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volume Dr. Kavadas sees the completion of his very considerable undertaking. The first volume appeared in 1956; see *Kew Bull.* 15: 230 (1961). In our notices of the work we have drawn attention to the large numbers of misprints which mar the text, and the present volume does not seem noticeably better than its predecessors in this respect. The last fourteen pages are occupied by corrections and additions, including some extra illustrations, of which fig. 5784 appears to be printed upside-down. Almost the entire second half of the volume is occupied by an index to the Latin and other non-Greek names appearing in the dictionary; on one page taken at random we find 'Dueteromycetes', '*Dermaleocephalaeae*' and '*Demaracanthi*' in quick succession. It seems possible that the author's apparent contempt for proof-correction was a measure designed to reduce printing costs, but we wonder whether it has been really justified by the results. The volume includes longer articles on *Ficus*, Leaf (*phyllon*), Photosynthesis, etc. The author is to be congratulated on the conclusion of his enterprise, in the face of what were probably considerable practical difficulties.

H. K. AIRY SHAW

A favourite refurbished!—Those of us who learnt our first lessons in botany from the yellowed and well-thumbed pages of old copies of 'Wayside and Woodland Blossoms', will look at this new, three-volume edition through sentimental eyes. It is like a return to the scenes of one's childhood; much has changed, but many of the old landmarks remain to bring back memories of other days. There is the neat, precise illustration of *Opbrys apifera* which sent the reviewer on a determined but hopeless search for this oddity in an area where no Bee Orchid ever grew—and there is the Chicory which turned up so miraculously, together with Lucerne, where no phytogeographer would have expected them. Photographs, additional illustrations, new names, enlarged and amended descriptions, changes and improvements of every kind are evident on almost every page, but the spirit of Edward Step still haunts his immortal work. Did his ghost ordain that *x Ammocalamagrostis ballica* should be included in the chapter on Grasses, and *Poa annua* excluded? Perhaps not, but how characteristic of a spirit that enjoyed caprice, and (very sensibly) relegated the 'less interesting' species to small print, omitting any mention whatsoever of really odious blossoms.

R. D. MENKIE

* *Eikonographemion Botanikon-Phytologikon Lexikon* [Illustrated Botanical-Physiological Dictionary]. By Demetrios S. Kavadas. Vol. 9, *Ferulaeae—Ochroma*. Pp. 4091-4584, figs. 5509-5790. Athens: Leophoros Alexandras [1964]. Price £4 10s.

† *Wayside and Woodland Blossoms*. By Edward Step, revised by R. A. Blacklock. 3 vols. I. Pp. 1x+138, 150 text-figures, 19 half-tone plates, 98 coloured plates; II. Pp. xxx+170, 135 text-figures, 17 half-tone plates, 125 coloured plates; III. Pp. xxii+194, 114 text-figures, 42 half-tone plates, 95 coloured plates. London: Frederick Warne & Co. Ltd., 1963. Price £1 5s. each.

Synopsis of the genus *Bursera* L. in western Mexico, with notes on the material of *Bursera* collected by Sessé & Mocino

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and

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INTRODUCTION

Several important papers on the taxonomy of the Mexican species of *Bursera* were published by A. A. Bullock (1936, 1937, 1938, 1939). A large part of the work was based on the more than 200 numbers, representing some 25 species of *Bursera*, gathered in the states of Mexico, Guerrero and Michoacán by G. B. Hinton. The ample collections obtained by Hinton in these areas made it possible for the first time to interpret and delimit several species that had previously been known from the types only, or from fragmentary or limited materials. Bullock made it plain, however, that a number of additional species in western Mexico were still imperfectly known, and that certain specific complexes were not to be subdivided into natural taxa in the state of knowledge then prevailing.

After study of a large series of specimens recently collected in western Mexico (mostly in the States of Sinaloa, Nayarit, Jalisco, Colima and Michoacán, in the region west of and adjoining that from which Hinton's

drawn by Bullock; we can comment upon the matter of local endemism in western Mexico, and clear up at least a part of the taxonomic confusion that has continued to plague the students of this large and primarily Mexican genus. Our collections have been made for the most part in connection with a proposed 'Flora Novo-Galiciana,'* of which *Burseria* forms an important element.

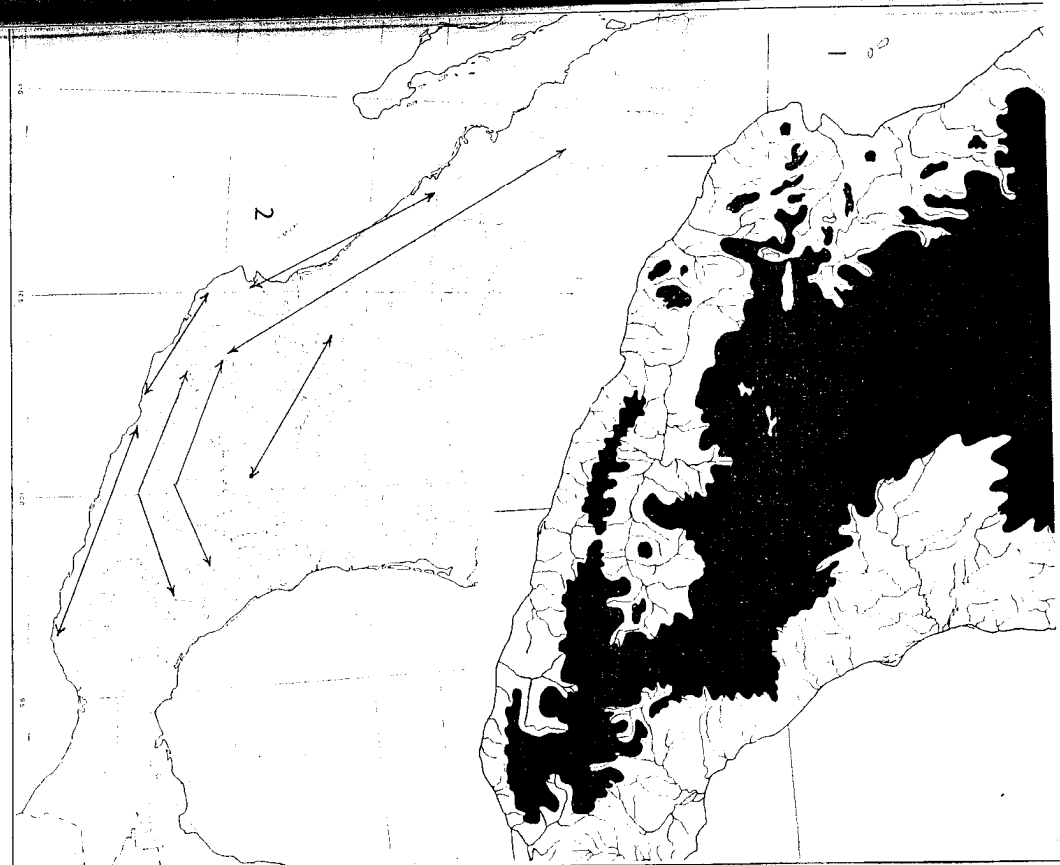
Although several species are known in other areas, and some of them participate in other plant formations, the evidence suggests that the *Burseria* evolutionary line has been most successful in the environment of the tropical deciduous forest on the Pacific slopes of Mexico, and that the history of the evolution of *Burseria* is closely related to the history of that vegetation-type, particularly in western Mexico. Local endemism is frequent there, suggesting that the genus has undergone considerable adaptive radiation associated with ecological and geographical factors (see Map 1, p. 319). As yet there has been so little exploration that few generalizations can be made, but it can be said that a rather natural floristic region extends from northwest to southeast (see Map 1), from about central Sinaloa through most of Nayarit, Jalisco and Colima, and along the coastal mountain ranges (Sierra Madre del Sur) and Guerrero or Oaxaca. The maps accompanying this paper (see Map 1, p. 319; Map 2, p. 336; Map 3, p. 353; Map 4, p. 368) indicate that the ranges of most species extend generally along the same northwest-southeast axis, some near the Pacific coast at low elevations; others (a majority of the species) at middle elevations particularly in the valley of the Río Balsas and to a lesser degree in the barranca-systems of the Río Grande de Santiago and its tributaries; and a small group at higher elevations (1500-2300 meters) near the western and southern limits of the central plateau of Mexico. Few species occur under the conditions that support oaks and pines, and few in the more humid tropical lowland forests; the greatest development of species and of individuals has been in the Balsas depression (see Map 1, p. 319), where much additional field work is needed before an understanding of all the populations of *Burseria* can be reached. There is good evidence that the genus as such existed in early Tertiary time and, accordingly, that evolution in *Burseria* has been a long process. An abundant species in the Lower Oligocene of Colorado, *B. serrulata* (Lesq.) MacGinitie, is superficially very similar to the modern *B. kerberi* Engl. (MacGinitie, 1953: 131). We are indebted to Dr. Alan Graham for calling this to our attention.

In the key and comments that follow, we have attempted to include all the species known from Guerrero or from further west, except for those of the Sonora-Baja California region (which belong to quite a different flora) and a few species that seem to enter Guerrero from the east or northeast by way of the Balsas valley, or are known from that valley only. As far as we know now, these species do not form a part of the 'Flora Novo-Galiciana.'

COLLECTIONS EXAMINED

Five species of *Burseria* were described by A. P. DeCandolle (under the generic names *Elaphrium*, *Amymis*? or *Icica*?) on the basis of paintings from the unpublished 'Flora Mexicana' of Sessé & Mocino. These paintings,

* See Brittonia 13: 145-146 (1961).



Map 1. Generalized correlation between topography and plant-distribution in southwestern Mexico. 1, topography: Areas above 1500 meters in elevation are shown in black. The valley of the Río Balsas and its tributaries occupies the interior lowland paralleling the Pacific coast south of the central highland. 2, principal range-patterns of plant-species as inferred from the known distribution of *Burseria*. Several species of *Burseria* not treated in this paper occur in the area east of the 100th Meridian, but their patterns of distribution are not well known and are not mapped here.

which must be regarded as the types of the species described by DeCandolle (who saw no specimens corresponding to them), form a part of The DeCandolle Library now at the Conservatoire Botanique, Geneva, where they were all photographed for the Chicago Natural History (then Field) Museum (negative Nos. 30582-30584, 30587, 30588). Tracings of four of the plates (all except that representing *Icica*? *serrata*, neg. 30583) were distributed by Alphonse DeCandolle (1874) with the text of his 'Calques

the photographs and the 'calques'. Further, we had in 1962 the invaluable privilege of studying all the material of *Bursera* in the herbarium of Sesse & Mocino, while the collection was on loan from Madrid to the Chicago Museum. All the specimens in the collection have been photographed (Chicago Nat. Hist. Mus. negatives Nos. 41794-41827, 47122, 47123, 47925, 47931), and references below are to these negative numbers.

The collections cited below are all in the herbarium of the University of Michigan, Ann Arbor (MICH), unless otherwise indicated. An almost complete set of the collections of McVaugh, Wilbur & Wilbur, and Feddema, has been sent to Kew (K). The most complete set of Rzedowski's collections is at the Escuela Nacional de Ciencias Biológicas, Mexico, D.F. (IPN).

ACKNOWLEDGEMENTS

The authors acknowledge gratefully the assistance of the National Science Foundation, Washington, D.C., which made possible a part of the field-work in Mexico and also the joint work of the authors in Ann Arbor. The Chicago Natural History Museum kindly permitted the reproduction of several photographs from their files. The drawings are the work of Mr. Charles Feddema.

ECONOMIC USES

To the notes on economic uses outlined by Bullock in his 1936 paper, it should be added that at present the most important use made of *Bursera* trees in Mexico is for living fences. This use has already been noted for *B. simaruba* (L.) Sarg. in Guatemala (see Standley & Steyermark in Fieldiana Bot. 24(5): 440 (1946)). In Mexico several species, including *B. mulungu* Engl., *B. kerberi* Engl. and *B. penicillata* Engl., are used in the same way. A transplanted trunk grows readily and regenerates a normal tree within a few years.

