, 6, Nov. 1, 1891, 36 (without date), Oct. 1890; near Independence, *B. F. Bush* 623, Sept. 16, 1894, 628, Oct. 14, 1895, 10347-a, Sept. 22, 1924; Hyde Park, Kansas City, *Kendall Laughlin*, Oct., 1935; Van Buren, Carter Co., *E. J. Palmer* 19497, Oct. 11, 1920. Cultivated in the Arnold Arboretum, Bronx Park, New York, and in other parks and gardens in the United States and Europe.

× *Quercus Sargentii* Rehder (Q. *montana* × *robur*), in Bailey Stand. Cyclop. Hort. 5: 2886. 1916; Mitt. Deutsch. Dendr. Ges. 1915(24): 215. 1916. — Sargent, Man. Trees N. Amer. ed. 2, 306. 1922.

This hybrid between the chestnut-oak and the English oak was discovered on the grounds of Professor C. S. Sargent, Holm Lea, Brookline, Mass. Large trees are now growing in the Arnold Arboretum grown from seeds

of the original tree planted in 1877. The seedlings, although differing from each other, retain the intermediate characters of the original hybrid.

× *Quercus Saulei* Schneider (*Q. alba* × *montana*), Ill. Handb. Laubh. 1: 203. 1904. — Sargent, Man. Trees N. Amer. ed. 2, 302. 1922.

Quercus alba × *Prinus* Engelm., Trans. Acad. Sci. St. Louis 3: 399. 1877. — Vasey, Bull. Torrey Bot. Club 10: 25, pl. 28–30. 1883. — Sargent, Silva 8: 18, pl. 361. 1895.

This seems to be one of the commonest hybrids among the white oaks, and it may be looked for wherever the two parent species are found growing together. The leaves are usually symmetric and are more uniform in type than is the case with most hybrids. The blades usually resemble those of the chestnut-oak in outline, but are more deeply incised with mostly simple ovate or oblong lobes rounded at the apex.

VERMONT: Monkton, C. G. Pringle, May 21, Sept. 29, 1879. MASSACHUSETTS: Jamaica Plain, C. E. Faxon, July 16, 1897, J. G. Jack, March 25, Sept. 21, 1914; Concord, H. A. Purdie, Aug. 1903; Middlesex Fells, H. J. Koehler, June, 1908. RHODE ISLAND: Providence, J. F. Collins, Oct. 2, 1892; Durfee Hill, near Chepachet, Providence Co., E. J. Palmer 44641, Aug. 20, 1938; near Diamond Hill, Providence Co., E. J. Palmer 46132, June 14, 1942, 47913, Aug. 11, 1946. NEW YORK: Fort Wadsworth, Staten Island, Leon Croizat, June 15, 1937; Alley Pond Park, New York, Leon Croizat, Sept. 15, 1936. PENNSYLVANIA: Roslyn, C. S. Sargent, Sept. 13, 1914, J. C. Swartley S-856, Sept. 1936; Rocky Mountain Run, Franklin Co., John C. Kase 17, 1935; near Hatboro, Charles C. Mann; Bedford Co., David Berkheimer 5417, Aug. 16, 1944. NEW JERSEY: Elwood, Isaac C. Martindale, Aug., 1877; near Newark, Hans J. Koehler, July, 1906; Sandsboro, C. S. Sargent, Aug. 22, 1916; Ocean Grove, J. K. Hayward, 1890. DISTRICT OF COLUMBIA: Washington, John Saul, May (and autumn), 1894, Geo. B. Vasey (without date); Woodley Park, L. F. Ward, Oct. 19, 1884. NORTH CAROLINA: Biltmore, ex Herb. Biltmore, no. 5723-b, May 10, Oct. 13, 1897; Highlands, T. G. Harbison 26, May 18, 1916, 38, Sept. 24, 1916. OHIO: Steece, F. W. Dean, July 13, 1921. KENTUCKY: Echols, Ohio Co., E. J. Palmer 22542, May 6, 23699, Sept. 13, 1923. ALABAMA: Valleyhead, T. G. Harbison 37, June 26, 1918. Cultivated in the Arnold Arboretum and in Franklin Park, Boston, Mass.

