PAST AND PRESENT OAKS OF TURKEY. PART I*

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Dedicated to the foresters of Turkey.

A B S T R A C T

The 450 spp. of Quercus are restricted to diverse environments of the northern hemisphere. One of the ancient angiosperm genera, it was abundant during the Cretaceous associated with spp. of Magnoliaceae and Lauraceae. Tentatively, eighteen fossil taxa are recognized, mostly from the upper Miocene diatomite sediments along the Gürcü Valley some 90 miles north of Ankara. From western Anatolia, additional leaf remains were collected from open strip mines of lignite. Most coriaceous leaf impressions are of evergreen taxa with affinities to extant Caucasian, Himalayan and east asiatic spp. Presently Quercus is represented by 20 spp. in Turkey, most of which are deciduous trees of economic importance. Distributional maps indicate the geographical extent of these spp. Q.troyana and Q.pontica are very rare Tertiary relic spp. which merit protection from danger of extinction. Interspecific hybridization is common; 31 hybrids have been recognized. No attempt has been made to describe the hybrids of the fossil spp. although the magnitude of foliar and cupular variation suggests a high degree of hybridization.

My interest in the genus Quercus started in 1937 when I was a student of Kurt Krause, one of the collabor-

* This research was partly supported by the grant No. DEB 76-06883 from the National Science Foundation and partly by a Faculty Research Grant from Mills College, Oakland, California 94613.

ators of Adolf Engler. Amentiferae, so-called primitive angiosperms, were exemplified by the oaks and oak allies under the order Fagales. Since then, I have been collecting oaks during my botanical excursions as well as during my leisure trips in Turkey and elsewhere. My collections grew bigger and bigger and tempted me to study them for my doctoral dissertation at the University of California, Berkeley. Unfortunately, my specimens were shipped to a wrong address and it took me many years to locate them. Meanwhile as students of Herbert Mason at U.C. Berkeley, we questioned the primitive status of Amentiferae with simple flowers versus the complex flowers of the Ranalian groups. Most of us inclined to believe that the simplicity of the Amentiferae resulted from a series of abortions of the floral appendages and therefore, Amentiferae could not be primitive. In fact, we were pleased to note that the heterogenous group of Amentiferae occupied advanced levels in the monophyletic system of Charles Bessey. I postponed my studies of oaks and studied some of the members of Lauraceae instead.

Many years later, I discovered quite incidentally the Tertiary fossil beds of Gürcü Valley near Güven Village some 90 kilometers north of Ankara during a picnic outing. During my first excavations in 1968, I collected 125 specimens of impressions, mostly belonging to the oaks, maples, chestnuts, elms and Zelkova, Magnolias and Mahonias. Among these broad-leaved trees, Quercus was the most common element, represented by leaves, catkins, and cupule impressions. Glyptostrobus, Sequoia, Taxodium and five species of pines were the most common species of gymnosperms. When I showed the collections to the late Professor Ralph Chaney, he was most impressed with the redwoods, of couse, since they had never been reported from Asia Minor. Dr. Chaney identified the age of the Güven deposits as Upper Miocene while several other colleagues in Paleobotany and Geology suggested the Pliocene epoch. With the support of the National Science Foundation, I made three additional visits to the Gürcü (Georgian) Valley and with the collaboration of Daniel Axelrod and the paleontologists of the Mineral Research and Exploration Institute of Turkey (M.T.A.), we collected more than a thousand specimens in 1975, 1976 and 1978. The duplicate or counterpart specimens were deposited at the Turkish Museum of Natural History M.T.A. in Ankara, but all the plant and animal impressions were loaned to me for identification. With the assistance of Professor Axelrod, we also selected rock samples of andesite, rhyolite and welded tuffs for absolute age determination through K/Ar isotopes in biotites contained in these rocks. The age of the fossil deposits in Gürcü Valley was 14.1 $\pm$ 1 million years, corresponding to the Upper Miocene. This ancient coniferous forest, rich in Arcto-Tertiary elements, occupied a mesophytic environment around a large fresh-water lake as evidenced by the abundance of frustules of pennate fresh-water diatoms, Cyprinid fish fossils, frogs, salamanders, mosquito larvae, Nematoceran flies, dragon flies, bees and beetles as well as by aquatic plants such as Salvinia, Egregia, cattails,etc.. Apparently, repeated volcanic activities took place around this fresh-water lake pouring lava and hot volcanic ash into the lake which I believe was a remnant of the Sea of Paratethys which consisted of brackish water. The rapid sedimentation of diatomaceous frustules associated with volcanic ash and the accumulation of fine silt through the streams flowing into the lake formed the laminated diatomites and paper shales which contain the fossil impressions. Unfortunately, most of the organic matter was decomposed and I had no compressions to study the foliar cuticles. From the sediments, we extracted a great variety of pollen grains, most of which belong to Quercus spp.. However the morphology of the pollen grains under the resolving power of the light microscope was not a useful tool for the species distinction. On the other hand, the foliar venations of the oaks were well preserved including the minor venations in many specimens. The extant species of the oaks of Turkey were the main tools of comparison with those of the Miocene oaks. With the generous help of the Turkish Forestry Service, I built up a sizable collection of the living oaks. Serveral leaves from each of the twenty living species were cleared in sodium hydroxide and Chloral hydrate solutions. After having been stained with safranin, these cleared leaves were mounted permanently in large-size glass plates. For the description of the foliar vasculations, I followed the standardized terminology outlined by Hickey and Dilcher. Some Miocene oaks of Turkey exhibit strong affinities to North American and Far Eastern taxa as I will point out in this paper. The cleared leaves of the American and Asian oaks were borrowed from the U.S. Geological Survey in Menlo Park through the courtesy of Jack Wolfe and from the slide collections of the U.C. Paleontology Department in Berkeley through the courtesies of Wayne Fry and Howard Schorn. The Miocene oaks of Turkey display an enormous variation with respect to the foliar, floral and cupular structures. Obviously, the Tertiary oaks exhibited an enormous amount of interspecific hybridization and introgression as is characteristic of the extant species of oaks. Although I could recognize the possible hybrid oaks among the extant species, it was impossible to make such an attempt for the Miocene oaks since not a single specimen was collected with leaves, buds, catkins, or fruits attached to a branch.

As we know now, the oaks are not as recent as we thought. *Quercus*, *Quercophyllum* and *Dryophyllum* were reported from the Early Cretaceous of the northern hemisphere. Approximately 135 million years ago, the oaks were widely distributed together with the several members of Magnoliaceae and Lauraceae. Unfortunately, we have no information concerning their occurrence in Asia Minor during the Cretaceous period. During Oligocene and Miocene, the oaks were widely distributed together with Tertiary relics such as *Metasequoia* and *Cercidiphyllum*. Some Cretaceous and Early Tertiary oaks were confused with the genus *Fagus* since the foliar remains resemble each other. *Quercus miopontica* reported in this paper is very similar to *Q.pontica* native to the mountains of N.E.Turkey and Abkhasia in Caucasus. *Q.pontica* in the high elevations of the Caucasian range (1400-2000 m.) and *Q.sadleriana* in northern California and southern Oregon (1300-2300m.) represent the most primitive taxa of the genus as pointed out earlier by Schwarz. In spite of a disjunct distribution, these two living taxa are very similar with regard to their habits, vegetative and reproductive structures, foliar venation and their epidermal ultrastructure; hence they deserve to be reduced to a single taxon.

I am very grateful indeed to my colleague Hicri Aksoy, former Undersecretary of the Turkish Ministry of Agriculture who collected excellent specimens of fossil oaks from the Güven locality and Gerçek Saraç, a paleontologist of the Mineral Research and Exploration Institute (M.T.S.) of Turkey for accompanying and helping me a great deal during my expeditions to Güven of Ankara and to the open lignite mines of western Anatolia.

I particularly wish to thank my colleague Ismail Karakan, former Chief of Turkish Forestry Service who provided a large collection of herbarium specimens of oaks collected from Turkey. These specimens will be deposited in the herbaria of the University of California, Davis and California Academy of Sciences in San Francisco upon the completion of this work. Since the Turkish Forestry Service in Ankara has a complete set of these collections, the surplus specimens will be distributed to the herbaria and other institutions or individuals upon the priorities of the written requests I receive. I would like to thank Dr. Robert Ornduff, Director of the Univ. Herbarium in Berkeley, Dr. Daniel Axelrod and Dr. John Tucker (Botany Dept., U.C.Davis), the staff members of the Botany Dept. of the California Academy of Sciences and the curators of the Paleobotanical collections at the Paleontology Dept. of U.C.Berkeley who kindly allowed me to use their collections and libraries for comparison and identification

of my specimens. The hand drawings were prepared by Anne Crocker, Elizabeth Fall, Anne Jones, Shannon Parr, Lee Ann Tegart and Angela van Patten, all former students of Mills College. Credit is given to every artist in the legends of the illustrations. The photographs of the fossil specimens and cleared leaves were taken by David Kasaplıgil with the assistance of Howard Schorn, by Margret Mukai and Robin Rickensrud. The microslides of the cleared leaves were prepared by Joan Amorogo, Margret Mukai and Ellora Ong. Several other students of mine such as Elizabeth Fall, Sylvia Hsi, Sue Kirkbride, Keli Ryan and Elizabeth Varnhagen were most helpful in preparing the specimens for this study and classifying the research material. My humble role in the course of this work was being the conductor of an orchestral team and assuming all responsibilities regarding the factual and speculative statements.

For the sake of convenience and simplicity, partly due to my own ignorance, the taxa included in this study are arranged alphabetically covering the extant and fossil species as well as the hybrid oaks of Turkey. However, the classical systems of classifications proposed by Camus and Schwarz are presented synoptically.

Last but not least, I would like to thank my friends Lita Clapper and Sylvia Hsi for a difficult task of typing the manuscript and Dr. Rimo Bacigalupi (Curator Emeritus of the Jepson Herbarium, U.C. Berkeley) for reading this introduction.

A KEY FOR THE IDENTIFICATION OF THE EXTANT SPECIES OF GENUS QUERCUS IN TURKEY

1. Acorns ripening within the first year
  2. Leaves are deciduous
    3. Leaf margins lobate
      4. Petiole is grooved and twigs are glabrous
        5. Peduncle long, usually longer than petiole
          6. Blades with 9-12 pairs of lobes 1/6 to 1/10 the breadth of the blade; no intercalary veins; petiole 10-20mm. ......1. *Q.hartwissiana*
          6. Blades with four to six pairs of lobes 1/3 to 1/5 the breadth of the blade; has intercalary veins; petiole 5-7mm. .2. *Q.robur*
        5. Peduncle short or absent
          7. Scales of cupule are pubescent and not tuberculate; intercalary veins are not present..3. *Q.petraea*
          7. Scales of cupule are glabrous and tuberculate; intercalary veins are present. ....4. *Q.polycarpa*
      4. Petiole is ungrooved and twigs are tomentose
        8. Has persistent stipules; petioles 2-6mm long. ....5. *Q.frainetto*
        8. Stipules not persistent
          9. Blades with 4-7 pairs of lateral veins; sinuses 1/3 to 1/5 the breadth of the lamina
            10. Petiole 15-25mm; broad obovate leaves up to 16cm. ...6. *Q.vulcanica*
            10. Petiole 5-12mm; leaves obovate-oblong, 4-10cm. ......7. *Q.pubescens*
          9. Blades with 7-12 pairs of lateral veins; sinuses 1/6 to 1/5 the breadth of the lamina. ...8. *Q.macranthera*
    3. Leaf margins entire or serrate
      11. Singly or doubly toothed serrate margins; leaves glabrous above, eliptic-obovate; 10-20 pairs of lateral veins. ....9. *Q.pontica*
    3. Leaf margins lobate or serrate or entire
      12. Shallowly lobed or serrate blades with entire margins at base; glabrous above, pubescent below

8-11 pairs of lateral veins. ....10.<u>Q.boissieri</u>
2.Leaves are semi-decidous
13.Entire at leaf base and lobed towards tip; leaves glabrous, 4-6cm; peduncle is short or sessile. ...11.<u>Q.infectoria</u>

1.Acorns ripening within the second year
14.Leaves are evergreen
15.Lower leaf surface is tomentose; leaf margins are entire or irregularly serrate
16.Leaves 1.5 to 3 cm in length, oblong-obovate; iregularly toothed. ....12.<u>Q.aucherii</u>
16.Leaves 3-7 cm in length, oblong -ovate to lanceolate. ....13.<u>Q.ilex</u>
15.Lower leaf surface is glabrous; leaf margins are undulated
17.Spinespoint toward tip of leaf; leaf margin not cartilagenous; cupule scales are recurved. ...14.<u>Q.calliprinos</u>
17.Spines spread outward; leaf margins are more or less cartilagenous; cupule scales are compact. ....15.<u>Q.coccifera</u>
14.Leaves are deciduous
18.Leaves variably lobate
19.Stipules are persistent; 4-7 pairs of lobes; petiole 8-15mm long. ....16.<u>Q.cerris</u>
18.Leaves simple with serrate margins
20.Leaves tomentose with short bristles on teeth. ....17.<u>Q.brantii</u>
20.Leaves glabrous
21.Long bristles on teeth; 7-12 pairs of acuminate teeth; leaves 5-10 cm in length. ..18.<u>Q.libani</u>
21.Short bristles; 8-14 pairs of subaristate teeth; leaves 3-7 cm in length. ....19.<u>Q.trojana</u>
14.Leaves are semi-deciduous
22.Leaves are tomentose beneath, oblong-ovate, 6-10 cm in length; margins have triangular aristate lobes. ....20.<u>Q.macrolepis</u>

A synoptic classification of the Turkish oaks according to the system of A. Camus (1936-38):

[Subgenus Cyclobalanopsis Schneider (cupular scales concrescent & concentric 77 spp. in East Asia (Malaysia) not reported from W. Asia, but some oaks from Turkey with concentric cupular scales]

Subgenus Euquercus Hickel et Camus

Section Cerris spach

subsect.: Cocciferae Schott. (Q. coccifera L., Q. calliprinos Webb., Q. aucherii Jaub. et Spach.)

subsect.: Macrolepides A. Camus (Q. libani Oliv., Q. aegilops ssp. brantii Lindl, Q. aeg. ssp. macrolepis ky., Q. aeg. ssp. vallonea ky., Q. trojana Jaub. et Spach)

subsect.: Eucerris Oersted (Q. cerris L.)

Section Mesobalanus A. Camus

subsect.: Ponticae A. Camus (Q. pontica Koch)

subsect.: Macrantherae A. Camus (Q. macranthera Fisch. et Mey.)