CHARACTERS USED IN CLASSIFICATION

Earlier students of *Bursera*, including Engler, Rose and Standley, depended chiefly upon leaf-characters for the separation and delimitation of species. Unfortunately it is still necessary to do this to a large extent; flowering material of many species is hardly known, and there is still need for carefully collected series of flowering, fruiting and vegetative specimens from the same trees. Flowering specimens are particularly necessary for study because the plants are dioecious or polygamodioecious, and functionally pistillate flowers are quite different from the functionally staminate ones. Both kinds of plants can usually be found at one locality, but flowering specimens are poorly represented in herbaria because, like most of the trees of the deciduous forests of Mexico, the species of *Bursera* begin to flower at the end of the dry season, from April to June, just before or at the same time as the development of new leaves. Most collectors in the past have attempted to profit by the flush of vegetation brought on by the rainy season, and have collected for this reason in the later summer and autumn months, when *Bursera* leaves are fully developed but the fruits are already half-grown or even mature.

ing out the existence of two groups, viz. the species with 2-valved fruit and those with 3-valved fruit. It is our observation that these two groups do indeed form natural taxa, distinguished not only by the character of the fruit, but also in other ways. Characteristics of the ovary, the flowers, the growth-habit and the bark are consistently correlated with those of the fruits and, in addition, hybridization between species seems to take place rather readily within each group but not, as far as we have observed, between groups. The two groups are commonly recognized in Mexico by different names; the species of the bivalvate group are usually given the name 'copal', whereas those of the trivalvate group are usually called 'cuajote'.

The flowers in the bivalvate group of species are predominantly 4-merous (occasionally 5-merous); in the trivalvate group they may be 3-, 4-, or 5-merous.

The ovary in the pistillate flower is bilocular in the one group and trilocular in the other. Our observations indicate that the bivalvate fruit is invariably derived from a bilocular ovary and not, as Engler supposed, from a trilocular ovary in which two locules were completely abortive. The bilocular ovary was noted (in *B. curata* Engl.) by Schlechtendal as long ago as 1843.

As to growth-habit, it may be said in general that the species of the bivalvate group, the 'copales', form short-trunked round-headed trees not unlike apple trees in aspect. Even when they are growing in or at the edge of a forest, when the trunk may become longer and the opportunity for lateral expansion less, the trees may be recognizable at a distance by the divaricate branches arising from various levels along the trunk, individual branches thus often extending beyond the general level of foliage. The species of the other group, the 'cuajotes', prevalently form short-trunked round-headed trees, but with quite a different aspect. The principal branches tend to arise from near the same point, thus producing a head with no central trunk above the point of origin of the branches, and with no prominent projecting branches. Some species of 'cuajotes', it may be noted additionally, are tall trees in the wet tropical forests, where they may reach a height of as much as 20-30 meters; on the other hand some species (e.g. *B. schlechtendalii* Engl., *B. fagaroides* (H.B.K.) Engl.) in arid habitats may be hardly more than shrubs.

The most apparent superficial distinction between the 'copales' and the 'cuajotes' is provided by the bark. In the bivalvate group of species, the 'copales', the bark of the trunk and the larger branches is somewhat rough, with a texture and colour not unlike that of the beech (*Fagus*). The colour varies from pale grey to reddish-grey or dull reddish, greyish-brown, dark grey or almost black. The outer bark even in old trees may be fairly smooth as in *Fagus*, or the surface may be checked or cracked or even separating in thick plate-like scales. The outer layers never separate in thin papery sheets. We have remarked on various occasions that the species of this group are uniform with respect to the bark, so that individual species cannot be distinguished by bark-characters.

In the trivalvate group, the 'cuajotes', the bark is far more colourful and distinctive. The name 'cuajote' itself refers to the fact that the outer layers of bark peel off in thin papery sheets that may be yellow, dull grey-brown or straw colour, coppery-brown, reddish-brown or bright red. The smooth

bluish-green (the papery layers then mostly yellow or straw-colour), or it may vary from brown to bright red or greenish-red (the papery layers then often coppery or red). Old trunks often become loosely scaly with the remnants of the peeled outer layers. The extent of peeling, the thickness and brittleness of the peeling layers, and the colours of both inner and outer barks, vary to such an extent in this group that they sometimes provide valuable means of identification of species.

As pointed out by Standley, there is not complete consistency in the application of vernacular names, the term 'copal' sometimes being applied rather too widely (as, e.g., in the redundant 'cuajote copal'). Both names are also applied to trees of other genera, e.g. 'cuajote' to *Pseudotsingium* Engl. of the *Anacardiaceae*, and 'copal' to *Protium* Burm.f. of the *Burseraceae*.

HYBRIDIZATION

Finally, we believe that useful indications of relationships in the genus are provided by natural hybrids between species. Instances of proven hybridization, of course, are not easy to find but the existence of hybrids may be suggested by conveniently intermediate forms. Field studies of living populations will be needed, as Bullock indeed pointed out, before we can profitably speculate about the extent of hybridization and introgression. Many observations, however, already support the proposition that hybrids occur to a limited extent in nature. This was suspected by Bullock, who cited as evidence the incompletely bipinnate leaves of such species as *B. collina* T. S. Brandegee, *B. diversifolia* Rose, *B. eleniifera* (Royle) Baill. and *B. stenophylla* Sprague & Riley; all of which perhaps owe their peculiarly divided leaves to the presence of genes from the widely distributed *B. bipinnata* (DC.) Engl. Each of the above may represent a different hybrid combination with *B. bipinnata* as one parent, e.g., as suggested by Bullock, *B. collina* with some unspecified species; *B. diversifolia* with *B. glabrifolia* (H.B.K.) Engl., *B. eleniifera* with *B. penicillata* (DC.) Engl.; and *B. stenophylla* with *B. laxiflora* S. Wats. In Guatemala *Bursera excelsa* Engl. is reported as perhaps hybridizing with *B. bipinnata* (Standley & Steyermark, 1946: 437). Our own recent observations suggest that in the group of 'copals' there may be occasional hybrids between *B. copallifera* (DC.) Bullock and *B. bipinnata*, between *B. copallifera* and *B. palmieri* S. Wats., and between *B. bipinnata* and almost any member of the *excelsa* complex. Among the 'cuajotes' we suspect the existence of several hybrids; *B. confusa* (Rose) Engl. may have originated as a series of hybrids, and apparently such species as *B. kerberi* Engl., *B. multijuga* Engl. and perhaps *B. lancifolia* Engl. may occasionally cross in nature. Among the 'cuajotes' there are rarely found individuals that suggest the possibility of hybridization between the red-barked species and those with yellow bark. Some remarks on these several situations are made below in the discussion of individual species. It seems noteworthy that no hybrid between a 'copal' and a 'cuajote' has ever been found or the possibility of such suggested. We have on many occasions searched for such inter-group hybrids in localities where the appropriate species were growing closely together, but we have never seen any indication of the existence of such hybrids.

The species known to Bullock (1936) were treated by him in alphabetical sequence, on the ground that any attempt at an evolutionary classification was unjustifiable in the then state of knowledge. We cannot claim to have clarified the major taxonomic problems in *Bursera*, but it does seem profitable now to call attention to the existence of two major sections of the genus, and to what seem to be several small natural groups within these. The species are arranged below according to the sequence of groups established in the following conspectus, but the sequence of groups, and of the species within each group, is more or less arbitrary and does not pretend necessarily to represent phylogenetic trends, or relationships.

The groups as outlined below seem to us to reflect taxonomic affinities to some extent, but the individual groups are scarcely susceptible of more precise definition and some (e.g. Nos. 1, 2) are, frankly, based on superficially striking vegetative characters. Judging from what we surmise of the parents of the so-called *Bursera diversifolia* Rose, groups 1 and 4 are more closely related than 1 and 3. Group 5 is made to include *B. sarcopoda* P. G. Wilson, *B. fragrantissima* Bullock, and *B. heterosites* Bullock as a matter of convenience; the relationships of these species may well be with group 3 or group 4. Group 7 seems to comprise a natural unit. The inclusion of *B. staphyleoides* McVaugh & Rzedl. in group 8 was dictated by our lack of knowledge of any more likely position for this species. It is possible that further revision of the species in groups 9-11 will suggest quite a different alignment. We cannot suggest any more suitable disposition for *B. schlechtendalii*; although this species resembles those of group 10 in having red, papery bark, it seems to have little more in common with them. It is unique in having entire unifoliate leaves, rather than tough rubbery branchlets and a fragrant but scarcely turpentine-like odour. A connection between groups 10 and 11 is suggested by the morphological features of *B. confusa*, which may well have arisen from hybrids involving *B. multijuga* and one of the yellow-barked plants of the *fagaroides* complex. The species of group 10 are individually distinct, whereas those of group 11 are separated by no very remarkable features.

CONSPECTUS OF THE SPECIES OF BURSERIA IN WESTERN MEXICO

1. **Bursera L.**, Sect. **Bullockia** McVaugh & Rzedl., sect. nov. Arborea medioeres, cortice griseo scabrinusculo nec papyraceo nec desquamante, (*B. sarcopoda* fortasse excepta), floribus plerumque tetrameris, rare pentameris, ovario biloculare, drupis bivalvatis; 'copales' Mexicanorum. Typus, *B. bipinnata* (DC.) Engl.
1. Leaves bipinnate. *B. bipinnata*, *B. diversifolia*. (Species 1-2).
 2. Leaflets mostly 6-8 pairs, dentate, lance-attenuate, lustrous above, white-tomentulose beneath. *B. bicolor*. (Species 3).
 3. Leaflets 1-5 pairs, prominently but not doubly serrate. *B. penicillata*, *B. citronella*, *B. laxiflora*, *B. glabrifolia*. (Species 4-7).
 4. Leaflets 2-12 pairs, usually doubly serrate; inflorescences short and stout, mostly less than 10 cm. long, the fruiting pedicels 5 mm. long or less. *B. copucensis*, *B. copallifera*, *B. excelsa*, *B. palmieri*. (Species 8-11).

- and elongate, often 10 cm. long or more, the fruiting pedicels 5-10 mm. long or more. *B. sarcopoda*, *B. fragrantissima*, *B. heteresthes*. (Species 12-14).
6. Leaves trifoliolate, acuminate, glabrous, prominently and somewhat irregularly serrate from base to apex with many teeth; inflorescences loose, drooping. *B. tecomanca*. (Species 15).

II. *Bursera* L., Sect. *Bursera*.

Bursera N. J. Jacq. ex L., Sp. Pl., ed. 2: 471 (1762), *nom. conserv.*, quoad typ.

Arbores mediciores vel grandes vel frutices, corice exteriori papyraceo colorato desquamato, floribus 3-, 4- vel 5-meris, ovario trilobulato, drupis trivalvatis; 'cajaites' Mexicanorum. Typus, *B. simaruba* (L.) Sarg.

7. Leaflets entire, relatively few and large, mostly 6 pairs or fewer, often 5(-12) cm. long and 2.5(-7) cm. wide; leaf-rachis not winged. *B. attenuata*, '*Terebinthus acuminata*', *B. aff. simarubae*, *B. arborea*, *B. grandifolia*, *B. instabilis*. (Species 16-20).
8. Leaves simple or trifoliolate, the leaflets mostly obtuse, glabrous, elliptic or oblanceolate, finely crenate-serrate with numerous teeth; bark dark red. *B. crenata*, *B. trimeria*, ?*B. subtrifoliata*, ?*B. staphyleoides*. (Species 21-24).
9. Leaves unifoliolate or trifoliolate; leaflets mostly 1-2 cm. long or less, obtuse or rounded at apex, sparingly dentate or quite entire; pistillate inflorescence short, the fruit often nearly sessile; outer papery bark red. *B. trifoliolata*, *B. schlehtendalii*. (Species 25-26).
10. Leaves once-pinnate, the leaflets one or several pairs, mostly elliptic, 2-3(-5) cm. long, acute or acuminate, sharply but sometimes finely serrate; inflorescence short-pedunculate; outer papery bark red. *B. multijuga*, *B. lancifolia*, *B. denticulata*, *B. kerberi*, *B. multifolia*. (Species 27-31).
11. Leaves once-pinnate; leaflets several or many pairs or one pair only, low-serrulate or occasionally small and entire; pistillate inflorescence short and few-flowered, often sessile; outer papery bark straw-colour or yellow. *B. confusa*, *B. fagaroides*, *B. arvensis*, *B. occulta*. (Species 32-35).