× *Quercus Schochiana*¹ Dieck (*Q. palustris* × *Phellos*), Nat. Arboretums Zoschen 1894–95. — Schoch. Mitt. Deutsch. Dendr. Ges. 1896, 9. — Rehder, Man. Cult. Trees and Shrubs ed. 2, 156. 1940.

Quercus palustris × *Phellos* Palmer, Jour. Arnold Arb. 2: 143. 1921.

This hybrid was first recognized in the park at Wörlitz, Germany, where it had appeared spontaneously. The name was first published without other description than citation of the supposed parents in a seed list by Dieck, and Schoch had a brief reference to it the following year, as cited above. It has been cultivated in several European gardens, but both the name and the hybrid plants that have lately been found native in several localities in the United States seem to have generally been overlooked by American botanists. Earlier specimens have in some cases been confused with × *Quercus heterophylla*. The leaves are quite variable, but usually resemble more closely those of the willow-oak in size and

¹ Arbor foliis lanceolatis vel oblongo-lanceolatis margine raro integris plerumque undulatis vel incomposite acute lobatis, junioribus infra pubescentibus mox glabris venularum axillis exceptis.

outline. The blades are mostly two to four times as long as wide, from narrowly lanceolate and entire to undulate or lobed with small asymmetric rounded or sharp bristle-tipped lobes, thinly pubescent beneath as they unfold, but soon becoming glabrous except for tufts of tomentum in the axils of the principal veins.

ILLINOIS: Cairo, Alexander Co., *E. J. Palmer* 14919, April 23, 1919, 15090, May 8, 1919, 16475, Sept. 18, 1919, 19551, Oct. 16, 1920, 29648, Nov. 16, 1925; Mounds, Pulaski Co., *E. J. Palmer* 14995, April 30, 1919; Mound City, Pulaski Co., *E. J. Palmer* 15102, May 11, 1919, 16635, Oct. 1, 1919; Olive Branch, Alexander Co. *E. J. Palmer* 15097, May 10, 1919; Brookport, Massac Co., *E. J. Palmer* 15339, June 2, 1919. KENTUCKY: Wickliff, Ballard Co., *E. J. Palmer* 15108, May 12, 1919, 16506, Sept. 20, 1919. ARKANSAS: Dover, Pope Co., *E. J. Palmer* 27096. Cultivated in the Arnold Arboretum and elsewhere in the U. S., Germany, and France.

× *Quercus Smallii* Trelease (*Q. georgiana* × *marilandica*), Proc. Amer. Phil. Soc. 56: 51. 1917; Mem. Nat. Acad. Sci. 20: 17. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 250. 1922.

Quercus georgiana × *nigra* (*marilandica*), Small, Bull. Torrey Bot. Club 22: 75, pl. 233. 1895.

The leaves of the specimens examined somewhat resemble those of *Quercus marilandica* in shape, but are of thinner texture. Small's figures show leaves of a variety of shapes, some of them deeply divided and suggestive of *Q. georgiana*.

GEORGIA: Stone Mountain, De Kalb Co., *J. K. Small*, Sept. 6–12, 1894; Little Stone Mountain, De Kalb Co., *J. K. Small*, Sept. 11, 1894.

× *Quercus stelloides* Palmer (*Q. prinoides* × *stellata*), Jour. Arnold Arb. 18: 139. 1937.

The leaves of the parent species are quite different from each other and the hybrid is well-marked in its intermediate characters. The plants are usually shrubby, from one to two meters tall, but rarely they become arborescent and up to four meters or more. The leaf patterns vary between those of the parent species, but usually they resemble more closely those of *Quercus stellata*, being obovate in outline, with 3–4 pairs of shallow rounded or pointed lateral lobes, simple or rarely enlarged and indented at the apex. At maturity they are green and nearly glabrous above and pale stellate-pubescent beneath.