Section Lepidobalanus Endl. (= Subgenus Quercus)

subsect.: Ilex Liebmann-Oersted (Q. ilex L.)

subsect.: Galliferae (Spach) Gurke (Q. infectoria Oliv.)

subsect.: Hartwissianae A. Camus (Q. hartwissiana Steven)

subsect.: Sessiliflorae A. Camus (Q. sessilis Ehrh. = Q. petraea Liebl., Q. dschorochensis Koch, Q. pinnatiloba Koch, Q. iberica Steven, Q. lanuginosa Lam.)

subsect.: Pedunculatae A. Camus (Q. robur L. = Q. pedunculiflora Koch = Q. haas ky.)

[subsect.17: Sadlerianae Trelease (Represented by Q. sadleriana R. Br. in northern Calif. & S.W. Oregon, but closely related to Q. pontica Koch classified under Sect. Mesobalanus by A. Camus).]

[subsect.18: Prinoideae Trelease (Includes Q. prinus L. = Q. montana Willd., Q. muhlenbergii Engelm., Q. prinoides Willd. Related to subsect. 17 and both subsects. related to subsect. Ponticae under Section Mesobalanus]

The classification of the Turkish oaks in the subgeneric system proposed by O. Schwarz (1934, 1936-37, 1964).

Subgenus Quercus (= Lepidobalanus (Endl.) Oersted)
  Section Roburoides Schwarz
    subsect.: Castaneiformis Schwarz
      ser. Ponticae (Stef.) Schwarz (Q. pontica K. Koch)
      [ser. Sadlerianae Trel. (Q. sadleriana R. Br. in Calif.]
    subsect.: Roburiformis (Q. petraea (Mattuschka) Liebl., Q. p. ssp. iberica (Stev.) Krassiln., Q. polycarpa Schur., Q. dalechampii Asch. et Gr.)
  Section Robur Rchb. (Q. hartwissiana Stev., Q. robur L.)
  Section Dascia Kotschy (Q. macranthera Fisch. et Mey. = Q. syspirensis K. Koch, Q. frainetto Ten. = Q. conferta Kit., Q. vulcanica Boiss. et Heldr., Q. pubescens Willd.)
  Section Gallifera Spach (Q. boissieri Reut., Q. infectoria Oliv.
Subgenus Cerris (Spach) Oersted
  [Section Suber Spach (Q. Suber L. only under cultivation in Turkey)]
  Section Vallonea Schwarz (Q. brantii Lindl., Q. macrolepis Kotschy)
  Section Erythrobalanopsis Oerst. (Q. libani Oliv., Q. trojana Webb)
  Section Eucerris Oerst. (Q. cerris L.) [Q. castaneifolia C.A. Mey not recorded from Turkey, but present in Upper Miocene of Ankara]
Subgenus Sclerophyllodrys Schwarz
  Section Ilex (Endl.) Oerst. (Q. ilex L.)
  Section Coccifera spach (Q. calliprinos Webb., Q. coccifera L. Q. aucherii)
[Erythrobalanus (Oerst) Schwarz, with 175 spp. from North and Central America (Q. rubra L, Q. coccinea Muench, Q. palustris Muench. in cultivation only.]

The Hybrid oaks of Turkey (Based on the available collections examined and the hybrids reported by Bean, 1976, Camus, 1936-1954, Karamanğlu, 1976, Kasaplıgil, 1947, Kotschy, 1867, Menitsky, 1968, 1972; Rechinger, 1938; Schwarz, 1934, 1936-1937, 1964; Zohary 1961):

Q. x auzendi Gren. et Godr. (= Q.coccifera x Q.ilex) from S.France, introduced into cultivation in Europe. Possibly, the same as Q. x aucherii).

Q.boissieri x Q.pubescens
Sterile specimen from a denuded coppice. Erzincan Prov., Arapkir distr., Dutluca subdistr., alt. ca. 1300m. (Ahmet İpiçürük No. 5 and 34 Adıyaman, Taslıyazı, alt.850m. of Turkish Forestry Service); Hakkari Prov. Semdinli Distr., Alt. 1450m in pure stands, (Cavit Araz No. 3, Turkish Forestry Service) Malatya-Hekimhan, Akpinar Locality. (B. Kasapligil No. 5097 ex A.Tuncer, T.F.S.)

Q.brantii x Q.boissieri
[Fertile specimens growing in pure stands. South eastern Anatolia, Diyarbakır Province, Lice Distr., Hani Subdistr. Takyanos series, alt. ca. 950m. (Cavit Araz No. 8 Turkish Forestry Service)]

Q.brantii x Q.vulcanica
[Diyarbakır Prov.:Lice Distr., alt. 950m. (Cavit Araz, T.F.S.)]

Q.calliprinos x Q.coccifera
[B. Kasaplıgil,(a very common hybrid between the two closely related spp. in western and southern Asia Minor; Mersin, Kuzuncubelen (Kasaplıgil No. 5107 ex E.H. Bozakman)].

Q.cerris x Q.infectoria
[B. Kasaplıgil No. 5030, N. Anatolia, alt. 600m.]

Q.cerris x Q.libani
[Not to be confused with Q.x libanerris Boom from Netherlands. Maras Prov. : Akerdağ (E.K.Balls No. 994)].

Q.cerris x Q.pubescens ssp. anatolica
[Common in Anatolia (B.Kasaplıgil No. 4874, U.C.Davis No. 6515); Konya Prov.:Kadın Hanı, Yukdur Distr. (B. Kasaplıgil No. 4874)].

Q.frainetto x Q.brachyphylla
[=Q.conferta x Q.brachyphylla tomassinii, Schwarz, E. Thrace:Istrancadağ(Mattfeld No. 3549, 3933, 3937)]

Q.frainetto x Q.polycarpa
[=Q.conferta x dschorochensis,Shwarz, E. Thrace: Istrancadağ (Mattfeld No.3657)].

Q.frainetto x Q.pubescens
[=Q.conferta x Q.pubescens, Shwarz in vicinity of Istanbul: Beykoz(DinglerNo. 111), Üsküdar (Krause No. 3200); B. Kasaplıgil No. 3384, Zonguldak; Istanbul Prov: Çatalca, Durusu, (V.Yönelli No. 32); Zonguldak Prov.: Çaycuma, (M. G. No. 32); Çaycuma, Kilimli distr., (M.G. No. 33); E.Thrace: Istanbul, Çatalca, Durusu, alt. 160 m., (Vedad Yönelli No. 32).]

Q.frainetto x Q.vulcanica
Ankara Prov.: Çubuk distr., near Karagöl, alt. ca. 1500m., on the western slope of the dormant volcano,(S.Erik No. 479, Sept. 9, 1973.)

Q.hartwissiana x Q.petraea
[Sterile specimen from Trabzon Prov., southern slopes of Zigana Pass, Alt. ca. 2000m., (Kasaplıgil No. 5281, Sept. 8,1976)]

Q.hartwissiana x Q.petraea ssp.iberica
[Q.armeniaca x Q.iberica, Schwarz, N.Anatolia: Trabzon (Ky.No.385a); Trabzon: Zigana Pass, Southern Slopes, Alt. 2000m. (B. Kasaplıgil, 1976)].

Q.hartwissiana x Q.polycarpa
[=Q.armeniaca x Q.dschorochensis,Q.pseudodschorochensis, Q.sessiles var. dschorochensis, Schwarz, N.E. Anatolia:Gümüşane (Schnell in Ky.Rev. No.39)].

Q.infectoria x Q.boissieri
Sterile specimens from pure stands of denuded coppice. Eastern Anatolia :Adıyaman Prov., Taşlıyazı village, Harmandere Forest, Alt.850 m., Ahmet Ipiçürük No. 34 and 36 Turkish Forestry Service,Oct. 4, 1974.

Q.infectoria x Q.polycarpa
[Istanbul Prov.:Belgrad Forest (O.Schwarz in Rechinger)].

Q.infectoria x Q.pubescens
[Schwarz, B.Kasaplıgil, ex M.Posat No. 11, Kocaeli Prov.: İzmit; B.Kasaplıgil No.4875, Konya Prov.: Kadınhan; B.Kasaplıgil No.4733, İzmir Prov.: Bergama, Kapıkaya Village].

Q.infectoria x Q.robur
[İstanbul Prov.:Ortaköy and Beykoz along the Bosphorus (O.Schwarz in Rechinger)].

Quercus x libanerris Boom.
A cultivated hybrid between Q.libani and Q.cerris reported from Rotterdam, Netherlands

Q.libani x Q.brantii
Fertile specimens from a denuded coppice, associated with Fraxinus. Hakkâri Prov.: Üzümcü Village, Çimen Community forest, Zapsuyu series, alt. ca. 1200m. (Cavit Araz No. 8) Turkish Forestry Service,Bingöl, Ağaçeli Forest,Alt. ca. 1250 m.(Cavit Araz No. 9) Turkish Forestry Service.

Q.libani x Q.boissieri
(Kasaplıgil No. 5090, ex I.Bozakman, Konya Prov.: Akşehir, Dereli, alt. 500m.)

Q.macranthera x Q.pubescens
Sterile specimen from Hakkâri Prov., Şemdinli Distr., Alt. 1750m., Associated with Sorbus.(Cavit Araz No.6)

Q.macrolepis x Q.cerris
[=Q.aegilops x Q.cerris, Schwarz 1934, N.W. Anatolia: Erenköy, (Sintenis Nos. 1883

1196); Troy (Virchow).]

Q.petraea x Q.cerris
Sterile specimen from E. Thrace: Kırklareli Prov., Vize Distr., Kızılağaç village, Kiremithane series, Alt. 200m., exp.:East, in pure stands, 20m. high, Ø 30cm.

Q.petraea x Q.pubescens
[Ankara Province, Çubuk Distr., in the vicinity of Karagöl, alt. ca. 1550m. on the volcanic Western slopes, associate with Populus tremula. (S.Erik No. 480); Sinop Prov.: Ayancık, (M. Şahin No. 24); Istanbul. (Schwarz in Rechinger)].

Q.petraea x Q.robur
[=Q.rosacea Bechst., Kocaeli Prov.: Adapazarı, Uğurlu Village (M. Posat, Turkish Forestry Service No. 7)].

Q.polycarpa x Q.brachyphylla
[=Q.dschorochensis x brachyphylla tommasinii, Schwarz, E. Thrace: Istirancadağ(Mattfeld No. 3373, 3551)].

Q.polycarpa x Q.petraea ssp.iberica
[=Q.dschorochensis x iberica, Schwarz; Q.pubens Ky. in Sched., Q.pubescens var. pubens Wenzig, N. Anatolia: Giresun and Trabzon (Schnell in Ky. Rev. No. 37, 37a.)]

Q.polycarpa x Q.pubescens
[=Q.dshorochensis x pubescens, Schwarz, in vicinity of Istanbul:Tarabya, Bosphorus (Dingler No.99), Anadoluhisarı (Krause No. 2991), N.W. Anatolia: İnegöl (Dingler No. 818)].

Q.polycarpa x Q.robur
[=Q.dschorochensis x pedunculiflara ? , Schwarz, E. Thrace: Belgrad Forest in Istanbul (Mattfeld No. 3172)].

Quercus aucherii. Jaub et Spach, Ill. plant. or., I, p. 113, t. 58 (1842-1843). Syn.: Coccigera aucherii; Gandogar, Flora Europae, 21, p. 64 (1890).

Trees up to 14 m. high; trunk diameter up to 60 cm.; crown shape oval. Terminal buds oval, pubescent, 2-4 mm long and stipules deciduous. Leaf blade 4 cm long, 1-2 cm wide, upper surface pale green-grayish to green and subglabrous, lower side grayish and pubescent; shape: whole lamina symmetrical; apex obtuse, mucronate; base normal obtuse to rounded; margins entire or sinuate and irregularly toothed with both kinds of leaves sometimes occuring on the same tree; if serrate: apical side concave, basal side concave to somewhat widely acuminate; no glands on teeth; sinuses rounded; spacing regular; serration simple; ours, on upper part of lamina; cuspidate tip; outline oval-oblong=elliptical; texture coriaceous, petiole yellowish-brown, pubescent, 2-6 mm long and not grooved; midrib wavy; pedicel of fruit very short; fruit cylindrical, 3.5 cm long, 10-16 mm thick, purplish brown; cupule bell-shaped, covering 1/3 or 1/4 of acorn, cupular bracts triangular, appressed at base, free at tips, densely pubescent.

Venation: if margin entire, brochidodromous; if margin serrate, semicraspedodromous; primary vein stout, straight to slightly sinuous; secondary veins not parallel, directed towards teeth; moderate acute angle to wide acute toward base of lamina; angle of divergence 40-65 degrees; uniform; moderate width; if margin entire, curved abruptly (brochidodromous condition): if margin serrate: curved uniformly (craspedodromous condition); loop-forming branches mostly at right angles, rarely acute, seldom, composite intersecondaries present; secondary veins both opposite and alternate along midrib; tertiary veins: lower ones at right angle or subright, upper ones at right angle; percurrent: mostly forked, sometimes simple, sinuous, oblique; angle of tertiaries decrease towards apex, mostly alternate, often opposite; higher order of venation: the highest order of vein 5th degree; no excurrent branching, secondaries branch to form loops; quaternary veins at moderate width, random; ultimate marginal venation: fimbrial, of tertiary size; areoles: mostly rounded quadrangular and triangular shape, small; veinlets none or simple linear, sometimes curved, rarely branched once.

Distribution: Mainly southwestern Anatolia (see the map), associated with Pinus brutia, Juniperus and Ceratonia along the coastal regions.

Localities: B. Kasaplıgil I. Batat #5075, ex. Meyer and Peşmen, S.W. Turkey, Aydın Province, Akçakonak, along the road to Pirianne; Kenan Alpacar #9 Turkish Forestry Service, S.W. Turkey, Antalya Province, Finike District, Belen Village, altitude 600 m.; K. Alpacar #27

Turkish Forestry Service, S.W. Turkey, Antalya Province, Elmalı District, altitude 1350 m.; K. Alpacar #54 Turkish Forestry Service, S.W. Turkey, Antalya Province, Fenike District, Belen Village, altitude 550 m.; B. Kasaplıgil #5076, S.W. Turkey, Muğla Province, between Karaböğürtlen and Muğla.

Quercus aucherii may represent a hybrid species between Quercus ilex and Q. calliprinos since foliar characteristics are intermediate between these two evergreen species. However, the fruit and cupular characteristics are quite different from those of the possible parental species as seen in the illustrations at the end.

Quercus boissieri Reut. ex Boiss. Diagn. Ser. 1, 12, p. 119 (1853). syn: Q. infectoria ssp. boissieri (Boiss.) Gürke, Pl. Eur. 2, p. 69 (1897); Q. lusitanica ssp. orientalis DC., Prod. 16 (2):18-19 (1864); Q. infectoria Tchihatchef, Asie min. Bot. 2:18 (1864); Q. petioloris Boiss. Diagn. 1 (12):120 (1853); Q. tauricola Kotchy Die Eichen tab. 10 (1862); Q. inermis Kotchy in Unger and Kotschy, Cypern. 215 (1865); Q. pfaeffingeri Kotschy Die Eichen tab. 23 (1862); Q. boissieri spp. petiolaris (Boiss.) Schwz. Notizbl. Bot. Gart. 13:17 (1936); Q. araxina (Trautv.) Grossh. Fl. cauc. 2:23 (1930).