KEY TO THE SPECIES AND VARIETIES

1. Drupes bivalvate; ovary bilocular; flowers tetramerous or sometimes pentamerous; bark not peeling in thin papery layers:
2. Leaves \pm bipinnate:
3. Ultimate leaflets small, entire and rounded, up to 1 cm. long
1. *bipinnata*
3. Ultimate leaflets larger, up to 3 cm. long, at least the terminal ones toothed 2. *diversifolia*
2. Leaves simply pinnate, with 3-many leaflets:
4. Leaflets 1-2 cm. long, with 0-3 coarse and often lobe-like teeth on each side, some of the leaflets on each plant usually entire
6. *laxiflora*
4. Leaflets usually longer, \pm regularly crenate or dentate, with five or more teeth on each side:

tendency seen in most leaulets:

6. Leaflets relatively large and broad, some or all of them 5-8 cm. long or more, only the smallest ones as short as 3 cm. and then 1-2 cm. wide:
7. Inflorescence slender, the pedicels in fruit mostly 5-10 mm. long; leaves trifoliolate or, if the leaflets 2 or more pairs, the leaf-rachis not winged:
8. Leaflets mostly 3, obtuse or acute or those on shoots short-acuminate 14. *heteresthes*
8. Leaflets 5-9, acuminate:
- 8a. Leaflets glabrous; pedicels not thickened beneath the fruit 13. *fragrantissima*
- 8a. Leaflets pubescent to tomentulose; pedicels fleshy-thickened beneath the fruit 12. *sarcopoda*
7. Inflorescence relatively compact, the pedicels in fruit 5 mm. long or often less; leaflets often 3-5 pairs, if two pairs the leaf-rachis winged:
9. Leaves persistently tomentose beneath, and stiffly velutinous or crisply pubescent above; leaflets (3-4-5(-6) pairs; fruit obtuse, or sometimes short-apiculate:
10. Leaflets white-tomentose beneath, the lateral ones mostly acute, and sharply serrate with deltoid teeth; pedicels in fruit 1-1.5 mm. long, very stout; fruit when young often loosely hairy, at maturity glabrous; staminate flowers in dense tomentose glomerules up to 1 cm. in diameter; anthers 0.8-1.1 mm. long; highlands; Durango and Zacatecas to Jalisco and Querétaro 11. *palmeri*
10. Leaflets brown-tomentose beneath, the lateral ones often obtuse or rounded at tip, and coarsely dentate with rounded teeth; pedicels in fruit 3-5 mm. long; fruit glabrous from the first; staminate flowers in small loose glomerules; anthers 0.5 mm. long; coastal mountains, Guerrero and Oaxaca
- 10a. *excelsa* var. *excelsa*
9. Leaves softly pubescent beneath, sometimes with long straight hairs also, soon green and rather sparsely pubescent, only the very young foliage white-tomentose; fruiting pedicels (2-)3-5 mm. long:
11. Inflorescence and leaf-rachis pilose (densely when young, rather sparingly in age) with nearly straight hairs up to 1-1.3 mm. long; leaflets 3-5 pairs; fruit ovoid, tapering to a prominent point; Sinaloa to Colima, sea-level to c. 1000 m.
- 10b. *excelsa* var. *favonialis*
11. Inflorescence and leaf-rachis crisp-pubescent or nearly glabrous, usually without long straight hairs; leaflets 2-3(-4) pairs; fruit usually obtuse

or short-apiculate; near the coast, Jalisco to western Guerrero

10c. **excelsa** var. **acutidens**
Leaflets relatively small and narrow, oblong-elliptic, 3-5 cm.

long:

12. Leaflets mostly 7-10 pairs, \pm rugose-reticulate; herbage softly pubescent with mostly crisped or curled hairs

9. **copallifera**

12. Leaflets 3-5 pairs, scarcely rugose-reticulate; herbage pilose with pale nearly straight hairs up to 1-1.5 mm. long

8. **coyucensis**

5. Margins of the leaflets dentate or serrate with fine or coarse teeth, but the teeth all or mostly simple:

13. Leaflets strongly bicolorous, white beneath, lustrous above, (4-)-6-8 pairs, lance-attenuate, about 1 cm. wide, 4-8 cm. long

3. **bicolor**

13. Leaflets not bicolorous, if more than 3-5 pairs not as above:

14. Leaflets (5-)-7-10 pairs, strongly rugose and lightly pubescent above, tomentose beneath, oblong-elliptic, 3-4.5 cm. long; the margin rather finely serrate.

9. **copallifera**

14. Leaflets 1-5 pairs, and never with the above characters combined:

15. Leaflets acuminate to caudate, often narrower (2-5-3 times as long as wide) or with numerous teeth:

16. Leaflets 3, thin, glabrous

15. **tecomaca**

16. Leaflets more numerous, or if sometimes 3 rather thick and sparsely pubescent:

17. Leaflets mostly (1-)-2(-3) pairs, caudate-acuminate, sparingly pubescent; leaf-rachis not winged; pedicels not much enlarged below

13. **fragrantissima**

17. Leaflets 3-5 pairs or, if rarely 2 pairs, densely pubescent:

18. Rachis of leaf wingless; leaflets acuminate, up to 16 cm. long, conspicuously serrate-crenate, densely and softly pubescent on both sides; pedicels fleshy-thickened below the fruit

12. **sarcopoda**

18. Rachis of leaf winged; leaflets acuminate or attenuate, often caudate, 6-10 cm. long (often 3-6 cm. at flowering time), rather prominently but not doubly serrate, the teeth toward the narrow entire tip of the leaflet elongating but markedly diminishing in height; leaves mostly glabrous or nearly so, the rachis often more or less coarsely penicillate-barbate at the nodes; pedicels not thickened, or but slightly expanded below the fruit

4. **penicillata**

short-acuminate, often broader (1-2) times as long as wide); often (at least the lateral ones) with 10 teeth or fewer on each side:

19. Leaflets usually one pair, the lateral ones with (8-)-12-20 principal teeth on side

14. **heteresthes**

19. Leaflets 2-5 pairs, coarsely dentate with 8 or usually fewer often rounded teeth on each side:

20. Leaflets usually 3-5 pairs, rarely fewer, 2-3(-4) cm. long, even the terminal ones only rarely longer; blades coriaceous, lustrous above:

21. Herbage, especially the leaf-rachis, petioles and veins of the lower leaf-surface, coarsely pilose with straight pale hairs up to 1-1.5 mm. long

8. **coyucensis**

21. Herbage nearly glabrous, or the nodes of the leaf-rachis barbate, or sometimes the rachis and petiole velutinous with soft brownish hairs

7. **glabrifolia**

20. Leaflets usually 2 pairs, sometimes 3 pairs, only the shorter ones as little as 2-3 cm. long and the terminal leaflets then 3.5-6(-8) cm. long; blades thinner, not lustrous above

5. **citronella**

1. Drupes trivalvate; ovary trilocular; flowers trimorous, tetramerous or pentamerous; bark peeling off in thin papery sheets (except some populations of 7, *grandifolia* and 16a, *attenuata*):

22. Leaves 1- or 3-foliolate:

23. Leaves rather densely pubescent on both surfaces, trifoliolate (rarely 5-foliolate on vigorous shoots); terminal leaflets notably larger than the sessile lateral ones, broadly obovate-cuneate, 1.5-3(-5) cm. long, the cuneate base entire; Michoacan; Guerrero; Edo. de México

25. **trifoliolata**

23. Leaves quite glabrous, or barbate along the nerves:

24. Petioles 5-9 cm. long; leaflets 3, caudate-acuminate, coarsely serrulate with numerous teeth

30. **kerberi**

24. Petioles 1-2(-4) cm. long or less; leaflets various:

25. Blades entire; leaves simple, or if 3- or 5-foliolate the leaflets ovate, acute, 4-7 cm. long:

26. Leaves always simple, 1-4 cm. long, obtuse or rounded at tip, rarely acute; petioles usually less than 1 cm. long

26. **schlechtendalii**

26. Leaves simple or 3- or 5-foliolate, the blades ovate, 4-8 cm. long, prominently acute or acuminate; petioles 1-4 cm. long

20. **instabilis**

25. Blades toothed or, if entire, the leaves with 3 or more mostly obtuse leaflets, 1-2 cm. long or less:

27. Leaflets mostly more than 2 cm. long, the terminal ones (or unifoliolate blades) usually considerably longer than this; blades crenate or crenate-serrate with numerous teeth (15-20 or often more on each side):

22. Leaves 5- to many-foliolate:
31. Leaflets entire, relatively large and few, often 5(-12) cm. long and 2.5(-7) cm. wide, 2-4(-6) pairs:
32. Fruit and ovary densely crisp-pubescent like the branchlets, inflorescences and both surfaces of the leaves; leaflets 2-3(-4) pairs, rather persistently pubescent above, the lateral ones nearly sessile (petioles none, or up to 2-4 mm. long), rather abruptly acuminate; inflorescence 2-4 cm. long, congested, the stout pedicels in fruit 1.5-3 mm. long; drupe 7-10 mm. long; bark of the trunk green, yellow-green, greenish-grey or greenish-brown, the outer loose papery layers light brown or tan, orange-brown or reddish-brown 19. **grandifolia**
32. Fruit glabrous, the ovary sometimes sparingly pubescent; branchlets and herbage glabrous or variously pubescent; leaves glabrous or usually glabrescent above; lateral leaflets markedly petiolulate, the petioles often 5(-10) mm. long; inflorescence often 5 cm. long or more and the fruiting pedicels 5-10 mm. long:
33. Branchlets, inflorescence (except the ovary) and herbage at flowering time densely cinereous-puberulent; mature veins; lateral leaflets 1-4 pairs (usually 3 pairs); on slender petioles often 5-10 mm. long, the blades acute or rounded at base, not markedly unequally decurrent on the petioles; inflorescence 2-4 cm. long, the slender pedicels 3-5 mm. long in flower, 4-6 mm. in fruit; fruit about 7 mm. long; bark notably red, not brown or yellow, the outer papery layers 'brownish-red' or 'dark red' 18. **arborea**
23. **subtrifoliata**
24. **staphyleoides**
27. Leaflets mostly 1-2(-2.5) cm. long or less, the lateral ones often shorter; blades crenate with about 8-10(-15) teeth or fewer on each side, the crenations sometimes obscure or the margins quite entire: 22. **trimeria**
28. Blades of lateral leaflets and unifoliate blades elliptic, oblong or oblanceolate, obtuse or sometimes short-acuminate or acute, 1-2.5 cm. wide, rather deeply crenate-serrate; outer papery bark red:
29. Leaves mostly trifoliate, when rarely unifoliate the blades oblong, broadly rounded at base; petioles of trifoliate leaves 1 cm. long or more; fruiting pedicels 1-2 mm. long, stiffly spreading, not curved nor cernuous 21. **crenata**
29. Leaves mostly trifoliate, when rarely unifoliate the blades oblong, broadly rounded at base; petioles of trifoliate leaves 1 cm. long or more; fruiting pedicels 1-2 mm. long, stiffly spreading, not curved nor cernuous 22. **trimeria**
30. Leaflets crenate with 10-15 teeth on each side, cuneate at base; leaves simple or trifoliate; colour of outer papery bark unknown; region of Bolaños, Jalisco 23. **subtrifoliata**
30. Leaflets obscurely crenate, usually with fewer than 10 teeth on each side; leaflets 3, or usually more than 3; outer papery bark straw-colour.—anomalous forms of 33. **fagaroides**
31. Branchlets, inflorescence and herbage even at flowering time glabrous, or rather sparingly stiff-pilose especially about the nodes of the branchlets, nodes of the inflorescence or axils of the foliar veins; lateral leaflets often unequally cordate-auriculate, one side long-decurrent on the petiole; the pedicels 5-10 mm. long; bark loosely flowered, the pedicels 5-10 mm. long; bark greenish-red or greenish-brown, the outer papery layers grey-brown, orange-brown or reddish-brown:
34. Inflorescence usually much longer and the leaflets more numerous; petioles in 5-foliolate leaves mostly 6-11 cm. long; well-developed leaves always with 5 or more leaflets:
35. Leaflets glabrous except for dense tufts of coarse hairs on the lower surface in the axils of the basal veins; young leaves sparingly glandular, the plants otherwise glabrous from the first; lateral leaflets 3-5 pairs, as seen from above very unequal-sided and usually cordate-auriculate; Sinaloa, Nayarit 16a. **attenuata**
35. Leaflets glabrous or sparingly hairy especially on the veins beneath, the hairs never in axillary tufts beside the base of the mid-vein; tufts of hairs sometimes present about the nodes of the branchlets and inflorescences:
36. Leaflets 3-6 pairs, glabrous; petiole-bases and often lower part of the inflorescence rachis and the surrounding stem tufted with stiff hairs; Pacific lowlands, Sonora to Oaxaca 17. **B. sp. aff. simarubae**
36. Leaflets 2-3(-4) pairs, sparingly pilose at least when young on the main veins beneath, the plants otherwise glabrous; from Jalisco and Michoacán eastward, mostly 1200-1800 m. 16b. **Terebinthus acuminata**
31. Leaflets serrate-crenate, few or numerous, if entire much smaller (1-2 cm. long or less) or narrow and elongate, or both:
37. Leaflets linear or oblong-linear, entire, obtuse, glabrous, 6-40 mm. long, 2-3 mm. wide:

1. **Bursera bipinnata** (Sessé & Moc. ex DC.) Engl. in Engl., Bot. Jahrb. 1: 44 (1881).

Amyris? bipinnata Sessé & Moc. ex DC. in DC., Prodr. 2: 82 (1825); A. DC., Calq. Dess., t. 197 (1875).

There seems to be no question of the correct typification of this species. A photograph of Plate 197 of the 'H. mex. ic. ined.' (i.e. of A. DeCandolle's 'Calques') shows clearly the species under discussion and the original painting at Geneva may be regarded as the type (Field Mus. neg. 30584). In the herbarium of Sessé & Mociño there are four sheets (Nos. 4690-4693, inclusive) of *Bursera bipinnata*. Apparently these represent four different gatherings. Two of these are mature fruiting specimens (4690, 4692); one (4691) bears flowers and very immature leaves and one (4693) flowers and half-grown leaves. None bears the epithet 'bipinnata', but this is not surprising, as relatively few of the species in the herbarium of Sessé & Mociño bear the names under which they were described by DeCandolle.

This species is so distinctive and so widespread that it seems unnecessary to cite all the numerous specimens examined. The range of *B. bipinnata* is from southwestern Chihuahua to Michoacán and as far as Honduras and El Salvador, mostly at middle elevations (700-1800 m.).

2. **B. diversifolia** Rose in Contr. U.S. Nat. Herb. 5: 113 (1897).

Bullock (1938) has expressed the opinion that 'there is now little doubt that *B. diversifolia* is a hybrid between *B. bipinnata* . . . and *B. glabrifolia*'; he cited as confirmation of this a series of specimens collected by Hinton, some of which bore doubly pinnate leaves and others, from the same tree, simply pinnate leaves resembling those of *glabrifolia*. We are inclined to agree with Bullock as to the probable hybrid origin of *B. diversifolia*, but we are not sure that *B. glabrifolia* is involved. It is true that some of the leaflets of the supposed hybrids (e.g. in Hinton 9262 and 10072, taken from the same tree, and both cited by Bullock) suggest in size and general appearance those of *B. glabrifolia*, but they are copiously pubescent beneath with crisped tawny hairs, in this respect much like the leaflets of *B. excelsa* which grows in the same general region. Some of the leaves in No. 9262 and apparently all the leaves in No. 10072 are once-compound only, and many of the leaflets are larger than those of *B. glabrifolia*. It does not seem probable that a hybrid between two species would have larger leaflets than either parent, nor considerable amounts of pubescence on surfaces that are glabrous or essentially so in both parents.

Field observations made in 1962 confirm our view that *B. bipinnata* hybridizes occasionally in nature with *B. excelsa* and its close relatives, and with *B. copallifera*. In Chiapas, where *B. bipinnata* may be found closely associated with plants of the *B. palmieri-B. tomentosa* type (see p. 345), the so-called *B. diversifolia* has densely pale-tomentose leaves suggesting those of *B. tomentosa* in colour and texture; in our specimens the leaves are almost all twice compound, the largest undivided leaflets 2-2.5 cm. long:

CHIAPAS: Roadside tree near summit of *cuesta* about 10 road-miles [16 km.] E. of Chiapa (c. 20 miles [32 km.] E. of Tuxtla Gutiérrez), 1050 m., 15 Oct. 1962 (fr.), *McVaugh* 21842; roadside, tropical forest zone 14 miles [c. 24 km.] W. of Tuxtla, 825 m., 16 Oct. 1962 (sterile), *McVaugh* 21845.

B. bipinnata and *B. copallifera* occur in close association, we found occasional trees that without much question represented intermediates between these two species. The leaves in the two trees that we saw were lustrous as in *bipinnata*, rugose as in *copallifera*, most of the leaflets simple and suggesting those of *copallifera* but often only 1-2 cm. long, a few of them on each branch lobed or pinnate:

GUERRERO: Deciduous forest zone with some pines, 10 miles [16 km.] W. of Chilpancingo, road to Omiltemi, 1600 m., 21 Oct. 1962 (sterile), *McVaugh* 21915.

MICHOACÁN: Oak zone 12 miles [c. 19 km.] NW. of Zitácuaro, 1800 m., 24 Oct. 1962 (fr.), *McVaugh* 21924.

The following specimens, of which only one bears bipinnate leaves, may represent hybrids involving some member or members of the *excelsa*-complex; all the specimens are more or less pubescent as described above, and indeed resemble examples of *B. excelsa* in which the leaflets are of less than normal size:

MICHOACÁN: Distr. Coalcomán, Sierra Naranjillo, 1460 m., 26 Nov. 1938 (sterile; some lvs. bipinnate), *Hinton* 12686; *ibid.*, Huizontla, 340 m., 17 Nov. 1938 (sterile, with blunt lvs.), *Hinton* 12595; *ibid.*, 1260 m., 15 Nov. 1938 (fr.; lvs. blunt or acute), *Hinton* 12575; *ibid.*, Villa Victoria, 760 m., 12 Nov. 1938 (sterile; lvs. acute), *Hinton* 12553; *ibid.*, 1060 m., 13 Nov. 1938 (sterile, lvs. acute), *Hinton* 12652.

We have also seen the following specimen in which the leaves are multi-jugate, with 7-11 pairs of lanceolate and strongly pubescent leaflets; some of the leaflets on each leaf are themselves compound; the inflorescences are slender and 10-15 cm. long. If this plant represents a hybrid, we cannot guess what species (other than *B. bipinnata*) may have been involved in its production unless it be something like *B. bicolor* or *B. copallifera*:

MICHOACÁN: Distr. Coalcomán, Villa Victoria, 700 m., 11 Jul. 1939 (imm. fr.), *Hinton* 13910.

Evidently of the same stock as the above, but with most of the leaflets undivided, is the following:

MICHOACÁN: Distr. Coalcomán, 1100 m., 30 Nov. 1938 (sterile), *Hinton* 12691 (US).

In spite of the occurrence of these presumed hybrids involving *Bursera bipinnata*, that species does not seem to out-cross very freely in nature. It is one of the most common and widely distributed species of its genus and it is very often associated closely with one or more species of the bicarpellate group, including not only *B. excelsa* and its relatives, and *B. copallifera*, but often *B. bicolor*, *B. glabrifolia* or *B. penicillata*. In 1962 we searched repeatedly for hybrids involving *B. bipinnata* and either *B. glabrifolia* or *B. penicillata*, but even where the species grew together in disturbed habitats we found no intermediate individuals.

3. **B. bicolor** (Willd. ex Schlechtend.) Engl. in Engl., Bot. Jahrb. 1: 44 (1881). *Elaphrium bicolor* Willd. ex Schlechtend. in Linnaea 17: 625 (1843).

A distinctive species because of the narrow large well-separated leaflets which are dark green above and white-tomentose beneath. The margins of

seems to be no indication of the tendency to doubly serrate margins like those in the groups of *B. excelsa* and *B. copallifera*. We emphasize this because the one specimen (*Hinton* 7647), cited by Bullock (1936) as *Bursera copallifera*, has 5-6 pairs of rather narrowly pointed leaflets that are pale-tomentose beneath, and sharply and distinctively simply serrate. We have not seen anything else like it. It certainly is not *B. bicolor*, nor is it *B. copallifera* in our sense (*B. jorillensis*), but in some respects it seems intermediate between these species, and conceivably might be of hybrid origin. It also bears some resemblance to *B. cuneata* (see under *B. copallifera*, p. 342), which has inconspicuously doubly-dentate leaflets and which is known from the same general area in the State of Mexico.

In addition to the specimens cited by Bullock under *B. bicolor*, we have seen the following, which extend the range of the species barely into our area:

MICHOACÁN: Distr. Apatzingán, between Acahuato and Apatzingán, c. 750 m., 14 Aug. 1941 (vs.), *Laavmworth* & *Hoogstraal* 1531 (F); *ibid.*, above Acahuato, c. 960 m., 17 Aug. 1941 (fr.), *Laavmworth* & *Hoogstraal* 1694 (F).

4. *B. penicillata* (Sessé & Moc. ex DC.) Engl. in Engl., Bot. Jahrb. 1: 44 (1881).

Elaphrium penicillatum Sessé & Moc. ex DC. in DC., Prodr. 1: 724 (1824).

? *Bursera graveolens* β *pilosa* Engl. in DC., Monogr. Phan. 4: 49 (1883).

B. mexicana Engl. in DC., Monogr. Phan. 4: 51 (1883).

B. inopinata Bullock in Bull. Misc. Inf. Kew 1937: 456 (1937).

The type of *Elaphrium penicillatum* presumably is the drawing, now at Geneva, representing a Sessé & Mocino plant (Field Mus. neg. 30588). The drawing is crudely done, representing an ample specimen with several leaves and inflorescences. Another drawing (Field Mus. neg. 30351) is more carefully done and may have influenced DeCandolle's concept of the species. In both drawings the leaflets are in four pairs for the most part, somewhat broader than usual in this species but not excessively so. The inflorescences in both are as described by DeCandolle: 'Racemis paucifloris folio triplo fere brevioribus'. The barbellate nodes of the leaf-rachis and the pilose petiole-bases, both described by DeCandolle, are shown in neg. 30351 only.