MASSACHUSETTS: Yarmouth, *M. L. Fernald & Bayard Long* 9360, Sept. 19, 1913; Oak Bluffs, Marthas Vineyard, *E. J. Palmer* 45188, July 4, 1940. NEW JERSEY: Hampton Furnace, Burlington Co., *J. W. Adams* 4018, Sept. 16, 1937; Newtonville, *J. W. Adams* 4076, Sept. 24, 1937; Cape May, *C. F. Austin*, 1899 (G). MISSOURI: Greenwood (Jackson Co.), *B. F. Bush* 9744, Oct. 17, 1921, 10227-a, Oct. 3, 1923, 10330, Sept. 5, 1924, *E. J. Palmer* 26032, Sept. 5, 1924. KANSAS: Neodesha, Wilson Co., *E. J. Palmer* 21398, May 23, 1922, 22007 (TYPE), Sept. 18, 1922, 24372, Oct. 31, 1923. OKLAHOMA: Muskogee, *E. J. Palmer* 14285, June 30, 1918.

× *Quercus sterilis* Trelease¹ (*Q. marilandica* × *nigra*), Proc. Amer. Phil. Soc. 56: 51. 1917. — Sargent, Man. Trees N. Amer. ed. 2, 259. 1922.

Quercus aquatica (*nigra*) × *nigra* (*marilandica*) Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 92. 1894.

¹ Arbor foliis obovatis vel oblongo-obovatis integris vel ad apicem 3–5-lobatis mucronatis subsessilibus supra glabris infra aliquantum pubescentibus; venulis conspicuis. Fructus ovatus; cupula obconica squamis laxis puberulis.

Ashe's description of the tree and specimen on which the name was based was fairly adequate. Trelease in the American Oaks reduced it to synonymy under *Quercus arkansana* which he considered a hybrid of the same parentage. While the leaves of the hybrid and those of *Q. arkansana* are somewhat similar in shape in certain forms, the resemblance is superficial, those of the hybrid differing in their firmer texture and more prominent veins, in the sessile or nearly sessile base, and in the character of the pubescence. Careful study of *Quercus arkansana* in the field and in cultivation at the Arnold Arboretum leaves no room for doubt that it is a good species and not a hybrid.

NORTH CAROLINA: Bladen Co., *W. W. Ashe* 246, June 10, and Nov., 1898. GEORGIA: Climax, *T. G. Harbison* 12, Nov. 6, 1917. TEXAS: Fletcher, Hardin Co., *E. J. Palmer* 9556, April 25, 1916, 10677, Sept. 10, 1916, 12730, Sept. 13, 1917, 13103, March 17, 1918.

× *Quercus Sterretti* Trelease (*Q. lyrata* × *stellata*), Mem. Nat. Acad. Sci. 20: 17. 1924.

This hybrid may be recognized by the shape of the leaves, which are loosely stellate-pubescent beneath and with traces of pubescence at least along the midrib above at maturity. I have not seen the specimen on which the description was based (*W. D. Sterrett*, no. 6, July 28, 1917, Little Rock, Ark.). Presumably, it was sterile, as no mention was made of the fruit. But on the specimen cited below the immature fruit is peduncled and resembles that of the overcup oak.

ARKANSAS: between Brinkley and Wheatley, Monroe Co., *Delzie Demaree* 10883, Aug. 30, 1934.

× *Quercus subintegra* (Engelm.) Trelease (*Q. incana* × *falcata*), Proc. Amer. Phil. Soc. 56: 52. 1917; Mem. Nat. Acad. Sci. 20: 17. 1924. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus falcata var. *subintegra* Engelm., Trans. Acad. Sci. St. Louis 3: 542. 1877.