Deciduous trees up to 12 m in height with a diameter of 60 cm. Young twigs glabrescent; at maturity covered with white, solitary hairs. Terminal buds ovoid, brown, glabrous, bud scales oblong and stipules persistent. Leaf blade oblong-elliptical, size: 1.5-10 cm long and 1.5-4.3 cm wide, grayish green and glabrous above, yellowish green and puberulent below and microphyllous to mesophyllous; shape: whole lamina symmetrical, base mostly symmetrical; normal oblong to narrow obovate, sometimes narrow to wide; apex: acute to obtuse, apical lobe acute to obtuse; base mostly rounded, sometimes auriculate; margin: entire to widely crenate or serrate, 1/3-1/2 to apex; apical side of teeth straight, basal side convex; no glands on teeth apices; sinused rounded; spacing regular; simple venation; extent of serration variable; apex cuspidate. Petiole yellowish brown, 5-10 mm long and not grooved. Midrib straight. Fruits almost sessile, cups obovate or hemispherical, bracts appressed and prominently tuberculate, densely pubescent; acorns cylindrical-ovate, halfway enclosed within cupule, mucronate at apex, approximately 4 cm in length.

Venation: if margin entire of crenate-brochidodromous, if margin serrate-craspedodromous; primary vein; moderate to stout; straight, sometimes sinuous toward apex; secondary veins; if margin entire: wide acute to right angles; if margin not entire: narrow to moderate acute; upper secondaries more acute than lower secondaries; moderate width; if margin entire or crenate: curved abruptly, if margin serrate: straight; where loop-forming branches exist, joined at right to obtuse angles; rare, composite intersecondaries from midvein in serrate condition, frequent, simple intersecondaries in entire margin; secondary veins not parallel; directed toward teeth with an angle of divergence of 31-61 degrees; 6-12 pairs secondary veins either alternate or sub-opposite along midrib; tertiary veins from lower to right angles, upper ones at right angle; percurrent: mostly forked, sometimes simple straight; if margin entire: tertiaries close to parallel to midvein, if margin serrate: oblique, tertiary angle decreases upward; alternate; higher order of venation: the highest order -- 5th degree, sometimes 6th degree; no excurrent branching; quarternary veins--moderate, orthogonal; quinternary veins--moderate to thick, orthogonal to random; ultimate marginal venation fimbrial, or tertiary size; areoles: irregular, often quadrangular; small; veinlets usually linear to branched twice, often more than one veinlet per areole; sometimes none.

Distribution: Mainly S.E. Anatolia, but some in S.W. Anatolia as well as along the Mediterranean coasts of Southern Anatolia. Mostly in denuded coppices associated with Pinus brutia, Juniperus spp., Pistacia, Daphne, Sorbus, Platanus, Ulmus, Quercus calliprinos, Q. cerris, Q. libani, Acer hyrcanum, A. obtusifolium, Ostrya carpinifolia, Fraxinus ornus, Pyrus syriaca, Ostrya carpinifolia. Q. boissieri usually occupies semi arid and arid regions of the Middle East extending southward to Lebanon, Syria and Israel and from eastern Anatolia through northern Iraq, it reaches Transcaucosus and northern Iran. It also occurs in western Cyprus.

Localities: C. Araz #21 Turkish F.S., E. Turkey, Bingöl Province, Ağaceli Village, Yayladüzü Arş Forest, altitude 1250 m.; A. Ipiçürük #7 T.F.S., E. Turkey, Malatya Province, Arapkir District, Dutluca Subdistrict, altitude 1300 m.; A. Ipiçürük #31 T.F.S., E. Turkey, Malatya Province, Hekimhan District, Akpınar locality, altitude 1000 m.; C. Araz #5 T.F.S., S.E. Turkey, Diyarbakır Province, Lice District, Taykanus ruıns, altitude 850 m.; A. Gökşin #12, S. Turkey, Adana Province, Osmaniye District, altitude 800-900 m.; A. Ipiçürük #25 T.F.S., E. Turkey, Malatya Province, Pötürge District, Bozkır Village, altitude 1000 m; A. Ipiçürük #19 T.F.S., E. Turkey, Malatya Province, Doğanyol District, Gökçe Village, altitude 900 m.; C. Araz T.F.S. #18, E. Turkey, Bingöl Province, Uzundere Village, Beluzar Forest, altitude 1350 m.; A. Ipıçürük #35 T.F.S., E. Turkey, Adıyanam Province, Taşlıyazı Village, Haramidere Forest, altitude 850 m.; C. Araz #1 T.F.S.,

E. Turkey, Elaziğ Maden, altitude 900 m.; C. Araz #2 T.F.S., E. Turkey, Siirt Province, Şirnak District, Şenola Village, Sivridağ, altitude 1000 m.; C. Araz #5 T.F.S., S.E. Turkey, Bitlis Province, Narlıdere District, Bocan Village, Dedetan Series, altitude 900 m.; H. Peşmen- A. Güner #1924, S. Turkey, Isparta Province, Eğridir District, altitude 850-1200 m.; K. Alpacar #24 T.F.S., S.W. Turkey, Muğla Province, Köyceğiz District, Çayhisar Village, altitude 800 m.; K. Alpacar #23 T.F.S., S. Turkey, Antalya Province, Finike District, Aykırıçay, altitude 700 m.; K. Alpacar #21, T.F.S., S. Turkey, Antalya Province, Finike District, Belen Village, altitude 600 m.; K. Alpacar #22 T.F.S., S.W. Turkey, Muğla Province, Köyceğiz District, Gökbel Forest, altitude 270 m.; C. Araz #19 T.F.S., E. Turkey, Bingöl Province, Yumaklı Village, Genç Series, altitude 1130 m.; C. Araz #13 T.F.S., E. Turkey, Hakkâri Province, Beytüşşebap District, Beşağaç Village, altitude 1650 m.; C. Araz #3 T.F.S., E. Turkey, Diyarbakır Province, Kokulu Pınar locality, Hani District, altitude 900 m.; A. İpiçürük #2 T.F.S., E. Turkey, Erzincan Province, Ekrek Village, altitude 1400 m.; Peşmen #3354, E. Turkey, Bitlis Province, Tatvan District. K. Alpacar #53 T.F.S., S.W. Turkey, Finike District, Belen Village, altitude 600 m.; A. Gökşin #18a T.F.S., S. Turkey, Adana Province, Osmaniye District, Nurdağ, altitude 830-1000 m.; K. Alpacar #33 T.F.S., S. Turkey, Antalya Province, Akseki-Murt, Kabız Road, altitude 450 m.; K. Alpacar #32 T.F.S., S. Turkey, Antalya Province, Akseki District, Kuyucak Subdistrict, altitude 1150 m.; K. Alpacar #11 T.F.S., S.W. Turkey, Antalya Province, Finike District, Aykırıçay subdistrict, altitude 700 m.; C. Araz #3 T.F.S., E. Turkey, Elazığ Province, Maden District, altitude 1020 m.; C. Araz #4 T.F.S., E. Turkey, Siirt Province, Şırnak District, Kızılsu Series, altitude 750 m.; C. Araz #6 T.F.S., E. Turkey, Bitlis Province, Narlıdere District, Bocan Village, altitude 910 m.; A. İpiçürük #20 T.F.S., E. Turkey, Malatya Province, Doğanyol District, Gökçe Village, Memnundere Forest, altitude 900 m.; A. Ipiçürük #11 T.F.S., E. Turkey, Malatya Province, Övledik Geçidi District, on the slopes of Keban Gölü, altitude 1450 c.; B. Kasaplıgil #5091 S. Turkey, Adana Province, Kozan District, 18 km. from Buruk Village, altitude 300 m.; B. Kasaplıgil #5099, S. Turkey, Mersin Province, Camilli Village.

Quercus boissieri is related to *Q. infectoria* and *Q. pubescens*. The intermediate forms between these species are common. In fact, Camus (1937) and Menitski (1968,1971) consider *Q. boissieri* as a subspecies of *Q. infectoria*. It also hybridizes with *Q. brantii* producing fertile hybrids. Its wood is used mainly for fuel and charcoal production. Unfortunately, most of the coppices are in denuded condition due to overgrazing and human pressure. It is a hardy oak suitable for reforestation. Q. boissieri is a beautiful tree with grayish-green foliage suitable for landscaping. Although most of the naturally growing ones are in shrubby habits, they do have tremendous potentiality to reach enormous sizes under protection.

Quercus brantii Lindl., Bot. Reg. 26 suppl. 41 (1840). Syn: Q. persica Jaub. et Spach. Pl. Or. 3,1: tab. 55 (1842-1843); Q. brantii ssp. persica Jaub. et Spach. O. Schwarz, Notizbl. Bot. Gart. Berlin 13, 116:19 (1936); Q. baneica Djavanchir. Les chenes de l'Iran 123 (1967); Q. globularis Djav. Les chenes de l'Iran 127 (1967); Q. saii Dajv. ibid 143 (1967); Q. ungeri Djav. ibid 151 (1862); Q. aegilops ssp. brantii Lindl. 1936-38. A. Camus Monogr. du Gen. Quercus 1:544 (1934).

Deciduous tree up to 15 m high. Twigs densely tomentose; greenish brown. Buds ovoid, 3-8 mm long, pubescent, scales ovoid and stipules persistent. Leaf blade ovate or oblong-elliptical, 2.9-11.4 cm in length, 1.6-6.8 cm wide, upper surface dark green, lower surface gray green, both sides densely tomentose, whole lamina symmetrical, base symmetrical to slightly asymmetrical; from-narrow elliptic to mostly wide elliptic; apex acute to obtuse, mucronate; base cordate to sub-auriculate. Margins serrate, apical sides of teeth concave; basal side widely acuminate, sometimes spiny; without glands on teeth; sinuses rounded; spacing regular; simple serration; sometimes margins deeply lobed or entire towards base; apex sinuate; base rounded or somewhat auriculate. Petiole yellow, 0.7-2.8 cm long, pubescent and not grooved. Midrib straight, rarely wavy; number of lateral corresponds to number of lobes, usually 8-11 pairs; intercalary veins faintly visible. Cupules hemispherical or conical, with triangular or filiform scales spreading or recurved (Figs. A and C); acorns, 3-5 cm long, 12-22 mm thick, 1/3 of basal portion enclosed within cupules. Apex of fruit flat or convex with mucronate tips.

Venation: craspedodromous; primary vein: moderate width; straight to curved; secondary veins: narrow acute to wide acute (moderate acute at middle area); upper secondaries slightly more acute than lower secondaries; more or less straight, sometimes uniformly curved; no loop-forming branches; no intersecondaries off of the midvein, but rarely branching from a secondary to join a tertiary from an opposite secondary; tertiary veins: if blades narrowly elliptic in shape lower ones at right angles, if widely elliptic: lower ones at wider angles; percurrent: mostly forked, sometimes simple sinuous; oblique, angle of tertiaries decreases in upper leaf area, but otherwise generally remains uniform; alternate and opposite; the highest order of venation ,5th degree; no excurrent branching, intersecondaries from secondaries may join tertiaries; quarternary veins at moderate width, orthogonal; quinternary veins thin, mostly orthogonal, but often reticulate; ultimate marginal venation fimbrial, of tertiary size; areoles: mostly quadrangular, often irregular; medium; veinlets mostly simple, often with more than one veinlet in each areole, often branched once.

Distribution: Mainly in Southeastern Anatolia (see figure 4.).

Localities: C. Araz #9 T.F.S.,S.E. Turkey, Diyarbakır Province, Eğil Subdistrict, Boyalı Village, altitude 850 m.; C. Araz #10 T.F.S., S.E. Turkey, Mardin Province, Mazıdağ District, Daşot Village, altitude 1050 m.; C. Araz #13, S.E. Turkey, Diyarbakır Province, Dakyanus Hanı District, 60 km. north of Diyarbakır, altitude 950 m.; A. İpiçürük #48 T.F.S., S.E. Turkey, Fıstıközü Village, Halfeti, Öleturdu, denuded coppice, altitude 800 m.; C. Araz #3, T.F.S., E. Turkey, Siirt Province, Şirnak District, Kızılsu Forest, altitude 750 m.; C. Araz #7 T.F.S., S.E. Turkey, Diyarbakır Province, Çınar District, Sipyak Village, Bölçınar Forest, altitude 850 m.; C. Araz #4 T.F.S., S.E. Turkey, Bitlis Province, Narlıdere District, Bocal Village altitude 900 m.; C. Araz #2 T.F.S., E. Turkey, Mardin Province, Idil subdistrict, altitude 750 m.; C. Araz #2 T.F.S., E. Turkey, Mardin Province, Midyot District, Yolağzı Forest, altitude 1000 m.; C. Araz #6 T.F.S., S.E. Turkey, Diyarbakır Province, Çüngüş subdistrict, Çermik Forest, altitude 900 m.; C. Araz #4 T.F.S., E. Turkey, Diyarbakır Province, Kokulu Pınar Hanı subdistrict, altitude 960 m.; C. Araz #8 T.F.S., E. Turkey, Bingöl Province, Ağaçeli District, Arş Forest, altitude 1250 m.;.

This species is related to Q. macrolepis in western Anatolia and Q. ithaburensis in Syria, Israel and Jordan. It hybridizes with several other species such as Q. libani, Q. boissieri, Q. vulcanica; these hybrids are described under a separate heading. Q. brantii extends eastward through the mountain steppes of eastern Turkey to the Kurdish mountains of Iraq to southwestern Iran forming denuded coppices between the elevations of 700-1800 m. It is usually mixed with the typical elements of the Irano-Turanian steppes. Commonly, it is associated with trees and shrubs such as Pistacia spp., Olea, Ulmus, Amygdalus, Crataegus, Pyrus, Amelanchier, Celtis tournefortii, Berberis, Paliurus spina-christi, Juniperus oxycedrus, Sorbus and Fraxinus spp. The most common oaks associated with Q. brantii are Q. boissieri and Q. libani forming savannah-like, denuded forests with loosely scattered small trees. Most of my specimens are collected from small trees 4-8 m. high and their diameters at breast height ranging from 6 to 35 cm. This polymorphic species has many subspecies and varieties which are beyond the scope of this paper, but the interested readers are referred to Zohary's (1961,1973) and Djavaros' (1967) publications.