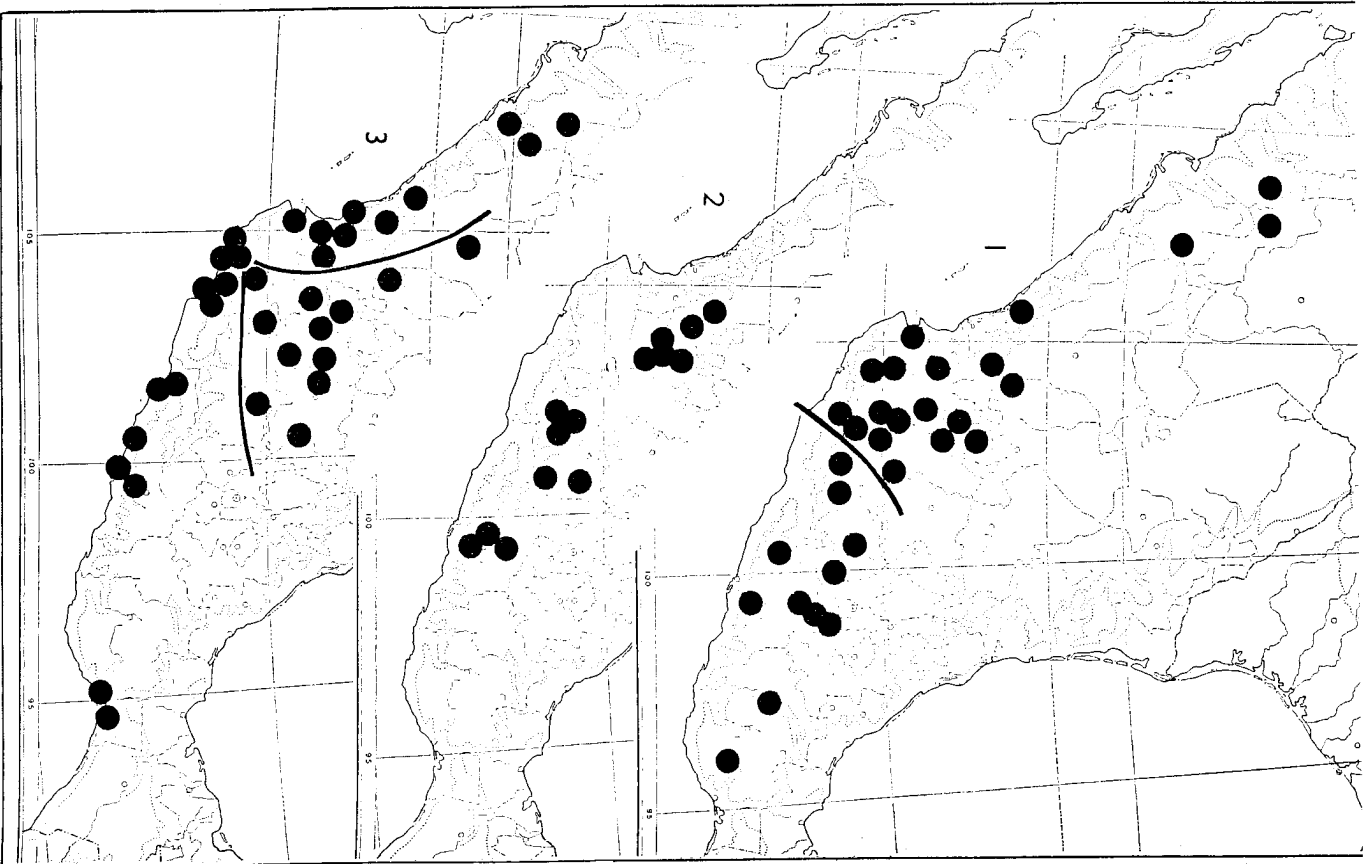
What appears to be the same species as that delineated by the artists of Sessé & Mocino is represented in their herbarium by Nos. 4688 (7 sheets) and 4689 (one sheet, with leaves only). All seven sheets of No. 4688 are from flowering plants or bear young leaves only, and in several specimens the inflorescences are half as long as the leaves or less, as described by DeCandolle. As often appears to be the case in the Sessé & Mocino herbarium, the labels bear little relation to names published either by the collectors themselves or by other authors. In this instance but two sheets are named; one to genus only (*Schinus*) and the other given a specific epithet (in *Schinus*) referring to the 8 stamens.

From the Sessé & Mocino drawings (imperfect as they are) we suppose the artist was working from a plant having rather prominently narrow-acuminate leaflets with large forwardly-directed teeth. Because of this; because of DeCandolle's description of the leaves of flowering specimens as 'subglabris' and his reference to the penicillate nodes; and because of the specimens in the Sessé & Mocino herbarium, as discussed above, we have no doubt of the identity of this species. It is in fact precisely *B. inopinata* in the sense of Bullock.

original concept of *Elaphrium penicillatum*.

The interpretation of *Elaphrium penicillatum* published by Bullock (1936: 374) is thus considerably different from ours. In his sense *Bursera penicillata* was a plant with leaflets mostly less than 4 cm. long, contrasted by him mainly with *B. glabrifolia*. We have not seen all the specimens cited by Bullock, but it seems to us that more than one species was involved. A specimen from Huejutlán, Jalisco, *Diguet* s.n. (US) we take to be *B. penicillata* in our sense, whereas *Hinton* 683 (F), 7697 (US), 7728 (F) and 7734 (F) we take to be flowering specimens of *B. glabrifolia* (H.B.K.) Engl. The type of *Elaphrium glabrifolium* H.B.K. (as well shown in Field Mus. neg. 35858) was a mature leafy specimen and most other specimens in herbaria have been collected at the same stage of development, after the flowers have passed and most of the pubescence fallen. Close examination of the leaves and branchlets of even an old leafy specimen of *B. glabrifolia*, however, will show the persistence of rather large amounts of long and closely aggregated hairs; the nodes of the leaf-rachis are barbellate (the hairs usually much longer than elsewhere on the rachis) as in *B. penicillata* (in our sense) but the plants are otherwise much more strongly pubescent than *B. penicillata*. The pubescence of the flowering specimens cited above agrees precisely with that of more mature specimens of *B. glabrifolia* except that as might be expected it is more generally distributed. The leaflets of these flowering specimens are in part obtuse as in most mature specimens of *glabrifolia*, and in part acute (as indicated by Bullock) but not more acute than some leaflets of the type of *B. glabrifolia*. The principal development of *Bursera penicillata* appears to be in western Mexico, where it is common and wide-ranging, and shows some variation in pubescence and in leaf-size. It is possible to demonstrate a completely intergrading series from plants with large tufts of coarse hairs on the leaf-rachis to those in which the leaves are quite glabrous. The plant is a characteristic one in partly open broken or rocky hills and canyons, on old lava-flows, flood-plains and bluffs, in subtropical deciduous forest or sometimes with oaks or pines, primarily at middle elevations (300-1850 m.), but sometimes near the coast, from southwestern Chihuahua to Sinaloa, Colima and western Michoacán (see Map 2/1, p. 336). We have not seen any material from further east in Mexico; specimens cited by Bullock from the State of Mexico, as pointed out above, we take to be *B. glabrifolia*; we have not seen the specimen cited from Puebla (*Purpus* 4070). Two collections from Guerrero, District of Mina (*Hinton* 10442, 10443), seen by us at US, cited by Bullock (1938: 167), seem to us to represent another and perhaps undescribed species. The leaflets are fewer than usual in *B. penicillata* (1 to 3 or occasionally 4 pairs), the teeth of the leaflets are more numerous and differently shaped, the crisped hairs of the veins of the lower leaf-surfaces are quite different from those of *B. penicillata*, and the leaf-rachis is very narrowly or not at all winged.

The type of *B. alpechinana* (Field Mus. neg. 35857), also referred by Bullock (1936: 374) to his *B. penicillata*, seems to us rather to suggest *B. glabrifolia* than what we take to be the true *penicillata*. The type of *B. mexicana* Engl. appears from the photograph (Field Mus. neg. 35861) to represent an average specimen of *B. penicillata* in our sense; like many of Vrielt d'Aroust's collections it presumably came from San Luis Potosí, but we have seen no modern collections from that state.



MAP 2. Distribution of *Bursera* in western Mexico. 1, *B. penicillata* and (east of the heavy line), *B. glabrifolia*. 2, *B. copallifera*. 3, *B. excelsa* and (inland from the heavy lines), *B. palmieri*.

4571: Sierra Surrotaro, Las Mesas, c. 900 m., 25 Aug. 1941 (H.), *Verney* 6157; *ibid.*, 15 Sep. 1941 (sterile), *Gentry* 6633; tropical deciduous forest 12 km. NNW. of La Concha, 50 m., 17 July 1957 (H.), *Rzedowski* 9201.

ZACATECAS: 14 km. SW. of Jalpa, 1450 m., 25 June 1957 (H.), *Rzedowski* 9124.

AGUASCALIENTES: Road to Calvillo, W. of Aguascalientes near km. 40, 1850 m., 25 Aug. 1960 (fr.), *McVaugh* 18320.

NAVARRA: Valley of Río Jesús María, 10 km. E. of Jesús María, 1000 m., 20–21 Sep. 1960 (fr.), *Feddena* 1368; Ojos de Agua near Yxtlán del Río, 1100 m., 23 Sep. 1926 (fr.), *Mexia* 749; above the lake NE. of Santa María del Oro, 1000 m., 18–20 Aug. 1959 (fr.), *Feddena* 719; km. 870, 22 miles [c. 35 km.] SE. of Tepic, 1150 m., 26 Aug. 1957 (fr.), *McVaugh* 16414; lava flows from Volcán Ceborroco, NW. of Ahuacatlán, 900 m., 13 July 1957 (H.), *McVaugh* 15381; *ibid.*, 1100 m., 13 Aug. 1959 (fr.), *Feddena* 414.

JALISCO: Road from S. Juan Capistrano [to Huejuquilla], 23 Aug. 1897, *Roe* 2506 (MEXU, US); barranca of Río Verde, 20 miles [32 km.] N. of Tepatlán, 1450 m., 27–28 Aug. 1958 (fr.), *McVaugh* 17370; near El Molino, ca. 25 miles [40 km.] SW. of Guadaluajara, 1650 m., 2 July 1957 (H.), *McVaugh* 15125; 5–5 miles [c. 9 km.] N. of Tecalitlán, 1200 m., 21 June 1957 (H.), 1892, *Jones* 43 (US); vicinity of Autlán, c. 1000 m., 27 June 1949 (H.), *Wilbur* & *Wilbur* 1385; *ibid.*, 12 July 1949 (imm. fr.), *Wilbur* & *Wilbur* 1687; *ibid.*, 18 Aug. 1949, *Wilbur* & *Wilbur* 2391; wooded summits, oak zone 7 miles [c. 11 km.] SW. of Ayutla, 1500 m., 2 Nov. 1962 (sterile), *McVaugh* 22004; Puerto Vallarta, 21 July 1932, *Howell* 10330 (US).

MICHOACÁN: Palo Alto, above the S. shore of Lake Chapala near the Jalisco line, 1500 m., 26 June 1957 (H.), *McVaugh* 15047; Cotija, 12 Aug. 1890, *García* s.n. (MEXU); 7 miles [c. 11 km.] NW. of La Piedra, in rocky ravine above Río Lerma, 1700 m., 6 Oct. 1962 (fr.), *McVaugh* 21779.

COLIMA: Bridge of Río Tuxpan, km. 189, 18 miles [c. 29 km.] by road E. of Colima, 300 m., 17 July 1957 (imm. fr.), *McVaugh* 15485.

The North American plant that we take to be *B. penicillata* (Pl. 1/2, p. 344) has been compared by several authors with the South American *Bursera graveolens* (H.B.K.) Triana & Planch. As pointed out by Bullock, the differences between the North and South American plants are not great, and the two may actually be conspecific. If the two species are to be united, it should be noted that the name for the North American plant is the older by a few months; the pertinent part of the first volume of De Candolle's 'Prodromus' was published in mid-January 1824, whereas the pages dealing with *Elaphium* in the 'Nova Genera et Species' appeared in print in November of the same year.

The range of *B. graveolens* extends north to Guatemala, Honduras, Chiapas and Yucatán. It seems surprising that, as far as we know, no collections referable to *B. penicillata* or to *B. graveolens* have been made anywhere in the area between the Isthmus of Tehuantepec and western Michoacán.