The original specimen of this hybrid was collected by J. H. Mellichamp near Bluffton, South Carolina, and sent to Engelm., who believed it to be a hybrid between *Quercus cinerea* (*incana*) and *Q. falcata*. It was first mentioned and described under the name *Q. falcato-cinerea* in the Oaks of the United States, a preprint of the Transactions of the Academy of Science of St. Louis for 1876, and in pages that were later "cancelled" by the author. Engelm. later decided that it was only a variety of *Quercus falcata*, but his first surmise seems to have been the correct one. I have not seen the type specimen, but several later collections listed below appear to belong with it.

GEORGIA: Lumber City, *T. G. Harbison* 5, May 30, 1917, 18, Nov. 10, 1917; Climax, *T. G. Harbison* 2, May 29, 1917; Decatur, *T. G. Harbison* 22, June 21, 1917; Traders Hill, *T. G. Harbison* 7, April 3, 1918. FLORIDA: Lake City, *T. G. Harbison* 22, June 23, 1917; Ocala, Marion Co., *E. J. Palmer* 38304, March 31, 1931. ALABAMA: Mobile, *T. G. Harbison* 4, Dec. 4, 1919.

× *Quercus sublaurifolia* Trelease¹ (*Q. incana* × *laurifolia*), Proc. Amer. Phil. Soc. 56: 52. 1917. — Sargent, Man. Trees N. Amer. ed. 2, 266. 1922.

Quercus cinerea × *laurifolia* Ashe, Jour. Elisha Mitchell Sci. Soc. 11: 89. 1894.

¹ Arbor minor foliis lanceolatis integris vel raro oblongo-obovatis inaequaliter lobatis apice mucronatis maturis subcoriaceis subtus pallidis pubescentibus.

No description or citation of specimens accompanied the publication of this name, but it was doubtless based on Ashe's collection and the publication referred to above, in which a good English description was given. In the American Oaks Trelease reduced it to synonymy under \times *Quercus atlantica*. See discussion under that name. A number of specimens that apparently represent this hybrid were found in the herbarium of the Arnold Arboretum under the name \times *Quercus dubia* Ashe, as interpreted by Sargent. Some of them are of doubtful relationship and can be distinguished from *Q. laurifolia* only by the presence of stellate pubescence on the mature leaves: others are possibly of a different hybrid origin.

SOUTH CAROLINA: Port Royal, *T. G. Harbison* 16, 17, Dec. 9, 1917; St. Helens Island, *T. G. Harbison* 1, 2, Oct. 27, 1917. GEORGIA: Lumber City, *T. G. Harbison* 5, 8, Dec. 15, 1917, 16, Dec. 16, 1917; Folkston, *T. G. Harbison* 26, May 15, 1918, 51, 53, May 16, 1918. FLORIDA: San Mateo, *T. G. Harbison* 1, 2, 13, May 26, 1917, 20, 22, 26, 27, 28, Dec. 12, 1917; Orlando, *T. G. Harbison* 20, 21, 25, Dec. 5, 1917, 38, Dec. 14, 1919; Plymouth, *T. G. Harbison* 35, Nov. 13, 1919. ALABAMA: Mt. Vernon, *T. G. Harbison* 11, Nov. 19, 1917.

\times *Quercus substellata* Trelease (*Q. bicolor* \times *stellata*), Mem. Nat. Acad. Sci. 20: 17. 1924.

I have not seen any material representing this hybrid. According to the description, it was based on a specimen collected by Percy Wilson, at Toms River, N. J., July, 1916.

\times *Quercus Townei* hybr. nov. (*Q. dumosa* \times *lobata*).

Arbor vel arbuscula ad 5–6 m. alta, ramulis gracilibus annotinis cinereo-
viridibus vel brunneis tomentosis lenticulis pallidis conspicuis. Folia per-
sistentia oblonga vel anguste obovata basi cuneata vel rotunda, margine
revoluto leviter vel profunde incisa lobis rotundis vel acutis mucronatis
subtus sparse stellato-pubescentia. Fructus annuus oblongo-ovatus; glans
2–3.5 cm. longa; cupula hemispherica squamis valde crassis pubescentibus.