The wood of Q. brantii is widely used for fuel and charcoal production. Under human and grazing pressures, most of the mixed-broadleaved deciduous forests of Q. brantii are highly denuded. Occasionally, mightly specimens are found in cemeteries by the grave-yards of the notables and "holy individuals". This is a hardy and drought tolerant oak with beautiful foliage and crown on a stout bole. Indeed, it is a valuable tree which deserves attention in landscaping of arid and semi-arid lands. As far as I know, there are no cultivated specimens of this oak in the Mediterranean region, nor in California. Unfortunately, there is not enough information in literature regarding its sylvies, seed germination and ecological requirements. It certainly deserves botanical as well as horticultural research for furthering our knowledge about this oak.

Quercus calliprinos Webb. Iter. Hisp.:15 (1838). Syn. Q. pseudococcifera Labill. Icon. Pl. Syr. Rar. 5:9, Pl. 6; Q. fenzlii Ky. Eichen Eur. u. des Orients p. 73-74, pl. 24 (1862); Q. palaestina Ky. ibid, p. 58-59, Pl. 19 (1862); Q. coccifera var. calliprinos (Webb) Menits. Gence Quercus L. Nov. Syst. Akad. Nauk, USSR, 9:136 (1972).

Small trees up to 8 m. high; some larger specimens reaching 1 m. in diameter. Twigs brown and puberulent. Terminal buds single or clustered, round-ovate, brown, 1-4 mm. long, more or less tomentose, scale shape ovate and stipules deciduous. Leaf blade 1.5-5 cm. long, microphyllous, 0.9-2.5 cm. wide, upper surface yellowish green, more golden below, both sides glabrous, outline mostly oblong to lanceolate, rarely ovate, margins not cartilaginous, dentate with sharp teeth oriented towards the apex, base frequently oblique, apex cuspidate; whole lamina, symmetrical, base cordate and sometimes rounded. Margins-entire or serrate. If serrate: apical side concave to straight; basal side concave to straight; glands, rounded, sometimes blunt on basal area; sinuses rounded; spacing regular; serration simple; on complete margin. Petiole golden, pubescent, 2-4 mm. long and not grooved. Midrib generally straight. Cupules greenish brown, involucral bracts 4-10 mm. long, oblong-linear, appressed at base only, variably curved, but not spiny at tips; acorns dark brown, roundish-oblong, rarely pubescent, 1-1.3 cm. long, 1.2-1.6 cm. thick, mucronate at apex.

Venation: if margin entire-brochidodromous, if margin serrate-semi-craspedodromous, each secondary which enters a tooth arises independently from the midvein and is not a result of secondary branching (compare with Q. coccifera); primary vein: moderate to stout; straight to curved, sometimes zig-zag; secondary veins sometimes parallel, often branching further; veins terminating at teeth; 6-9 pairs; secondary veins opposite or alternate along the midrib; divergence moderate acute to wide acute or at right angles; upper secondaries more acute than lower ones; thin to moderately thick; subsinuous to sometimes recurved at lamina base; loop-forming branches join mostly at right angles, sometimes acute; rarely composite intercalary veins present; tertiary veins: at lower right angles, upper ones at right angles; percurrent: mostly forked, rarely simple sinuous; running longitudinally at basal lamina area or oblique, tertiaries at decreasing angles upward direction; mostly alternate, often opposite; higher order of venation: the highest order--5th degree; no excurrent branching, secondaries branch to form loops; quarternary veins-thick, orthogonal; quinternary veins-moderate, random; ultimate marginal venation-fimbrial, of secondary size; areoles: mostly rounded quadrangular or triangular shapes; small; veinlets-mostly none or simple linear or curved, sometimes branched once.

Localities: A. Gökşin #11 Turkish Forestry Service, S. Turkey, Maraş Province, Andırın District, altitude 1075 m.; A. Gökşin #10 T.F.S., Andırın District, altitude 1075 m.; B. Kasaplıgil #4864, W. Turkey, İzmir Province, Alaşehir Forest District, in pure stands along foothills K. Alpacar #42 T.F.S., S. Turkey, Antalya Province, Akseki District, Akseki-Manavgat Road in the cemetery altitude 940 m.; A. Gökşin #18 T.F.S., S. Turkey, Adana Province, Osmaniye District, Nurdağ, altitude 830-1000 m.; K. Alpacar #1 T.F.S., S. Turkey, Antalya Province, Bük Research Forest, altitude 500 m.; K. Alpacar #7 T.F.S., S.W. Turkey, Marmaris, between Muğla and Marmaris, altitude 130 m.; K. Alpacar #6 T.F.S., S. Turkey, Antalya Province, Kaş District, Kalkan subdistrict, along the roadside between Kalkan and Fethiye, altitude 162 m.; B. Kasaplıgil #4870, S.W. Turkey, Aydın Province, Söke District, Kızılışık Village.

Quercus calliprinos is the predominant species of macchie occurring widely in the eastern sector of the Mediterranean basin. It is closely related to Q. coccifera. As a matter of fact, Boissier (1879), Schwarz (1934 & 1964) and Menitsky (1972) consider it as a variety or subspecies of Q. coccifera. On the other hand, DeCandolle (1864), Camus (1936-1938), Wenzig (1887) and Zohary (1961) recognize specific rank for it. Intermediate forms between Q. calliprinos and Q. coccifera are quite common in Asia Minor. However, the distinction between the two species are thoroughly investigated by Zohary (1961). Q. coccifera is primarily a small, shrubby, evergreen oak in the western section of the Mediterranean basin while Q. calliprinos often has arborescent habit, predominantly occurring in the eastern section of the Mediterranean basin. Under protection, they form sizeable trees 8-10 m. high with a stem diameter of 40-100 cm. Hybridization and introgression is noticeable especially in western and southwestern Anatolia where the distributional areas of both species overlap each other. Quercus calliprinos grows successfully especially in calcareous soils of southern Anatolia associated with Pinus brutia, Juniperus oxycedrus, Daphne oleoides, Styrax officinalis, Cistus, Pistacia, Platanus, Sorbus spp. and wild olives. In western Anatolia, it reaches an elevation of 1400 m., while along the Taurus mountain range it grows at the elevation of 1500 m. or even higher. The range of distribution in the south of Turkey extends to Lebanon and Jebel Duruz in Syria (Mouterde 1953, 1966), from Safad to Hebron in Israel (Zohary 1960), from Irbid to Salt and from Tafila to Shaubak and north of Wadi Musa in Jordan (Kasaplıgil 1956 a,b,c). Q. calliprinos is the most dominant shrub or small tree of the east Mediterranean macchie. The readers are referred to the publications of Zohary (1960, 1973) for the ecological and geobotanical relations of this species. Q. calliprinos is a highly polymorphic species with regard to its habit, morphology and to the great variety of edaphic and climatic habitats of its natural range. Zohary (1961) recognizes seven varieties in the Middle East which are distinguishable through their leaves, fruits and cupules.

Q. calliprinos is a hardy species, cultivated in England. Apparently, the legendary 'Abraham's Oak' in Hebron belongs to this species (Bean 1976). It is considered a sacred tree by the followers of all three religions of the Holy Land, hence no one dares to remove a twig from the aged specimen. However, the open forests of scattered trees are denuded throughout the Middle East since the wood of this species is used widely for fuel and charcoal production.

Quercus cerris L. Sp. Pl. 997 (1753). Syn. Q. austriaca Willd. Sp. Pl. 4:454 (1805); Q. tournefortii Willd. Sp. Pl. 4:453 (1805); Q. tukhtensis Czecott, Acta Soc.

Bot. P. 9:44 (1932); Q. lanuginosa Lam.; Q. cerris ssp. austriaca Willd. Schwarz.

Deciduous tree up to 35 m. high forming pyramidal or broadly open crowns. Twigs rough, glaborous, reddish-brown hairy and linear stipules persistent. Buds ovoid, 1-4 cm. long and bud scales oblong. Leaf blade oblong to narrow obovate or ovate, 4.2-13.8 cm. long, 3.2-6.8 cm. wide, deeply lobed usually 1/3-1/2 to midrib, dark green hairy, and rough to touch above, grayish green and pubescent below; whole lamina symmetrical or asymmetrical, with alternate 4-7 pairs of entire or dentate lobes, base slightly asymmetrical; apex obtuse, apical lobe acute to rounded, sometimes retuse or pointed; base mostly normal obtuse to subcordate, sometimes one side decurrent. Margin-lobate, with alternate, often very deep lobes: apices mostly rounded to rarely bluntly pointed, if pointed possibly with a gland; sinuses rounded; spacing regular; simple and often compound series; on entire margins. Petiole yellow-green, pubescent, 0.8-1.8 cm. long (moderate) and proximal portion grooved. Midrib generally straight.

Venation: craspedodromous; primary vein: moderate to stout; straight to curved; secondary veins: terminating at lobes; rarely branching further; narrow to moderate acute angle, sometimes wide acute in basal area; upper secondaries more acute than lower secondaries; moderate to thick; straight to uniformly curved upward in apical area, downward in basal area, sometimes branching as a secondary or intersecondary to form a secondary lobe (branching occurs on the lower side of a secondary); no loop-forming secondaries, except at base when joining tertiaries; frequent intersecondaries, simple, from midvein in non-lobate areas, sometimes from lower side of a secondary to form a secondary lobe; tertiary veins: lower ones at right angle, upper ones also at right angle, sometimes both angles acute in lobate areas; percurrent: mostly forked, rarely simple straight to sinuous; oblique, the angles of divergence in tertiaries, usually decrease towards apex, predominantly alternate; higher order of excurrent branching--2nd degree; quarternary veins-moderate, orthogonal; likewise quinternary veins moderate, orthogonal; ultimate marginal veins fimbrial of tertiary size; areoles: irregularly shaped, mostly medium, often small; veinlets none or simple linear or branched once. Fruit maturing in the second year, acorns (Fig. 8, C) light brown, 2.5-3.6 cm. long, mucronate, rarely concave at apex; cupules 1.6-2.4 cm. in diameter, 1.5-1.9 mm. deep, enclosing the nuts half way, cup scales linear-filiform, appressed at base, upper scale portions loosely arranged and recurving often.

Distribution: Western sector of the Black Sea coasts of Turkey, throughout Anatolia, except the eastern part. Not recorded from the Saltlake region of Central Anatolia. Very common along the Istranja mountains of eastern Thrace, but absent in the remaining areas of European Turkey possibly due to intensive agricultural land use (see Fig. 9).

Localities: A. Gökşin #13 T.F.S., S. Turkey, Adana Province, Osmaniye District, altitude 800-1000 m.; A. Aldemir #35 T.F.S., N. Turkey, Bolu Province, Mudurnu District, altitude 620 m.,; A. Aldemir #34, Bolu Province, Mudurnu District, Gölcük Series, altitude 500 m.; K. Alpacar #36 T.F.S., S. Turkey, Antalya Province, between Akseki and Manavgat; A. İpiçürük #43 T.F.S., E. Turkey, Adiyaman Province, Gölbaşi District, altitude 850 m.; K. Alpacar #14 T.F.S., S.W. Turkey, Muğla Province, Yaraş District, kıyıt Series, altitude 1020 m.; K. Alpacar #12 T.F.S., W. Turkey, Denizli Province, Acıpayam Road, altitude 950 m.; K. Alpacar #35 T.F.S., S. Turkey, Antalya Province, Manavgat District, altitude 450 m.; V. Yönelli #6 T.F.S., E. Thrace, İstanbul Province, Çatalca District, altitude 80 m.; K. Alpacar #34 T.F.S., S. Turkey, Antalya Province, Akseki District, Murt içi, Kabız Road along the creek, altitude 650 m.; V. Yönelli #5 T.F.S., E. Thrace, İstanbul Province, Çatalca District, altitude 160 m.; A. İpiçürük #47 T.F.S., E. Turkey, Adıyaman Province, Gölbaşı Forest, altitude 850 m.; C. Aksoy, A. Suner, Y. Duğarslan #4 T.F.S., N. Turkey, Tokat Province, Niksar District, Çamiçi Village, İmmidoğan locality, altitude 950 m.; K. Alpacar #46 T.F.S., S.W. Turkey, Muğla Province, Fethiye District, Çengerköy, Hatice ana hill, Kuz locality, altitude 250 m.; A. Aldemir #32 T.F.S., N.W. Turkey, Bolu Province, Mudurnu District, Ilıca Village, Sarot Forest, altitude 440 m.; A. Aldemir #33 T.F.S., N. Turkey, Bolu Province, Mudurnu District, Yürse Series, altitude 480 m.; M. Posat #2 T.F.S., N.W. Turkey, Kocaeli Province, Adapazarı District, Kemaliye Village.,M. Posat #23 T.F.S., N.W. Turkey, Adapazarı Province, Akyazı District, Karapürçek Locality; M. Şahin #35 T.F.S., N. Turkey, Samsun Province, Kavah District, Mahmutlu Village; M. Şahin #32 T.F.S., N. Turkey, Samsun Province, Bafra District M. Şahin #29 T.F.S., N. Turkey, Sinop Province, Gerze District, Hatin Village, Dihmen Forest; V. Yönelli #46 T.F.S., N.W. Turkey, E. Thrace, Kırklareli Province, Vize District, Kömürköy Series, altitude 150 m.; Vedat Yönelli #57 T.F.S., E. Thrace, Kırklareli Province, Vize District, Kızılağaç Village, Kiremithane Series, altitude 200 m.; V. Yönelli #61 T.F.S., E. Thrace, Kırklareli Province, Vize District, Kocataş Locality, altitude 10 m.; V. Yönelli #88 T.F.S., E. Thrace, Kırklareli Province, Demirköy District, Uzunbacak Locality, Karacadağ Series; V. Yönelli #85 T.F.S., E. Thrace, Kırklareli Province, Demirköy District, Istihkâmtepe Forest, altitude 350 m.; V. Yönelli #83 T.F.S., E. Thrace, Kırklareli Province, Demirköy District, Karayokuş Locality, altitude 500 m.; V. Yönelli #81 T.F.S., E. Thrace, Kırklareli Province, Demırköy District, Şarapnel Series, altitude 475 m.; V. Yönelli #80 T.F.S., E. Thrace, Kırklareli Province, Demirköy District, Işletme Locality, altitude 425 m.; V. Yönelli #78 T.F.S., E. Thrace, Kırklareli Province, Dereköy Region, Karlık Series, altitude 430 m.; M. Posat #3 T.F.S., N.W. Turkey, Kocaeli Province, Adapazarı District, Soğucak Village; M. Şahin #21 T.F.S. N. Turkey, Sinop Province, Ayancık District, Bakırlı zaviye Village, A. İpiçürük #32 T.F.S., E. Turkey, Malayta Province, Hekimhan District, Akpınar Forest, altitude 1000 m.; M. Posat #21 T.F.S., N.W. Turkey, Adapazarı Province, Akyazı District, Merkez Subdistrict, Beldibi Locality; V. Yönelli #73 T.F.S., E. Thrace, Kırklareli Province, Merkez Region, Düzorman Series, altitude 500 m.; A. İpiçürük #24 T.F.S., E. Turkey, Malatya Province, Doğanyol District, Gökçe Village, Memonun Forest, altitude 900 m.; M. Posat #8 T.F.S., N.W. Turkey, Kocaeli Province, Adapazarı District, Uğurlu Village, M. Posat #17 T.F.S., N.W. Turkey, Izmit Province, Adapazarı, Şosesi; A. Gökşin #9, T.F.S., S. Turkey, Maraş Province, Andırın District, altitude 1075 m.; A. Gökşin #8 T.F.S., S. Turkey, Maraş Province, Andırın District, Başkonuş locality, altitude 800-1000 m.; K. Alpacar #39 T.F.S., S. Turkey, Antalya Province, Akseki District, 3 km. along Ibradı Road, in cemetery, altitude 940 m.; B. Kasaplıgil #4620 S. Turkey, Burdur Province, Bucak District, Gerce Village; M. Posat #13 T.F.S., N.W. Turkey, Kocaeli Province, Lütfiye Locality; B. Kasaplıgil #5796, E. Thrace, İğneada, Longozlar Forest, H. Peşmen-A. Güner #1486, S. Turkey, Isparta Province, Eğridir, Yaka köyü, altitude 1500-1700 m.; M.G. #34 T.F.S., N.W. Turkey, Zonguldak Province, Kozlu District; A. Aldemir #29 T.F.S., N.W. Turkey, Bolu Province, Göynük District, altitude 1380 m.; M.G. #40 T.F.S., N.W. Turkey, Zonguldak Province, Devrek District, Dirgine, Kazdere Forest; A. Aldemir #31 T.F.S., N.W. Turkey, Bolu Province, Mudurnu District, Ilıca Village, Sarot Forest, altitude 460 m.; A. İpiçürük #41 T.F.S., S.E. Turkey, Adiyaman Province, Gölbaşı Forest, altitude 850 m.; V. Yönelli #32 T.F.S., E. Thrace, İstanbul Province, Çatalca District, Durusu subdistrict, altitude 160 m.; K. Alpacar #18 T.F.S., S.W. Turkey, Muğla Province, Yerkesik District, Kocadüz locality, Narçalıdağ Forest, altitude 550 m.; V. Yönelli #62, T.F.S., E. Thrace, Kırklareli Province, Vize District, Yumurtatepe Series, Kocataş Locality; A. Gökşin #15, T.F.S., S. Turkey, Adana Province, Osmaniye, Nurdağ, altitude 830-1250 m.; V. Yönelli #10 T.F.S., E. Thrace, Istanbul Province, Çatalca District, Yaliköy Bölgesi, Kozuldere Forest, altitude 20 m.; M. Şahir #28, T.F.S., N. Turkey, Sinop Province, Çerkez Village, Sinop Forest; B. Kasaplıgil #4840, S. Turkey, Antalya Province, Güngdoğmuş District, Vicinity of Senir Village; B. Kasaplıgil #4841, S. Turkey, Konya Province, Akşehir Tekke Village, altitude 1300 m.; B. Kasaplıgil #4859, N. Turkey, Sinop Province, Ayancık, altitude 600 m.; B. Kasaplıgil #4867 E. Central Turkey, Afyon Province, Sandıklı District, Burgaz Mountain; B. Kasaplıgil #4874 S. Turkey, Konya Province, Kadın Hanı District, Yukdur Subdistrict; B. Kasaplıgil #4877, S. Turkey, Konya Province, Ilgın District, Çiğil Subdistrict; B. Kasaplıgil #5028 N. Turkey, İzmit Province, between Akmeşe and İmaniye; B. Kasaplıgil #5031 N.E. Turkey, İzmit Province, Yuvacık; B. Kasaplıgil #5032, S. Turkey, Adana Province, Osmaniye District, Gâvurdağı, altitude 1000 m.; B. Kasaplıgil #5035, S. Turkey, Adana Province, Kozan Forest; B. Kasaplıgil #5077, S. Turkey, Antalya Province, Manavgat Forests; B. Kasaplıgil #5078 N. Turkey, Çorum Province, Hacılar hanı region; B. Kasaplıgil #5109 E. Turkey, between Malatya and Hekimhanı, Akpınar locality.