5. ***Bursera citronella*** *McVaugh* & *Rzed.*, sp. nov.; a *B. glabrifolia* (H.B.K.) Engl. foliols 5 vel 7 majoribus tenuioribusque vix reticulatis, ramulis subglabris, interstius inter juga anguste alatis recedent; foliola grossiuscule dentata, dentibus quoque latere plerumque 8–10 rotundatis.

bijuga, juvenilia subtus sparse pilosa, supra praesertim secus nervos puberula, rhachidibus petiolisque pluinuase stipitato-glandulosis, nodis rhachidis barbata; rachis anguste alata, alis 2-4 mm. latis; petioli 2-4(-6) cm. longi, demum glabrati; interstitia inter juga 1.5-3 cm. longa; foliolum terminale rhombico-obovatum vel -ovatum vel -ellipticum, 3-6(-8) cm. longum, apice acutum, ad basin cuneatum integrum; foliola lateralia subsessilia vel petiolulis 1-2 mm. longis instructa, apice acuta vel obtusa, basi rotundata vel plerumque acuta, 2.5-4(-6) cm. longa, quam terminale satis minor; foliola omnia plana, inconspicue pallido-venosa; inflorescentia coactanea, cum folia ex axillis perularum orta, laxe thyrsoida (δ tantum visi), 4-7 cm. longa, subglabra, sparse glandulis minutis stipitatis et superpellis pallidis 0.5-0.8 mm. longis praedita; ramuli irregulariter pauciflori, bracteis subulatis 1-3 mm. longis glandulosis, superioribus gradatim minoribus, pedicellis usque ad 3 mm. longis (inflorescentiae pedicelli ut videtur 8-12 mm. longi). Flores δ tetrameri; calyx parvus, 4-dentatus, dentibus triangularibus 0.5 mm. longis. Petala 4, oblongo-linearia, 3 mm. longa, 0.7-0.8 mm. lata, extra praesertim linea media leviter pilosa. Stamina 8, filamentis subulatis 1 mm. longis vel paullo longioribus, minutum. Drupae obovoideae vel ellipsoideae, circiter 10-13 mm. longae et 8 mm. diametro, glabrae, demum valvis 2 dehiscentes. Pyrenae lenticuliformes, 6 mm. longae, dimidio inferiore mesocarpio arilliforme indutae. Pl. 1/3, p. 344.

Type: MEXICO: MICHOACÁN: Distr. Coacomán, Trojes, barranca, 500 m. alt., 30 Sep. 1938 (fr.), *Hinton* 12299 (MICH, holotype; K, isotype).

COLIMA: Slate-gypsum hills near the pass 11 miles [c. 18 km.] SSW. of Colima, 500 m., 19 July 1957 (imm. fr.), *McVaugh* 15557; *ibid.*, 10 Aug. 1957 (fr.), *McVaugh* 16045.

JALISCO: Deciduous forest on creviced limestone 6 miles [c. 10 km.] SW. of Pihnamo, 650 m., 29 Oct. 1962 (fr.), *McVaugh* 21978.

MICHOACÁN: Distr. Coacomán, Parotas, 760-830 m., 28 Sep. 1938, *Hinton* 12280, 12281, 12282, 12283; *ibid.*, Trojes, 460-600 m., 30 Sep. 1938, *Hinton* 12294, 12295, 12297, 12299 (MICH, holotype; K, isotype); *ibid.*, Villa Victoria, 700-740 m., 2 Oct. 1938, *Hinton* 12305, 12308, 12311; *ibid.*, 700 m., 12 Nov. 1938, *Hinton* 12556; *ibid.*, 1080 m., 13 Nov. 1938, *Hinton* 12563; *ibid.*, San Pedro, 600 m., 21 June 1939 (fl.), *Hinton* 13829.

Our description of the flowers was drawn entirely from *Hinton* 13829; all the other cited specimens are in fruit, or sterile.

In Bullock's key (1936: 351) this plant would run down to *B. penicillata* or to *B. glabrifolia*, depending upon the individual specimen. As far as we can tell from Bullock's citations, he saw no material of it; it appears to be of restricted distribution, known to us only through three collections from calcareous hills in southeastern Jalisco and adjacent Colima, and a series of 14 numbers collected in the District of Coacomán, Michoacán, in 1938 and 1939. All the material is consistent in having two or three pairs of lateral leaflets, these nearly glabrous, with few coarse teeth. Specimens of *B. excelsa* var. *axatidens* from the same general area may have 2-3 pairs of leaflets but the margins of the leaflets are doubly serrate with up to 20 or more

having more numerous as well as doubly-serrate lealets. The new species differs from *B. penicillata* in having fewer and somewhat more coarsely toothed leaflets which are obtuse or acute, or very shortly acuminate, and at the same time 1.5-2 times as long as broad; in *B. penicillata* the leaflets are 3-5 pairs, mostly acuminate or caudate, and 2.5-3 times as long as wide; both in *B. penicillata* and in *B. citronella* the nodes of the leaf-rachis may be penicillate-barbate.

Finally, *B. citronella* seems to be closely related to *B. glabrifolia*; ordinarily the two are readily separable by the key characters, but an occasional specimen of nearly typical *glabrifolia* may suggest the new species by its somewhat larger and coarsely toothed leaflets.

In spite of numerous resemblances to *B. excelsa*, *B. penicillata* and *B. glabrifolia*, we think this plant represents a distinct but local species. In leaf morphology and in its distinctive odour it is quite unlike any other species known to us. The odour is at once apparent when the bark or foliage is cut or crushed, and is exactly that of citronella oil, distinctively different from the turpentine-like odour characteristic of many species of *Bursera*. Unfortunately we have little flowering material of the new species.

The vernacular name 'linaloe', to judge from the data on Hinton's specimens, is well established in western Michoacán. It seems to be well known in Colima also; the material used by Doelker* in a recent study of linaloe oil was obtained in Colima (Municipio de Tepames). Although no specimens are available, it is probable that the material studied by Doelker was taken from plants of *Bursera citronella*.

We have not seen any authentic material of *Amyris linaloe*? La Llave, which Bullock (1936: 363) refers to the synonymy of *Bursera glabrifolia*, but it seems unlikely that our plant is the same as that of La Llave, which came from somewhere east or southeast of Mexico City ('por el rumbo de Tehuacán y La Misteca') and was described as having 3 pairs of obovate-lanceolate leaflets. It is probable that the name 'linaloe' is applied to more than one fragrant-smelling species. Near Xalitla, Guerrero, in the valley of the Río Balsas, in October 1962, we were informed that *Bursera copalifera* was known here as 'linaloe' (*McVaugh* 21992); elsewhere the same species is commonly called 'copal'.

Mr. Hinton collected also, in the vicinity of Villa Victoria, Michoacán, whence came some of his collections of the plant called 'linaloe', several specimens of a *Bursera* for which he obtained the vernacular name 'copalillo' and concerning which he stated definitely that the plant was 'not linaloe'. Morphologically these appear to be identical with specimens of the true 'linaloe'. All the specimens are in fruit:

MICHOACÁN: Distr. Coacomán, Villa Victoria, 600 m., 11 Nov. 1938, *Hinton* 12539, 12542, 12543; *ibid.*, 10 July 1939, *Hinton* 13900.

6. **B. laxiflora** S. Wats. in Proc. Amer. Acad. 24: 44 (1889).

A species of Sonora and Sinaloa, apparently not reaching our area. The report of *B. laxiflora* from Guerrero, based on *Hinton* 10337 (Bullock, 1938: 166), seems to us to have been an error. The specimen (which we have seen at F) looks not unlike a sparingly pubescent form of *Bursera glabrifolia*. The

* Doelker S., J. Obtencción del aceite esencial de linaloe. Tesis, Escuela Nacional de Ciencias Químicas, Universidad Nacional Autónoma de México, México, D. F. 1949.

margins are crenate-dentate with 4-7 teeth on each side (not 1-2 prominent teeth as in *B. laxiflora*); and the leaflets tend to be broad at base (not crenate as so many of them are in *laxiflora*).

7. ***B. glabrifolia*** (H.B.K.) Engl. in Engl. & Prantl, Nat. Pflanzenfam. III. 4: 251 (1896).
Elaphrium glabrifolium H.B.K., Nov. Gen. & Sp. 7: 28 (1824).

From Bullock's key and from his comments on this species, we assume that our concept of *B. glabrifolia* (Pl. 1/4, p. 344) is approximately the same as his. As noted above, however, we question the identity of *B. glabrifolia* and *Amyris linanoe*. Moreover, although Bullock included the name *B. aloëxylon* in the synonymy of *B. glabrifolia*, Miranda (1947: 107, 110), in his study of the vegetation of the Balsas river basin, distinguishes *B. aloëxylon* from arid *Bursera* forests, and *B. glabrifolia* from forests at higher elevations. For distribution of *B. glabrifolia* see Map 2/1, p. 336. We were not able to see type specimens of any of the species involved. The following additional specimens seem referable to *B. glabrifolia* (see also the Hinton specimens discussed above under *B. pennilata*):

PUEBLA: Tlacuilotepec, May-June 1909 (H.), *Purpus* 4069 (F), 4070 (F), with fls. and young lvs.; also cited by Bullock as *B. pennilata*.

OAXACA: Wooded summits below the oak zone, 35 miles [56 km.] SE. of Oaxaca, 1600 m., 17 Oct. 1962 (fr.), *McVaugh* 21881; Distr. Nochistlán, El Paríán, 1000 m., 28 July 1907 (fr.), *Conzatti* 1924 (F).

GUERRERO: Cuernavaca-Taxco road, c. 10 miles [16 km.] from Taxco, c. 1650 m., 19 Aug. 1935 (fr.), *MacDaniels* 117 (F); Distr. Mina, Tepejuetla, 1350 m., 8 July 1939 (fr.), *Hinton* 14414; *ibid.*, Chiriagua, 1000 m., 13 Sep. 1937 (fr.), *Hinton* 10654; on the pass 8 miles [c. 13 km.] S. of Chilpancingo, 1300 m., 20 Oct. 1962 (fr.), *McVaugh* 21901.

MORELOS: Sierra Grande near Jojutla, 1300 m., 13 July 1947 (fr.), *Webster et al.* 2309; 20 km. NE. of Cuautla, c. 1950 m., 29 July 1950, *Fischer* 60; Cañón de los Lobos, between Cuernavaca and Yautepec, 1650 m., Sep. 1946, *Field* s.n. (F).

EDO. DE MEXICO: Distr. Temascaltepec, Temascaltepec, 21 Oct. 1934 (fr.), *Hinton* 6790 (F; also cited by Bullock); Ipericones, 30 May 1935 (H.), *Hinton* 7832 (F; also cited by Bullock).

MICHOACÁN: Distr. Zitácuaro, Zitácuaro-San José Purruá, 1950 m., 25 Sep. 1938 (fr.), *Hinton* 13268 (F); 4 miles [c. 6 km.] S. of Ario de Rosales, oak-pine zone, 1600 m., 25 Oct. 1962 (sterile), *McVaugh* 21931; Distr. Apatzingán, Acahuato, 620 m., 17 Aug. 1938 (fr.), *Hinton* 12039; Acahuato, *Leavenworth* & *Hoogstraal* 1690 (F), 1695 (F).

Although we hesitate to invoke hybridity as the cause of all unexplained variation, yet in the supposed *Bursera glabrifolia* we note examples of individual variation that seem unusual in any one species. In *Hinton* 14414, for example, the inflorescence is 6-8 cm. long and but sparingly pubescent; in *Fischer* 60 the inflorescences are 1.5-5 cm. long and rather densely pilose, suggesting in this respect those of *B. copallifera*. In *Hinton* 12039 some of the leaflets are subacute and up to 3 cm. long, suggesting a possible genetic admixture from the *excelsa* complex or some other source.

possibility of hybridization between a plant like '*glabrifolia*' and some other species with larger and differently shaped leaflets. These are cited below:

Leaflets small but mostly subacute; inflorescence 5 cm. long or less:
MICHOACÁN: Distr. Coalcomán, Coalcomán, 1250 m., 5 Sep. 1938, *Hinton* 12134.

Leaflets 3-4 pairs, broad, coarsely toothed, acute, somewhat with aspect of *B. citonilla*:

MICHOACÁN: Distr. Coalcomán, Naranjillo-Puentes Pedregal, 1500 m., 18 Oct. 1941, *Hinton* 15992.