Two trees supposed to be this hybrid were found by Mr. Stuart S. Towne, for whom it is named, near Pasadena, California, and a series of specimens with notes was sent by him to Professor C. S. Sargent. The notes stated that *Quercus dumosa* is abundant and extremely variable on the hills in the vicinity of the hybrid, but that *Q. lobata* is not known nearer than about four miles away. The leaves of the hybrid have more resemblance to those of *Quercus lobata* than to those of the other parent, but they are smaller, relatively narrower, and less deeply incised. The acorns are also somewhat intermediate between the two species, with the nut shorter and less pointed than that of *Quercus lobata*.

CALIFORNIA: near Pasadena along La Loma Road, *Stuart S. Towne* 1, 2, Sept. 23, 1918, (autumn), 1921, 1922.

\times *Quercus tridentata* (A. DC.) Engelmann (*Q. imbricaria* \times *marilandica*), Oaks of U. S. 18, 1876; Trans. Acad. Sci. St. Louis 3: 539. 1877. — Sargent, Man. Trees N. Amer. ed. 2, 268. 1922.

Engelmann stated that a single tree of this hybrid was found by him in the autumn of 1849, about six miles east of St. Louis, growing in company with the supposed parents. He remarked that the foliage and fruit

characters were such that the origin of the hybrid could scarcely be doubted, that the leaves were rather those of *imbricaria* with a touch of *nigra* (*marilandica*), and that the fruit was more like that of *nigra*. The hybrid is apparently an uncommon one, but specimens that probably belong with it have been found elsewhere within the common range of the parent species. A number of other specimens have been referred to it on account of their somewhat similar leaves with three-lobed apex, but in most cases they appear to belong with either \times *Quercus runcinata*, \times *Q. heterophylla* or \times *Q. Leana*.

ILLINOIS: Richland Co., *Robt. Ridgway* 90, Oct. 1914, 2810, May 28, 1927; Olney, *Robt. Ridgway*, Feb., 1917, *E. J. Palmer* 15584, June 24, 1919. MISSOURI: Cape Girardeau, *E. J. Palmer* 18012, June 22, 1920.

\times *Quercus vaga* Palmer & Steyermark (*Q. palustris* \times *velutina*), *Ann. Missouri Bot. Gard.* 22: 521. 1935.

Only a single tree of this hybrid is known, and it was found growing with the supposed parent species. The bark and habit resemble *Quercus palustris*, and the leaves are also of the *palustris* type and retain the characteristic tufts of tomentum in the axils of the veins. Traces of easily detached tomentum remain on the young branchlets and on the under surface of the leaves until mid-summer. The scales on the cups of the young acorns are loosely imbricated and pubescent, as in *Quercus velutina*.

MISSOURI: Maryville, *E. J. Palmer* 25421, June 13, 1924.

\times *QUERCUS VENULOSA* Ashe, *Jour. Elisha Mitchell Sci. Soc.* 41: 268. 1926.

This name was proposed by Ashe for what he believed to be a hybrid between *Quercus caput-rivuli* and *Q. cinerea* (*incana*). But the former has been reduced to a variety of *Quercus arkansana* (Ashe, *Jour. Elisha Mitchell Sci. Soc.* 40: 44. 1924). And Little (33) has pointed out that the name cannot be retained because it is a later homonym of a fossil species, and he prudently suggested that the supposed hybrid should receive further study before it is renamed. An isotype (*W. W. Ashe*, no. 217, Okaloosa Co., Fla., Nov., 1924) in the herbarium of the Arnold Arboretum shows mature leaves, branchlets, and winter-buds. There can be little doubt of its relationship with *Quercus arkansana* or its variety, but I think there might easily be a question as to the other parent species. There is little except the slightly narrower entire leaves to suggest *Quercus incana*, and it is possible that *Q. obtusa* may have been the other parent.