Q. cerris is the most widely distributed oak in Turkey (Fig. 9). In Europe, it extends from the Balkan Peninsula through Central Europe to France. In the Middle East, south of Turkey, Q. cerris grows along the coastal regions of Syria and Lebanon. In the U.S.A. and Great Britain, it is cultivated in parks and arboretums. It is a quick growing and hardy species suitable for streets especially in cold climatic zones. Several varieties are listed tentatively by Zohary (1961). The natural hybrids of Q. cerris with Q. libani in southern Anatolia and with Q. infectoria in northern Anatolia are recorded. However, Q. x libanerris Boom (1959) described from a cultivated specimen in Trompenburg Arboretum in Holland is not represented in my collections from the natural populations in Turkey. Karamanoğlu (1976) enumerates two subspecies from Turkey. Q. cerris ssp. austriaca (Willd.) Schwarz reaches the elevation 1500 m. in northern Anatolia between Kastamonu and Çankırı (Krause Nos. 2419 & 2424). Q. cerris ssp. tournefortii (Willd.) Schwarz is reported occurring between the elevations of 750-900 m. in Bolkardağı of the Taurus range in Mersin (Kotschy Nos. 386, 405), cf Karamanoğlu (1976). Both subspecies occur in steppic, arid regions as well as in mesic broadleaved forests of the Black Sea coasts of Asia Minor and eastern Thrace. Unfortunately, high forests of pure stands are rare, except in Osmaniye district of Adana Province, I observed in 1944, a seedling forest of magnificent tall trees mixed with Pinus nigra in Hagbel Frenk locality at the elevation of 1220 m. Depending on the vegetation type of its natural distribution areas in Turkey, Q. cerris associates with a large variety of trees and shrubs: Pinus brutia, P. sylvestris, Q. libani, Q. infectoria, Q. vulcanica, Castanea sativa, Fagus orientalis, Laurus nobilis, Carpinus, Fraxinus, Acer, Arbutus, Platanus, Populus, Phillyrea, Cornus, Paliurus, Mespilus, Sorbus, Melia, Styrax, Staphylea, Alnus, Daphne, Pistacia, Pyrus, Cistus,Calluna, Erica, Smilax, etc.

Along the coastal mountain ranges of the Black Sea coast, Q. cerris is quite an invasive species forming coppice type of forests following the clear cutting of broad-leaved high forests. It has a tremendous capacity of regeneration through suckers and easy establishment of young seedlings. The wood is not desirable for construction purposes, but it is used mainly as fuel wood. Under human and grazing pressures, most of the coppices are in denuded state. Being related to Q. suber = Cork oak, Q. cerris = Turkey oak is classified under Subgenus Cerris (Spach) Örsted by Schwarz (1964). In fact, hybridization between the two has been reported from western Europe. Like Q. suber, Q. cerris also is suitable for cork production. During the World War II, Turkey was unable to import cork from Spain and Portugal. The Turkish Forestry Service commissioned Dr. Kâzım Mıhçıoğlu to investigate and find a substitute for the cork. During early 1940s, Dr. Mıhçıoğlu settled with Q. cerris after a long survey of cork producing trees in Turkey. He established several experimental lots in southeastern Turkey where the primary cork from the barks of aged trees were ax-peeled, punched and used as cork stoppers for bottled beverage industries. The primary cork was too brittle and hard enough to resist the cork screws. However, a few years later, the secondary oak developed from the cork cambium was soft, elastic, and pliable. The foresters of the Osmaniye (Adana Province) called it "female cork" to distinguish from the brittle, porous "male cork" obtained from the primary barks of the trees. The early reports of the cork production from Q. cerris barks were published by Dr. Mıhçıoğlu in the 1942 volume of "Orman ve Av = Forestry and Hunting" journal of the Turkish Forestry Association. At the end of the World War II, Turkey was able to import cork again and consequently the experiments on cork production from the barks of Turkey oak were discontinued.

No doubt, the best use of this species would be in landscaping the streets and parks in the urban areas. In 1959, I planted three seedlings of Q. cerris at the

International Grove of the University of Washington in Seattle during the 5th International Forestry Congress. Twenty years later, when I visited the University of Washington campus again, I located the two survivors which were about 15 m. high with vigorous branching from single boles (Fig. 10). According to Bean (1976), it has been in cultivation in Great Britain since 1735.

Quercus Coccifera L. Sp. Pl.:995 (1753). Syn: Q. pseudococcifera Desf., Q. coccifera var. pseudo-coccifera (Desf.) A. DC., Ilex coccigera Clus.

Small evergreen shrubs or trees 203 m. high. Twigs grayish brown; pubescent. Terminal buds more or less glabrous, ovoid dark brown, bud scales ovoid and stipules persistent. Leaf blade ovate to wide ovate, rarely oblong, 1.7-5 cm long (usually about 2 cm.), microphyllous, 1.2-2.3 cm. wide, dark green and shiny above, pale green and glabrous below; whole lamina symmetrical, base symmetrically cordate or rounded; apex acute, mucronate. Margins--in ours serrate, with abruptly divarcating spines, more or less cartilaginous with spiny teeth not directed towards the tips of leaves, often radiating outward directions, apex cuspidate, base rarely oblique; if serrate: apical side concave, basal side straight, no glands on teeth; sinuses rounded; with regular spacing; simple serration; or occasionally complete margin. Petiole yellowish brown, pubescentat young stage, soon becoming glabrous, 1-6 mm. long. Midrib straight; rarely wavy. Fruits matruing in two years, concave and mucronate at tip, half way or 2/3 of acorn enclosed within cupule. The scales of the cup radiating in all directions, quite spiny. Fruits develop singly on short stalks, usually abundant.

Venation: semicraspedodromous, where secondary branching occurs almost midway between the margin and midvein, each of the 2 branches enter adjacent teeth; primary vein: stout; straight to subsinuous; secondary veins: mostly medium acute to wide acute angle, tending to right angle and recurved toward base of lamina; upper secondaries at a more acute angle; moderate width; straight and sometimes branching, lower secondaries re-curved; loop-forming secondary branches at acute angle or tight angles; seldom composite intersecondaries; 4-7 pairs of secondary veins terminate at teeth; secondary veins either opposite or alternating along the midrib; tertiary veins: lower ones at wide or right angles, upper ones at right angle; percurrent: mostly forked, rarely simple, sinuous; oblique, tertiary angle decreases upward, lower tertiaries sometimes parallel to midvein; alternate and opposite; higher order of venation: the highest order--5th degree; highest order of excurrent branching--2nd degree; quarternary veins--thick, orthogonal; quinternary veins--moderate, random; ultimate marginal venation fimbrial, of secondary size; areoles: mostly rounded quadrangular or triangular shapes; small; veinlets mostly none or simple linear, sometimes curved.

Distribution: Mainly southeastern Europe and North Africa, Mediterranean regions of Greece and Turkey.

Localities: B. Kasaplıgil #4682, W. Turkey, İzmir Province, Menemen District, Emiralem, foothills of Dumanlı Dağ, altitude 50 m.; B. Kasaplıgil #4625 S. Turkey, Konya Province, Ermenek District, Merkez subdistrict; B. Kasaplıgil #5105 W. Turkey, Manisa Province, Akşehir Village, altitude 1050 m.; K. Alpacar #26 T.F.S., S.W. Turkey, Muğla Province, Köyceğiz District, Yargı Village, altitude 1300 m.; K. Alpacar #19 T.F.S., S.W. Turkey, Muğla Province, Yerkesik District, Marçalıdağ Forest, Karahayıt locality, altitude 600 m.; K. Alpacar #20 T.F.S., S.W. Turkey, Muğla Province, Gökbel Village, Sarısu Forest, altitude 275 m.; K. Alpacar #41 T.F.S., S. Turkey, Antalya Province, Akseki District, Akseki-Manavgat Road near the cemetery, altitude 940 m.; K. Alpacar #10 T.F.S., S.W. Turkey, Muğla Province, Kavaklıdere Village, Road between Muğla-Aydın, altitude 350 m.; Mehmet Posat #10 T.F.S., N.W. Turkey, Kocaeli Province, İzmit District; B. Kasaplıgil #5070, W. Turkey, between İzmir and Manisa; B. Kasaplıgil #5082, S.W. Turkey, Muğla Province, Fethiye District, Karadere Village; B. Kasaplıgil #5102 S.W. Turkey, Antalya Province, Bükbeli District, altitude 850 m.; B. Kasaplıgil #5103, S.W. Turkey, Antalya Province, Finike District, altitude 500-600 m.; B. Kasaplıgil #5104 N.W. Turkey, Çanakkale Province, Eceabat District, Sarıkız Forest, altitude 850 m.; B. Kasaplıgil #5106, S. Turkey, İçel Province, Mut District, Karabağ subdistrict, 5 km. north of Mut, altitude 1120 m.; B. Kasaplıgil #5107, S. Turkey, Mersin Province, south of Kuzucubelen, altitude 625 m.; B. Kasaplıgil #4835, S.W. Turkey, Denizli Province, Bozdoğan #4839, S. Turkey, Antalya Province, Gündoğmuş District; B. Kasaplıgil #4841 Konya Province, Akşehir Forest District; B. Kasaplıgil #4856, N.W. Turkey, Bursa Province, Gemlik District; B. Kasaplıgil #4862 N.W. Turkey, Edirne Province, Keşan District; B. Kasaplıgil #5048, S. Turkey, Adana Province, Kozan Forest; B. Kasaplıgil #5050 W. Turkey, Manisa Province, Spil Mountain; B. Kasaplıgil #5051, S. Turkey, Mersin Forest.

Q. coccifera commonly known as Kermes oak is a predominant element of the macchie in western and southern Turkey (Kasaplıgil 1952). The vertical range of the Kermes oak reaches an altitude of 1400 m. in western Anatolia (Karamanoğlu 1976). It is often associated with Pinus nigra, P. brutia, Quercus cerris, Arbutus unedo, A. andrachne, Juniperus oxycedrus, Olea europaea, Phillyrea media, Paliurus spinachristi and many other Mediterranean elements. Under grazing pressure it becomes a creeping shrub which is typical in Phrygana vegetation in Kocaeli peninsula of northwestern Anatolia (Kasaplıgil 1947). Under protection or in cultivation, they become sizable trees about 6-7 m. high. The largest specimen in Turkey measures 8 m. in height with a stem diameter of 35 cm.