Leaflets 3-5 cm. long, serrate, acute; inflorescence 7-10 cm. long; somewhat suggest *pennilata*:

MICHOACÁN: Distr. Apatzingán, Ortigal, 1350 m., 25 Sep. 1939, *Hinton* 15220; Distr. Coalcomán, Villa Victoria, 700 m., 14 Nov. 1938 (fr.), *Hinton* 12565.

8. ***B. coyucensis*** Bullock in Bull. Misc. Inf. Kew 1936: 358 (1936).

To the specimens cited by Bullock from the valley of the Río Balsas in northern Guerrero, we can now add two collections from the lower valley, in western Michoacán:

MICHOACÁN: Barranca of Río Cancia, 9 miles [c. 14 km.] SE. of Apatzingán, 300 m., 18 Sep. 1958 (fr.), *McVaugh* 17983; tropical deciduous forest on dry hills 13 miles [c. 21 km.] SW. of La Huacana, 180 m., 26 Oct. 1962 (fr.), *McVaugh* 21948.

On the dry and thinly wooded hills between La Huacana and the Río Balsas, this is the commonest species of *Bursera*, forming a large population uniformly possessing the rather stiffly pilose herbage that characterizes the species. Probably it is closely related to *B. glabrifolia*, but as far as we know the two species never come in contact in nature; *B. glabrifolia* is often a plant of the oak-pine zone, found mostly at elevations between 1000 and 2000 meters, whereas *B. coyucensis* seems to be confined to the Balsas depression.

9. ***B. copallifera*** (Sessé & Moc. ex DC.) Bullock in Bull. Misc. Inf. Kew 1936: 357 (1936).

Elaphrium copalliferum Sessé & Moc. ex DC. in DC., Prodr. 1: 724 (Jan. 1824).
El. jorullense H.B.K., Nov. Gen. & Sp. 7: 22, t. 612 (Nov. 1824).

Bursera jorullensis (H.B.K.) Engl. in Engl., Bot. Jahrb. 1: 44 (1881).

B. palmieri var. *glabrescens* S. Wats. in Proc. Amer. Acad. 25: 145 (1890).

As pointed out by Bullock (1936: 357-358), the leafy flowering branch shown in Plate 202 of Alphonse DeCandolle's 'Calques' may be taken as the lectotype of *Elaphrium copalliferum*. This is well shown in Pl. 2/2, p. 345, and a line-drawing showing a part of the same flowering branch is represented in Field Mus. neg. 309350. Fortunately the herbarium of Sessé & Mocño includes a good representation (No. 4704 and 2 sheets of No. 4705) of what is certainly the same species (Pl. 2/1, p. 345). With the single exception of leaflet-number, the specimens agree with the original figures and with A. P. DeCandolle's description in every particular, including the rather unusual

small or partially developed leaves. In our opinion there can be little doubt that the drawings of *Elaphrium copalliferum* were based on these specimens. We can never be sure, or course, of the cause of the discrepancy between the number of pairs of lateral leaflets shown in the plate (3, 4, or 6 pairs), and those on the specimens (5-10 pairs, usually about 8).

As in the case of *Bursera paniculata*, our interpretation of *B. copallifera* differs from that of Bullock. As this involves the abandonment of a well-established name (*Bursera jorullensis*), the typification of *B. copallifera* is a matter of some importance. The choice seemingly lies among a relatively small number of species. The original description and the plate specify that *Elaphrium copalliferum* be a species with 3-6 pairs of ovate (or elliptic) serrately toothed pubescent acute but not acuminate leaflets, and congested interrupted inflorescences almost as long as the leaves (or as shown in the figures one-half to two-thirds as long as the leaves). A comparison of our illustration (Pl. 2/2, p. 345) of the pertinent part of the original plate with that of one of the Sessé & Mocino specimens (Pl. 2/1) shows, in our opinion, that the plate may well have been made from the same plant as the specimen, or even from the same plant-fragment. One would naturally assume that the artist in the field would work from living specimens; even making allowances for this, the correspondence between the plate and the herbarium specimen seems more than coincidental.

If one does not accept this interpretation, then one must explore other possibilities. It is entirely possible that Sessé & Mocino confused two or three species under the name of *Elaphrium copalliferum*. There is indeed mounted on one sheet of their herbarium, with two flowering pieces of the species discussed above (namely *B. jorullensis* in the sense of Bullock), one piece of *Bursera palmieri* S. Wats., also in flowering condition, and superficially similar to the others on the sheet. The leaflets in this specimen, however, are as usual in *B. palmieri* distinctly ovate, and narrowly pointed, whereas those of the Mocino plate and those of the other species tend rather to be elliptic and more bluntly pointed. We do not rule out the possibility that *B. palmieri* formed a part of the original concept of *Elaphrium copalliferum*, but we do not consider that it was a major part.

It is necessary also to consider *Bursera cuneata* (Schlechtend.) Engl., which was relegated by Bullock to the synonymy of *B. jorullensis*. This seems to us a recognizable local population, probably distinct from *B. jorullensis* (i.e. from *B. copallifera* as we understand it). We have not seen the type of *Elaphrium cuneatum* Schlechtend., but we have seen *Bourgeau* 338 (F.), which was cited by Engler. The species, as we understand it, differs from *B. copallifera* in having 2-4(-5) pairs of leaflets only (in the protologue the number of leaflets was given as 5-9, i.e. 2-4 pairs); the leaflets are ash- or pale brown-tomentose beneath, and rugose as in *B. copallifera*. We do not believe this species formed the basis for the Mocino plate of *Elaphrium copalliferum*, as the leaflets are rarely more than 9 and there are no specimens of the plant in the Sessé & Mocino herbarium. We have seen the following of what we take to be *B. cuneata*:

GUERRERO: Oak zone, 4 km. E. of Omiltemi, road to Chilpancingo, 2100 m., 31 Aug. 1962 (sterile), *Rzedowski* 1588f.

MICHOACÁN: Distr. Zitácuaro, Zitácuaro-Coatepec, 1950 m., 25 Oct. 1938 (fr.), *Hinton* 13410 (F).

21 June (fr.), *Bourgeau* 338 (F.); Uruapan, *Ullrich* 1003, *Turner* 03 (F), 1156 m. ex LE); Sierra Guadalupe, Sep. 1903, *Rose* & *Painter* 7302 (F); Cerro del Pasco prope Guadalupe Hidalgo, 2 Dec. 1924, *Wronow* & *Juzepczuk* 754 (F); Sierra de Guadalupe, 13 July 1913, *Reiche* s.n. (F); pedregal de San Angel, 2300 m., 6 Aug. 1961, *Rzedowski* 15515. See also a note under *B. bicolor* (p. 334).

Bullock pointed out that *B. copallifera* [*B. jorullensis*] is a variable species, particularly with respect to the amount of rugosity of the upper surface, and the amount of indumentum on the lower. He also discussed, in connection with the reduction of *Elaphrium cuneatum*, the unbroken series of gradations between leaflets with rounded bases and those with cuneate bases. He might have added that the tips of the leaflets vary from obtuse or abruptly acute to somewhat long-pointed, and the leaflets themselves vary in length (but relatively little in width), so that on the same plant a leaf on a short lateral spur-branch may bear leaflets 1.5-2.5 cm. long, while the leaf of a vigorous shoot may bear leaflets 4-5 cm. long. Some of the extremes of the *copallifera* species-complex have been described as species in recent years, but apparently none of these reaches our area. For distribution of *B. copallifera* see Map 2/2, p. 336. A population with very small leaflets, these whitetomentose beneath and with the margins scarcely if at all doubly dentate, is *B. velutina* Bullock (1936: 380). This has been collected several times in Guerrero and extreme eastern Michoacán.

We refer the following additional specimens to *B. copallifera*:

NAVARR: Near Jesús María, 600-700 m., 20 Sep. 1960 (fr.), *Feddena* 1310.

ZACATECAS: Tropical deciduous forest c. 17 km. S. of Moyahua, 1500 m., 25 June 1957 (sterile), *Rzedowski* 9130.

JALISCO: 'Barranca' of the Rio Grande N. of Amatitán, 750-800 m., 1 Sep. 1960 (fr.), *McVaugh* 18553; Sierra Madre W. of Bolaños, 17 Sep. 1897, *Rose* 3013 (US); in the 'barranca', Guadalupe, 9 Aug. 1899, *Rose* 4808 (US); near Guadalupe, 29 Sep. 1903, *Rose* & *Painter* 7443 (US); rocky bluffs of Rio Grande de Santiago near Guadalupe, *Pringle* 2335 (F, isotype of *B. palmieri* var. *glabrescens*; US, holotype).

MICHOACÁN: 2 miles [c. 3 km.] W. of Uruapan, 1800 m., *Leavenworth* & *Hoogstraal* 1273; Volcán Jorullo, 19 June 1950 (imm. fr.), *Turner* 1943; Distr. Apatzingán, Acahuato, 620 m., 17 Aug. 1938 (fr.), *Hinton* 12040; *ibid.*, between San Juan de los Plátanos and Amatitán, 275 m., 17 Sep. 1938 (fr.), *McVaugh* 17957; *ibid.*, vicinity of Apatzingán, c. 600 m., *Leavenworth* & *Hoogstraal* 1514, 1711, 1760; *ibid.*, Hda. California, c. 360 m., *Leavenworth* & *Hoogstraal* 1464; Distr. Huétamo, Tiquicheo, 450 m., 10 Apr. 1938 (fr.), *Hinton* 13317; Distr. Zitácuaro, Zitácuaro-Coyota, 1725 m., 25 Aug. 1938 (fr.), *Hinton* 13164 (F); *ibid.*, Zitácuaro-Laureles, 1200 m., 19 Sep. 1938 (fr.), *Hinton* 13252 (F).

GUERRERO: 15 miles [24 km.] S. of Chilpancingo, 21 Aug. 1947, *Barkley* et al. 17M865 (F); Balsas, *Lemmon* & *Lemmon* 188 in 1905 (F); mountainside 2 miles [c. 3 km.] W. of Chilpancingo, road to Omiltemi, with oaks and palms, 1400 m., 21 Oct. 1962 (sterile), *McVaugh* 21917.

excelsa.

Elaphrium excelsum H.B.K., Nov. Gen. & Sp. 7: 30, t. 611 p.p. (1824).
Bursera sphaerocarpha Sprague & Riley in Bull. Misc. Inf. Kew 1923: 170 (1923).

After study of a considerable series of specimens from Hinton's last collections, and from those of others, we believe that Bullock's concept of this species was somewhat too broad. As indicated in our key, there are in western Mexico several recognizable local populations akin to *B. excelsa* and to the very similar South American and Central American *B. tomentosa* (Jacq.) Triana & Planch. The plant called *B. excelsa* in Chiapas, in Guatemala, and elsewhere in Central America appears to us, after a somewhat cursory study, to be identical with *B. tomentosa* of northern lowland South America; it is also very similar in appearance to the plant of central Mexico that we are calling *B. palmieri*, so much so that Guatemalan specimens in herbaria have often been named *B. palmieri*. The leaflets of all these plants tend to be acute and relatively finely toothed, and persistently pale-tomentose (sometimes almost white-tomentose) beneath. The taxonomy of this species-group as a whole is beyond the scope of this paper; here it may be mentioned only that if later studies suggest the need for a more inclusive species-concept than the one we suggest, the relationships of *B. palmieri* and indeed of *B. excelsa* are to be sought with *B. tomentosa*, which is in any event the oldest name in the whole complex.

One species-group of the *excelsa-tomentosa-palmieri* alliance thus ranges from Colombia through Central America to the highlands of Mexico. A second species-group, typified by *B. excelsa* and comprising three or four local taxa, is distributed along the Pacific slope of Mexico, near the coast, mostly at elevations of less than 500 meters, from Oaxaca to Sinaloa (see Map 2/3, p. 336). In view of our still imperfect field-knowledge of these plants, we take the conservative course of referring all these west-Mexican populations to an inclusive *Bursera excelsa*, recognizing at the same time the existence of geographical races within the species and the need for further study of these.