\times *Quercus Walteriana* Ashe (*Q. laevis* \times *nigra*), *Proc. Soc. Amer. Foresters* 11: 89. 1916. — Sargent, *Man. Trees N. Amer.* ed. 2, 254. 1922.

\times *Quercus sinuata* Engelm., *Trans. Acad. Sci. St. Louis* 3: 400. 1877. — Sargent, *Silva* 8: 144, pl. 418. 1895. Not. *Q. sinuata* Walt.?

In proposing this name Ashe called attention to the fact that Engelm., followed by Sargent, had referred this hybrid to *Quercus sinuata* Walt., which he believed to be the white oak later described by Small as *Quercus austrina*. However, from the brief description given by Walter it does not seem possible to determine the identity of *Q. sinuata*, although it was

probably a hybrid and could scarcely have been *Q. austrina*.¹ So it seems best under the circumstances to accept Ashe's name.

SOUTH CAROLINA: Bluffton, *J. H. Mellichamp*, 1884, May 2, 1890, June, 1894, *C. S. Sargent*, Oct. 4, 1894, *T. G. Harbison* 14, Aug. 29, 1916; Walhalla, *T. G. Harbison* 10, Oct. 11, 1917. GEORGIA: Lumber City, *T. G. Harbison* 17, Nov. 16, 1917. FLORIDA: Jacksonville, *T. G. Harbison* 18, Dec. 3, 1917.

× *Quercus Willdenowiana* (Dippel) Zabel (*Q. falcata* × *velutina*), in Beissner, Schelle and Zabel, *Laubh.-Ben.* 67. 1903. — Schneider, *Ill. Handb. Laubh.* 1: 171. 1897. — Sargent, *Man. Trees N. Amer.* ed. 2, 257. 1922.

Quercus tinctoria Willdenowiana Dippel, *Handb. Laubh.* 2: 122. 1922.

× *Quercus Sudworthi* Trelease, *Proc. Amer. Phil. Soc.* 56: 52. 1917.

This hybrid was described from plants cultivated in Europe, and I have not seen the original material. But plants that apparently belong with it have been found in several parts of the United States.

NORTH CAROLINA: Biltmore, ex Herb. Biltmore, no. 5723-d, Sept. 20, 1897. GEORGIA: Cornelia, *T. G. Harbison* 24, June 30, 1918, 46, Oct. 1, 1919. ARKANSAS: Ozark, *Albert Ruth* 96, Sept. 14, 1927.

In addition to the hybrids enumerated and discussed in this list several others are indicated by material in the herbarium of the Arnold Arboretum and other collections. Among these are *Quercus alba* × *lyrata*, *Q. bicolor* × *montana*, *Q. bicolor* × *robur*, *Q. borealis* × *ellipsoidalis*, *Q. borealis* × *marilandica*, *Q. coccinea* × *palustris*, *Q. Durandii* (*austrina*) × *lyrata*, *Q. Durandii* (*austrina*) × *virginiana*, *Q. falcata* × *marilandica*, *Q. falcata* × *nigra*, *Q. hypoleucoides* × *Shumardii* (*texana*), *Q. incana* × *Phellos*, *Q. laevis* × *nigra*, *Q. macrocarpa* × *robur*, *Q. Nuttallii* × *Shumardii*, and others. There is no doubt that most of the specimens are from plants of hybrid origin and in some cases they are more complete and convincing than the types of some of the hybrids that have already been named. But since most of the specimens are without fruit and in nearly all cases there may be room for doubt as to the identity of one of the parents, it seems best to wait for fuller material or for further field study before naming them.

The hybrid oaks afford an interesting field for investigation and the subject is one that is worthy of much more attention. The present paper purports to do little more than to review the subject and to bring together the information already available in a convenient form for study. Many questions of identity and in regard to the variability and the behavior of the different hybrids will not be cleared up until they are approached experimentally and with the aid of cytological study.

¹ See Palmer, *Amer. Midl. Nat.* 33: 518. 1945.

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