Kermes oak is used primarily for fuel and charcoal production. The wood is dense and very hard; that is why it is called Steineiche in German and Taş meşesi (Stone oak) in Turkish. The name Kermes oak is derived from the Kermes insect (Chermes ilicis) which lives on the barks of this oak. The female insects were the source of "grana chermes", an important dye material during the Middle Ages (Baytop 1963). The leaves and fruits are very variable since it hybridizes freely with Q. calliprinos and Q. ilex in nature. It is a beautiful oak with shiny green, spiny foliage resembling Ilex aquifolium. Although several forms of Kermes oak are cultivated in Western Europe, I have never seen them under cultivation in Turkey and in the United States. For the infraspecific classification of Q. coccifera the readers are referred to the monograph of Vicioso (1950).

A provisional list of Miocene oaks of Turkey and their possible relationships to the extant species.

Quercus boissieri Reut. ssp. _pesmenii_, ssp. nov.
Very close to modern _Q.boissieri_, leaves obovate, serration sharply pointed towards apex.

Quercus drymeia Unger
Related to _Q.sartorii_ Liebm. from Mexico. Lanceolate blades with sparsely serrate margins, lamina base often rounded. Midrib and petiole strongly developed.

Quercus furcinervis (Rossm.) Heer
It may belong to _Castanopsis_. lanceolate leaves with craspedodromous venation; lamina tips often curved.

Quercus cf. _hartwissiana_
Cupule 2 - 2.5 cm. wide with tuberculate scales.

Quercus heidingeri Ettingh.
It has aff. to _Q.ilex_ but leaves are much larger.

Quercus kodorica Kol.
Blade margins shallowly lobed. Midrib and petiole strongly developed.

Quercus kubinyi (Kov.) Cz.
Affinities to _Q.macrolepis_, _Q.libani_, _Q.trojana_; most common oak of Tertiary period found in many fossil deposits of central Europe. See the distrubution map by H. Tralau.

Quercus lonchitis Ung.
Lanceolate or obovate leaves with entire margins.

Quercus mediterranea Ung.
Aff. with _Q.ilex_. Base of lamina entire, upper 2/3 of lamina coarsely serrate.

Quercus mioaxelrodii sp. nov.
Aff. with _Q.castaneifolia_ ± lanceolate leaves. Midrib zig-zag, blade margins serrate.

Quercus miopontica sp. nov.
Aff. to *Q.pontica* from N. E. Turkey and Abkhasia U.S.S.R., and to *Q.sadleriana* R. Br. Campst. from N. California and Southern Oregon.

Quercus miovariabilis Hu et Chaney
Roughly resembles chestnut leaves, it is identical with the Chines Miocene species described from Shantung Prov. of China. Palaeont. Sinica, Ser. 112, new Ser. 1, p. 36-37, pl. 15, figs 5, 6.)

Quercus neriifolia A. Braun
It may be related to *Q.imbricaria* Michx. from East. U.S.A. . Narrowly lanceolate leaves with entire margins, petiole well developed.

Quercus paulmouterdei sp. nov.
Aff. to *Q.libani* and *Q.regia*. Cupules are 3-3.5 cm. wide, scales triangular, prominently overlapping.

Quercus sclerophyllina Heer.
Aff. with *Q.coccifera* =Kermes oak. Petiole short and thick, midrib strongly developed, leaf margins sharply dentate, pointed outwards.

Quercus semecarpifolia fossils
Aff. with *Q.sosnovskyi*. Leaves 6-7cm. long, 2.5-3 cm.wide, midrib and petiole strongly developed. Secondaries diverging at broad angles. Tuft of hairs at angles.

Quercus seyfriedii A. Br.
Aff. with *Q.phellos* of Eastern U.S..

Quercus sosnovskyi Kol. f.*angustifolia* Kol.
It has aff. to *Q.glauca* Thunb. from Japan. Blader 12-14 cm. long, lanceolate with entire margins. The leaves are quite variable.

THE LEGENDS FOR ILLUSTRATIONS

Figure 1:

Quercus aucherii Jaub et Spach A) A flowering branch with staminate catkins x 1/2 drawing by Anne Crocker; B) Contact prints of two cleared leaves, to the left: with entire margins, to the right: partly dentate blade showing the brochidodromous venation in the lower portion of the lamina and semicraspedodromous condition in the upper portion of the leaf. C) Detail of the minor venation and ultimate areoles, x 30, Cl - areole, C2 - ultimate linear veinlet, C3 - fimbrial vein along the leaf margin; Kasaplıgil #5075. D) Fruit variation x 1/2, drawings by Elizabeth Fall. Dl - Bell-shaped cupule with imbricate bracts enclosing 1/4 of the slender acorn; D2 - A hemispherical cupule with adpressed scales enclosing 1/3 of a thick acorn. Note the mucronate tips of the acorns. Specimens provided by Kenan Alpacar #54 from Belen village of Antalya Province.

Figure 2:

Quercus boissieri Reut. A) A fruiting branch showing the variation of leaf outlines. Although most of the leaves are obovate, some of them are oblong-elliptical. Drawing by Anne Crocker. B) Acorns with mucronate apices. Note the prominently tuberculate cupule with short pedicel. C) Detail of two leaves with obtuse apices and cuneate bases. D) Contact prints of two cleared leaves showing the craspedodromous venation in the upper dentate-lobate portions of the leaves and brochidodromous venation in the lower blade portions with entire margins. All illustrations x 1/2.

Figure 3:

Distributions of Q. boissieri Reut. (circles), Q. libani Oliv. (solid circles) and Q. trojana Webb. (triangles).

Figure 4:

Distributions of Q. brantii Lindl. (circles) and Q. macrolepis Kotschy (solid circles).

Figure 5:

Quercus brantii Lindl. A) Fruiting branch showing the leaf variation and the young stage of fruit development. Specimen from Silvan south of Muş, T.F.S. #14. Note that the cupular bracts are more or less filiform at an early stage. Drawing by Anne Crocker. B) Contact print of a cleared leaf showing the detail of major venation, B. Kasaplıgil #4626. Note that the upper secondaries diverging at narrow angles and terminating at marginal teeth while the lower secondaries near the base of lamina diverging at wider angles and reticulodromous where blade margins entire. The tertiaries are oblique in relation to the primary vein. Slide and print by Margret Mukai. C) Variation of mature fruits and cupules. Basal involucral bracts are triangular, imbricately appressed, but their tips are free. The upper scales near the cupular margins are recurved. The specimen to the left: C. Araz #6 T.F.S., from Diyarbakır Province, Fermik Forest; The specimen to the left: A. Ipigürük #51 T.F.S., S.E. Turkey, Fıstıközü Village, Halfeti loc. Both drawings by Elizab. Fall. All figures x 1/2.

Figure 6:

A) Fruiting branch of Q. calliprinos Kasaplıgil #4864. Note that the teeth of the serrate leaves are pointed towards the leaf apex. The involucral bracts of this particular specimen are not recurved and that the cylindrical acorns are halfway enclosed within the cupules. Drawing by Anne Crocker, x 1/2. B) Contact print of a cleared leaf with entire margins showing the brochidodromous venation pattern in which the bifurcating secondaries forming loops. C) Another leaf clearing from the same specimen with dentate margins and semi-craspedodromous venation. Note that the teeth in the lower half of the leaf are pointed ourwardly and that the secondary veins diverge at narrow, right and broad angles. The intercalary veins are evident in both leaf samples (Kasaplıgil #4864). The slides and prints of B & C by Margret Mukai, X 2.

Figure 7:

Quercus calliprinos, details of leaf vasculation, Kasaplıgil #4625. A) Contact print of a serrate leaf with strongly developed primary vein and semi-craspedodromous secondaries alternating with intercalary veins. The teeth are spinescent and pointed toward the leaf apex, x 2-1/2. B) A secondary vein terminating at the tip of a marginal tooth. 2^{o}, 3^{o}, 4^{o}, 5^{o}; veins of the 2nd-5th degrees respectively, mf: marginal fimbrial vein. C) Bifurcation of a secondary vein near the blade margin giving rise to semicraspedodromous condition (bs), (ar): Areoles with compactly arranged palisade parenchyma cells. Photomicrographs by Margret Mukai, x 25.

Figure 8:

Quercus cerris = Turkey oak. A) A fruiting branch with persistent stipules and an immature fruit enclosed within the cupule covered by long, filiform bracts. Kasaplıgil #4620, drawing by Anne Crocker, x 1/2; B) Contact print of a cleared leaf showing the detail of major venation and the frequency of intercalary veins. Note that some of the lobes are coarsely dentate. Kasaplıgil #4620. Slide of leaf whole mount by Joan Amoroso, contact print by Margret Mukai, x 1/2; C) Variation of the mature fruits showing the detail of the cupular bracts. A. Aldemır #32, T.F.S., Bolu province, Mudurnu (left), A. Ipiçürük #46, T.F.S., Adıyaman province Gölbaşı (right). Both drawings by Elizabeth Fall, x 1/2.

Figure 9:

Distribution of Quercus cerris (Turkey oak) in Anatolia and Eastern Thrace.

Figure 10:

Quercus cerris (Turkey oak): A) Contact print of a cleared leaf showing a deeply dissected blade with simple lobes almost reaching the midrib region. Note the lobes and the secondary veins are alternating. Again the intercalary veins are common. See the text for the detailed description of the major and minor venation. Hasan Peşmen & Güner #1486, slide and the contact print by Margret Mukai x 1/2; B and C) cultivated specimens of Turkey oak in the International Grove of the University of Washington, Seattle. The trees were planted by this author in 1959 for commemorating the 5th International Congress of Forestry on behalf of the Turkish Government. The photographs were taken twenty years later on August 10, 1979 by B. Kasaplıgil.

Figure 11:

Quercus coccifera L. Kermes oak. A) A fruiting branch showing the variation of the leaves and acorns in the same individual plant. Kasaplıgil #4625, drawing by Anne Crocker, x 1/2; B-C) Contact prints of cleared leaves showing the detail of the major and minor venations. Note the remarkable resemblance of the foliar vasculature in Q. coccifera and Q. calliprinos (Figs. 6 and 7). Kasaplıgil #4625, both slides and prints by Margret Mukai, x 2.

Figure 12:

Distributions of _Q. aucherii_ Jaub et Spach (circles), _Q. calliprinos_ Webb. (triangles), _Q. coccifera_ L. (solid Triangles), and _Q. ilex_ L. (solid circles).

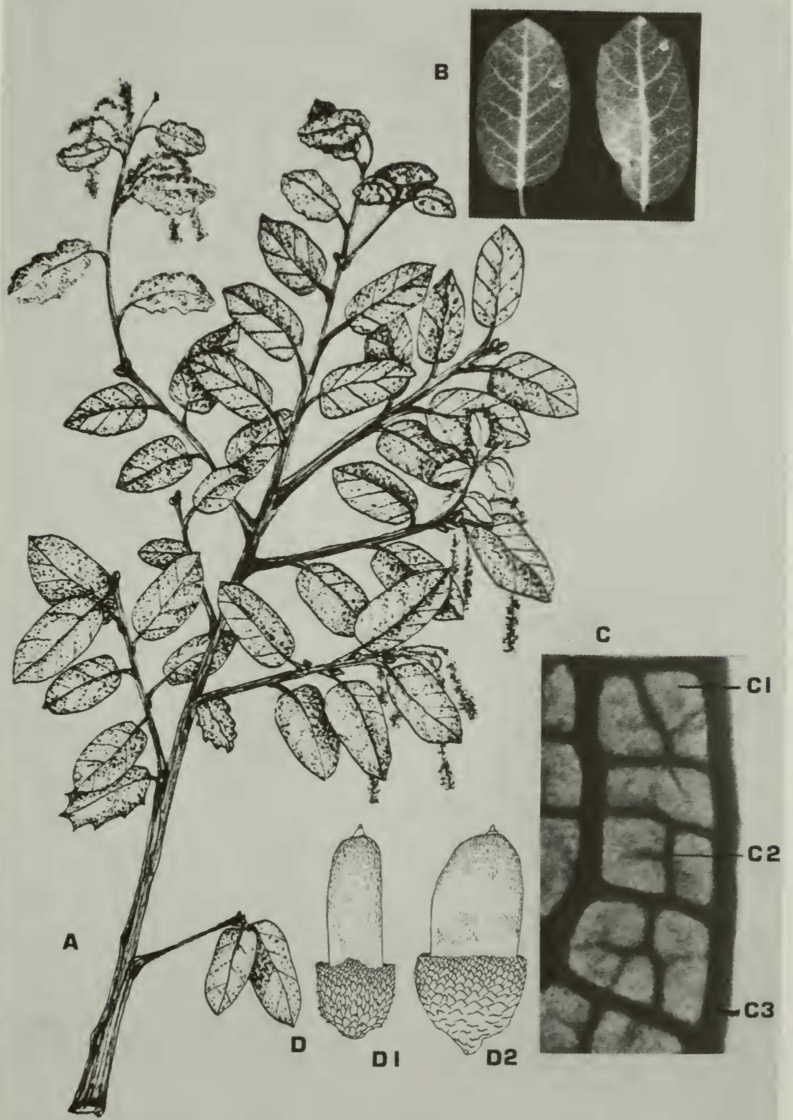


Fig.1. Quercus aucheri

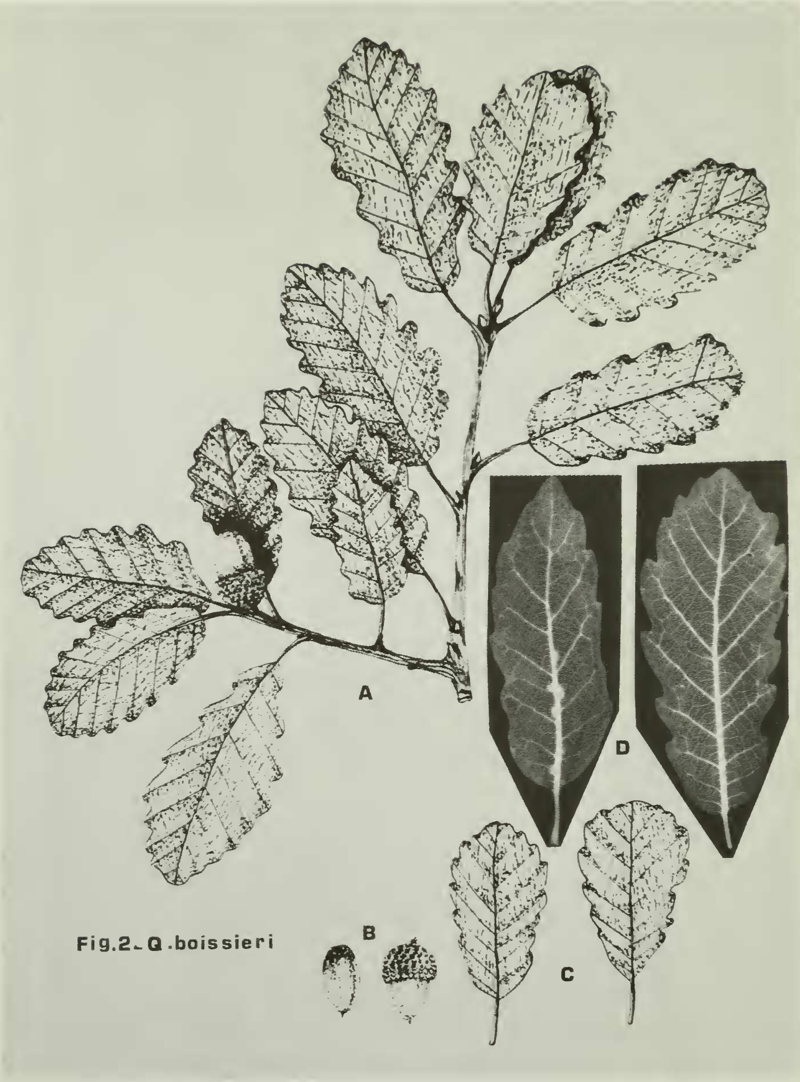


Fig.2- Q.boissieri

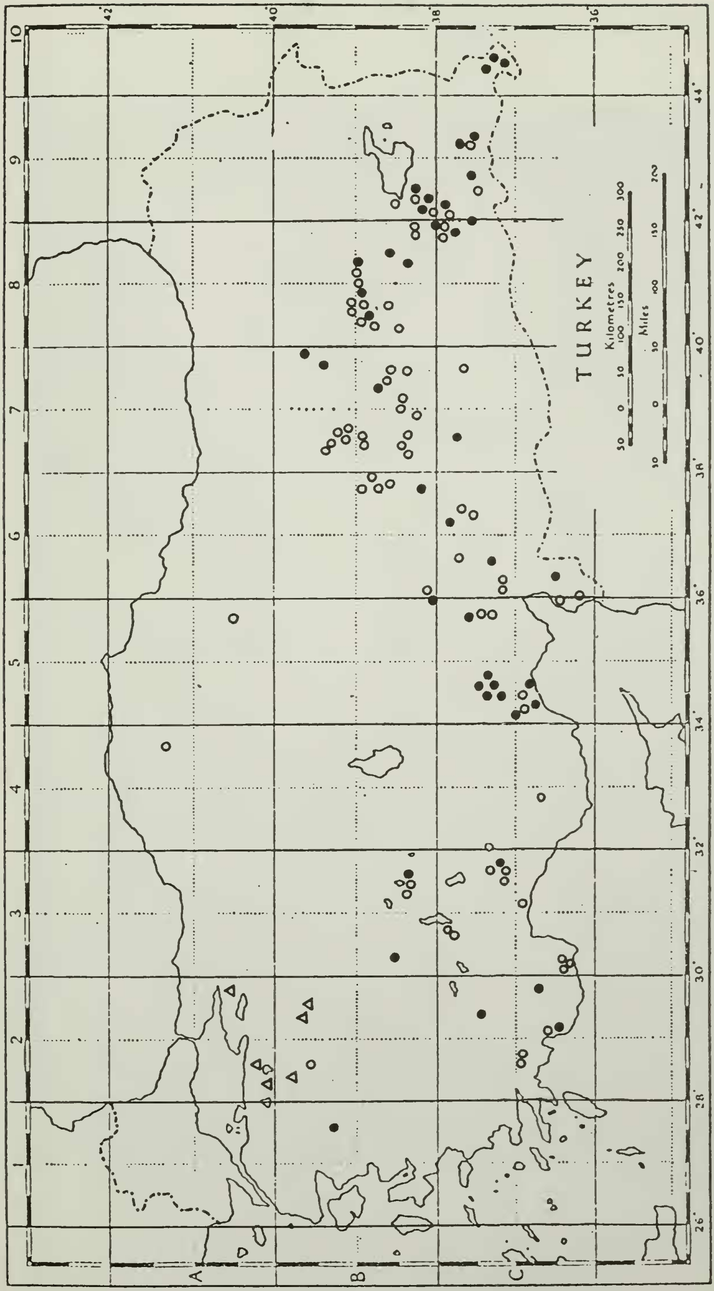


Fig. 3- Distributions of Quercus boissieri (o), Q. libani (•) and Q. trojana (Δ).

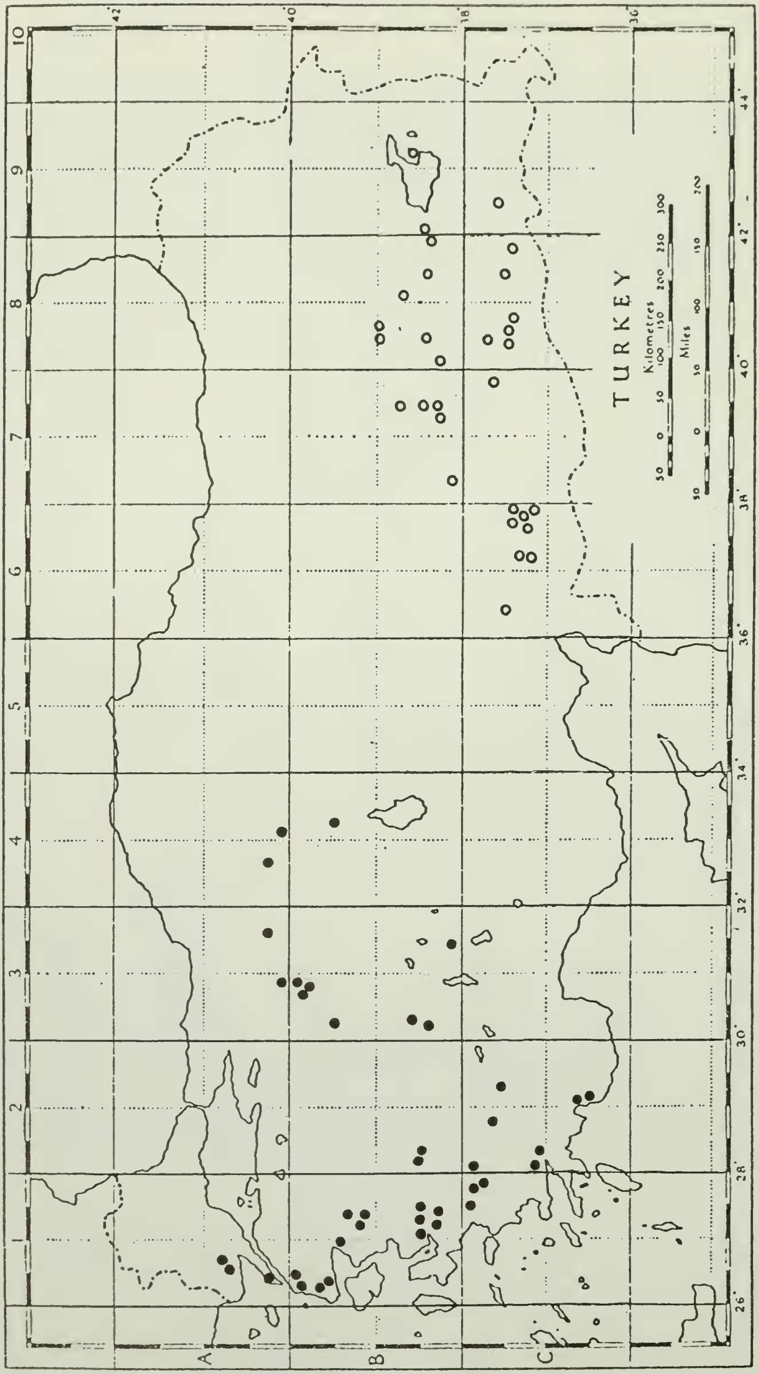


Fig. 4 - Distributions of *Quercus brantii* (o) and *Q. macrolepis* (●).

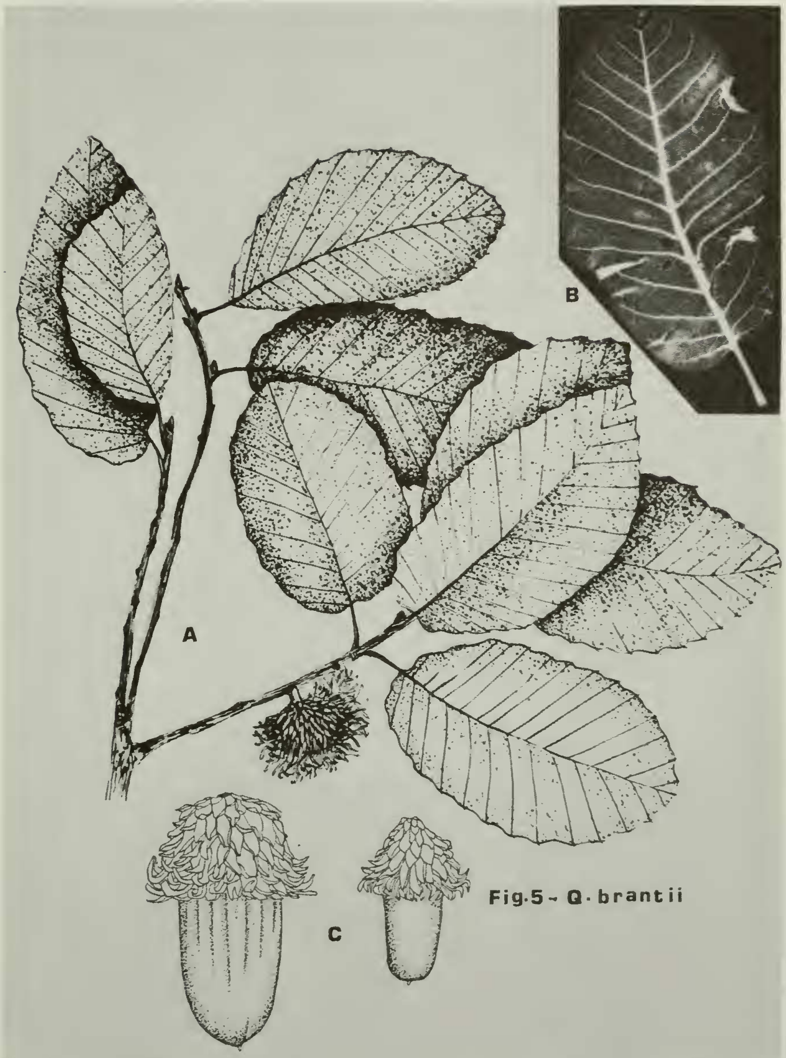


Fig.5 - Q. brantii

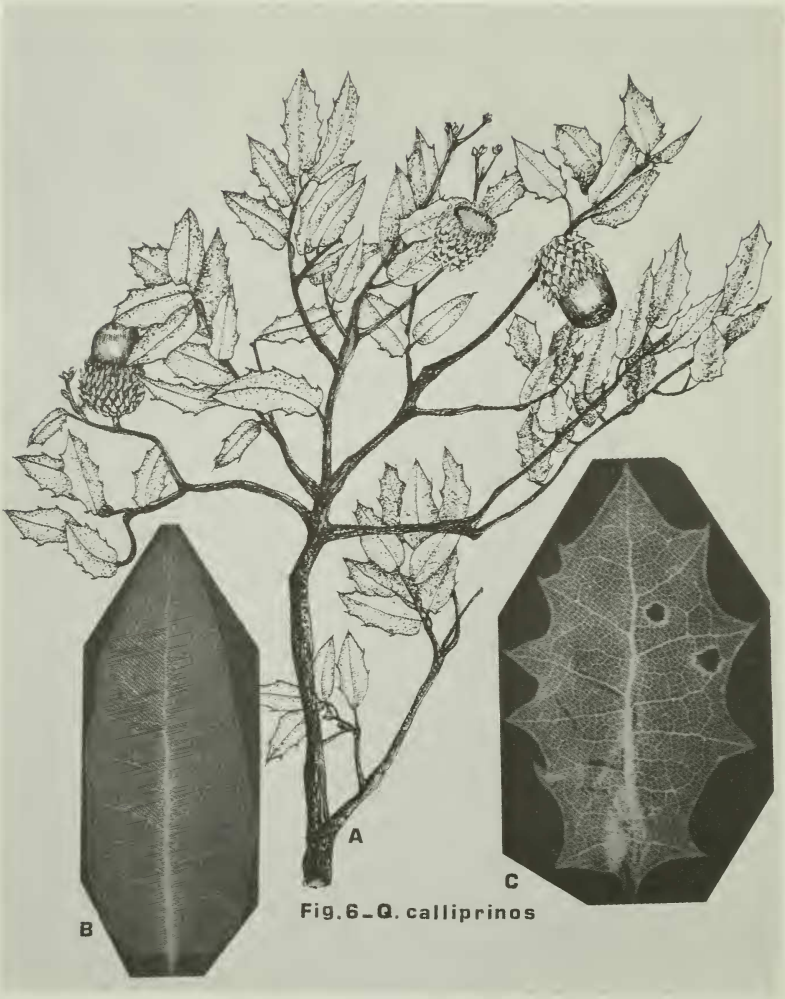


Fig. 6_Q. calliprinos

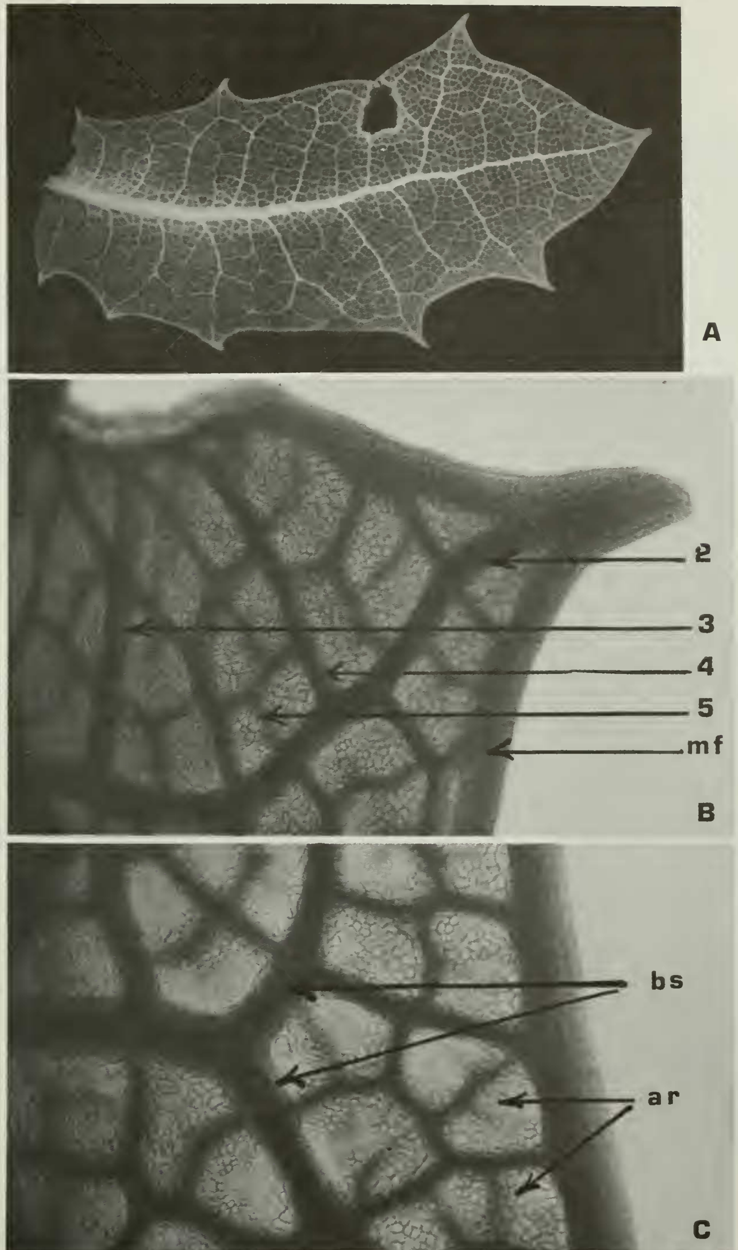


Fig. 7- Foliar vasculation of Quercus calliprinos.

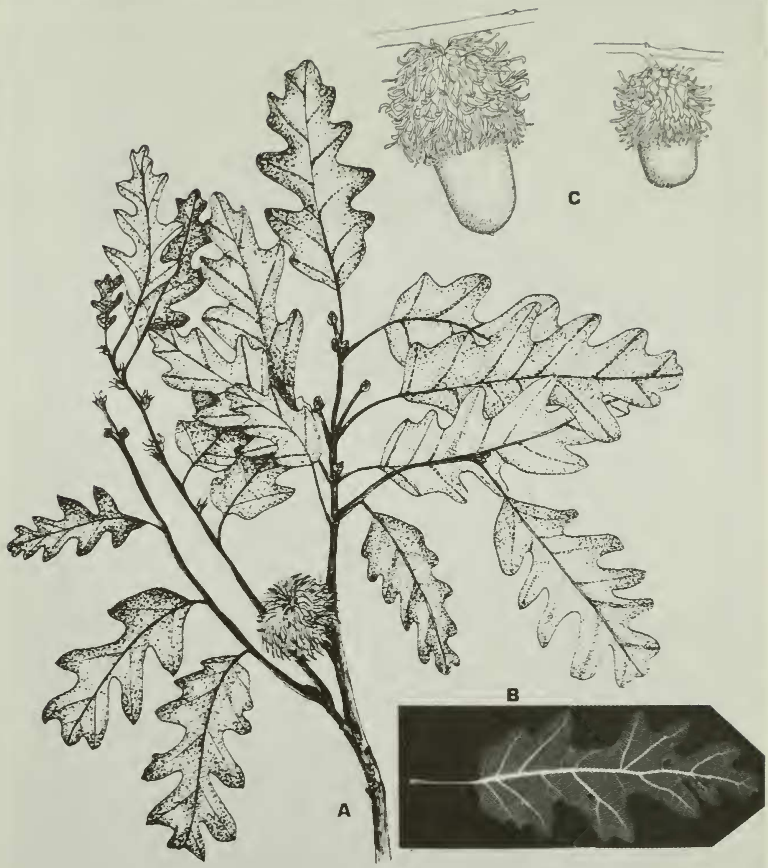


Fig.8- Q.cerris

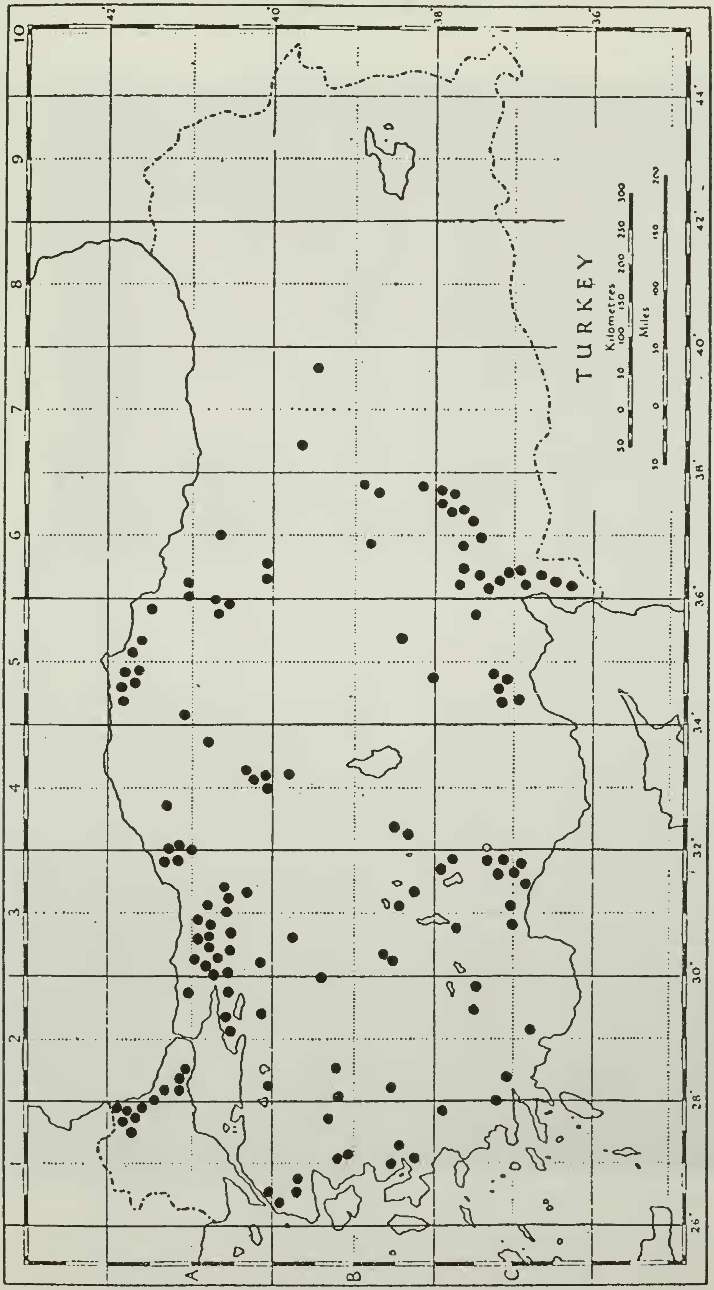
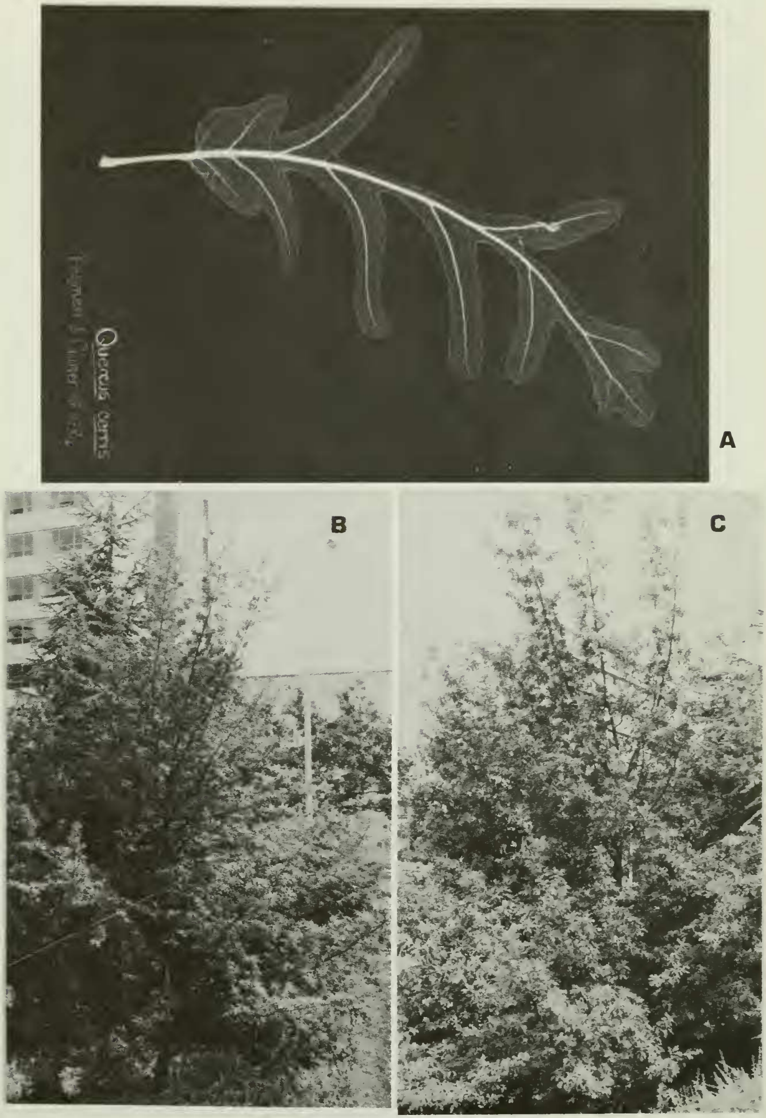


Fig. 9- Distribution of _Quercus cerris_ in Turkey (●).


A
B
C

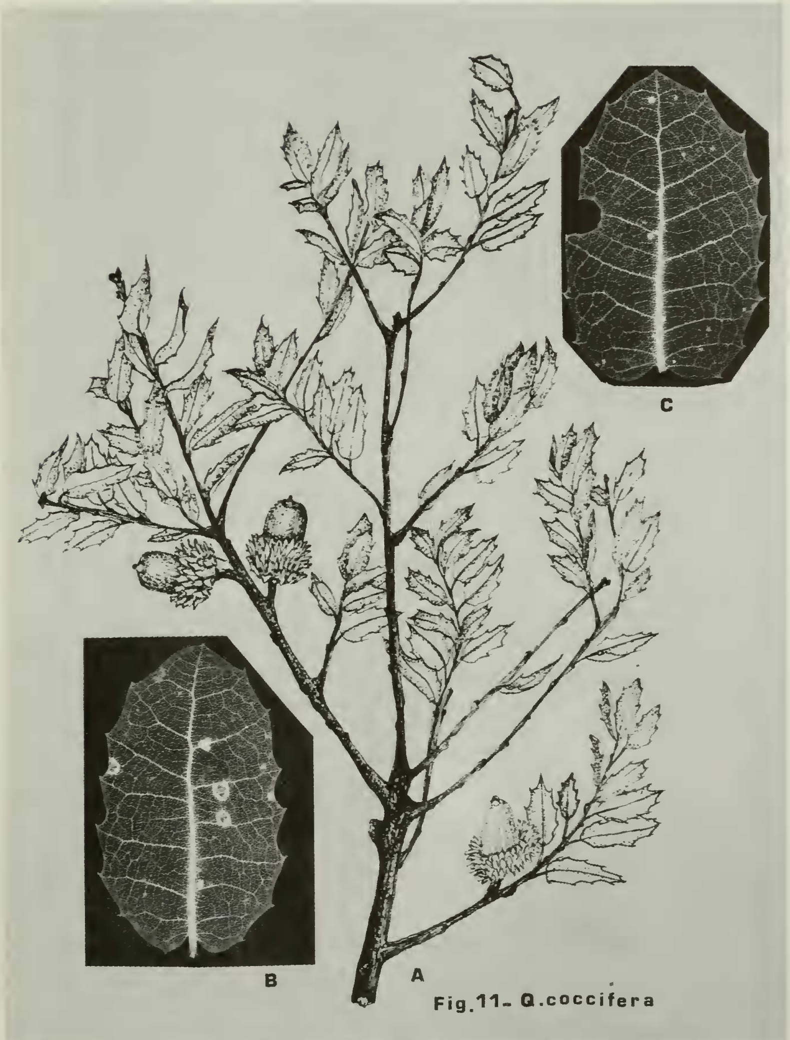


Fig.11- Q.coccifera

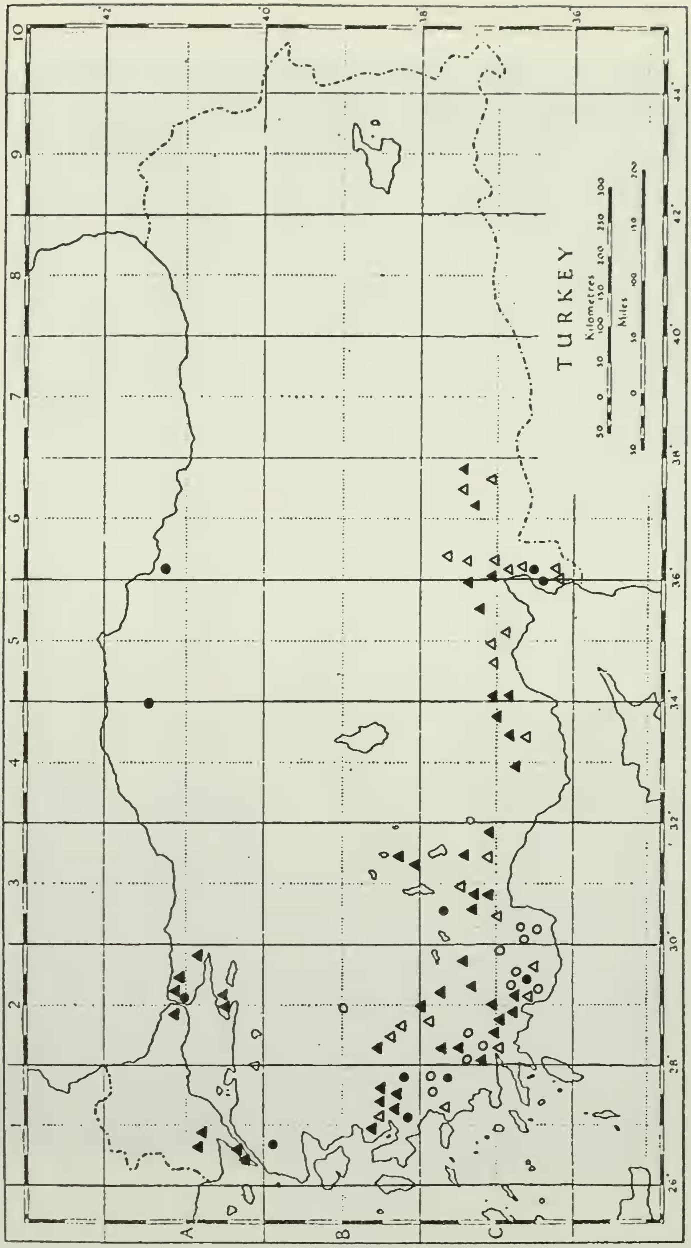


Fig.12- The distributions of *Quercus aucheri* Jaub.et Spach (○), *Q. calliprinos* Webb.(△), *Q. coccifera* L. (▲) and *Q. ilex* L.(●).

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