The populations vary from one locality to another along the Pacific slope, but in general it may be said that they are recognizably different from the *palmieri-tomentosa* alliance in having the leaflets more often blunt at apex, pale-tomentose (if at all) only when very young, and often coarsely and bluntly toothed. Individual specimens may have the leaflets acute, or finely toothed, or both, and in *B. excelsa* var. *excelsa* the leaflets are more or less permanently brownish-tomentose.

The type of *Elaphrium excelsum*, well shown in Pl. 3/3, p. 344, represents the plant common in the coastal mountains of Guerrero and Oaxaca. It is well marked by its 3-6 pairs of obtuse or rarely acute leaflets that are brownish-tomentose beneath, and coarsely dentate with rounded teeth. The type of *B. sphaerocarpha* Sprague & Riley seems to represent precisely the same taxon.

We have seen the following specimens:

OAXACA: Coastal hills 2 miles [c. 3 km.] E. of Salina Cruz, 30-50 m., 13 Oct. 1962 (sterile), *McVaugh* 21838; savannah forest, limestone hills 13.5 miles [c. 22 km.] E. of Juchitán, 50 m., 16 Oct. 1962, *McVaugh* 21850.
GUERRERO: 25 miles [40 km.] S. of Chilpancingo, 16 Aug. 1947 (fl.), *Bankley et al.* 17M826 (F); Acapulco, *Palmer* 432 in 1894-95 (F, MICH).

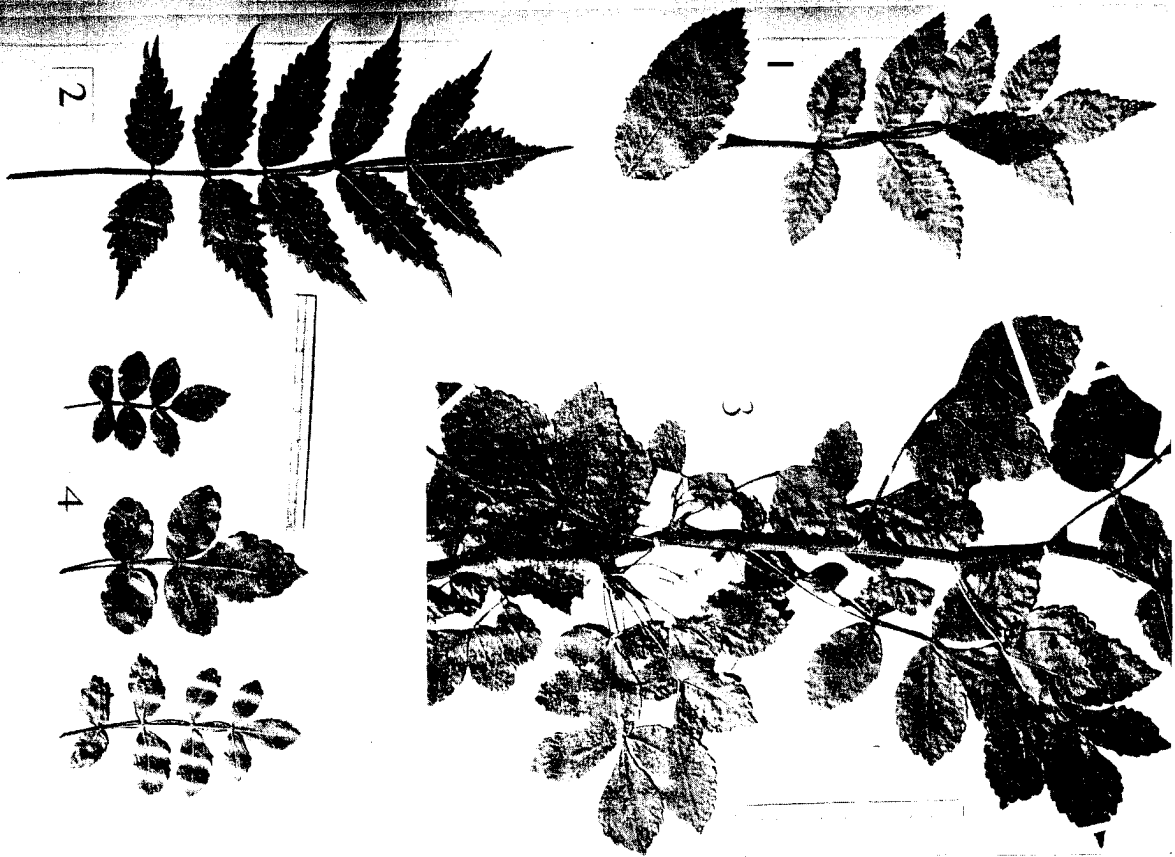


PLATE 1. Leaves of species of *Bursera* sect. *Bullockia*. 1, *Bursera palmieri*; 2, *B. pectinellata*; 3, leafy branch of *B. citronella*; 4, *B. glabrifolia*. All $\times \frac{3}{8}$. 1 from *McVaugh* 21779; 3 from *Hinton* 12299, type of *B. citronella*, Univ. of Mich. neg. 1545; 4 from *McVaugh* 21881.



PLATE 2. *Bursaria copallifera*. 1, Part of plant with leaves and inflorescences presumed to have been the basis of 2, the plate that constitutes the lectotype of *B. copallifera*. Both $\times c. \frac{1}{2}$, 1 from Herb. Sesté & Moench No. 4705; Field Mus. neg. 41821; 2 from Pl. 202 of DeCandolle's Calques; Field Mus. neg. 30587.

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PLATE 3. Branchlets and leaves of *Bursaria excelsa*. 1, *B. excelsa* var. *acutidens* (terminal and attached lateral leaflet only); 2, *B. excelsa* var. *acutidens*; 3, *B. excelsa* var. *excelsa*; 4, *B. excelsa* var. *jaumontii*. All $\times \frac{1}{2}$. 1 from Hinton 12600; 2 from McVaugh 20745; 3 from Bonpland 3890, type of var. *excelsa*, Field Mus. neg. 35862; 4 from McVaugh 15219, type of var. *jaumontii*, Univ. of Mich. neg. 1542.

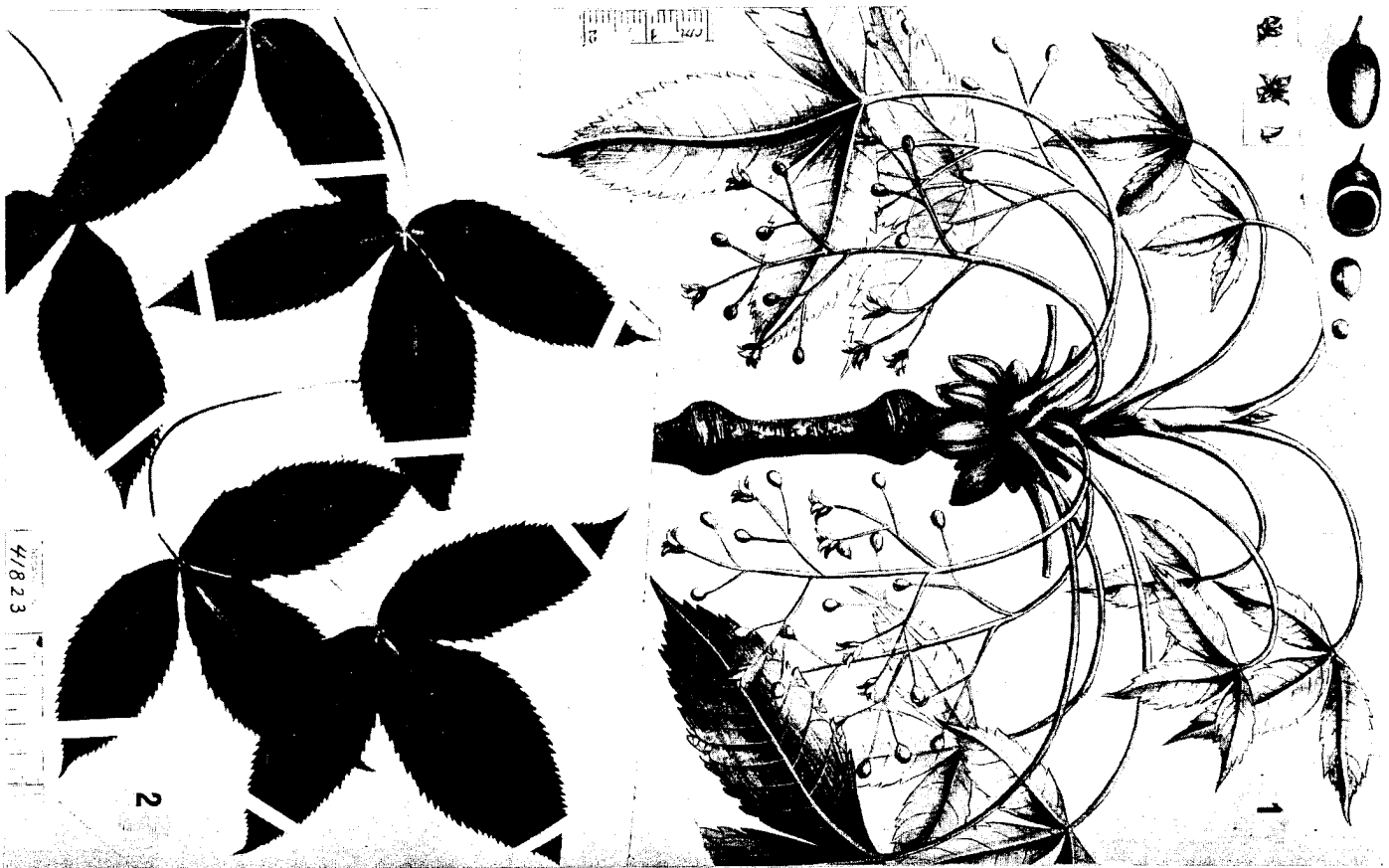


PLATE 4. *Bursaria leonaca*. 1, illustration on which *Amyris*? *leonaca* DC. was based, $\times \frac{1}{2}$; 2, leaves, $\times \frac{2}{3}$. 1 from Pl. 248 of the unpublished 'Flora Mexicana' of Sesse & Mocino, Field Mus. neg. 30582; 2 from *Herb. Sesse* & *Mocino* No. 4932, Field Mus. neg. 41823. For discussion see text p. 350.

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(fr.), *Lundell* & *Lundell* 12599; Distr. Galeana, Teapan-El Verde, 75 m., 23 June 1939 (fl.), *Hinton* 14339; *ibid.*, Atoyac, 25-100 m., 15 Aug. 1939 (fr.), *Hinton* 14542; *ibid.*, 25 Aug. 1939 (fr.), *Hinton* 14565; *ibid.*, San Luis de la Loma, 140 m., 24 Oct. 1937 (fl.), *Hinton* 10851; *ibid.* (fr.), *Hinton* 10852; *ibid.*, by the beach, 30 Oct. 1937 (fr.), *Hinton* 10869; *ibid.*, Atoyac, 20 m., 19 Nov. 1937 (fr.), *Hinton* 10937; Distr. Montes de Oca, Murga, 100 m., 21 June 1937 (fl.), *Hinton* 10934 (F).

In the low mountains both east and west of the Isthmus of Tehuantepec the var. *excelsa* seems to be replaced by a rather sparingly pubescent series of local populations which except for the matter of pubescence are indistinguishable from var. *excelsa*. The leaflets of var. *excelsa* are tomentose beneath, whereas in these other plants they are merely thinly hairy. The thinly hairy forms have been collected at several localities along the highway between Juchitán, Oaxaca, and the savannah-covered hills in the vicinity of Cintalapa, Chiapas, about 100 km. to the east and northeast. Only a little further east these thinly pubescent forms of *excelsa*, which seem to be associated with low thorn-forests and savannah-forests in the lowlands, give way to what we take to be *Bursaria tomentosa* (see p. 344), a common inhabitant of the taller and more humid forests of central Chiapas. We have seen nothing intermediate between *B. tomentosa* with its often strikingly acute and sharply toothed pale-tomentose leaflets, and the geographically adjacent but distinctive *B. excelsa* with often obtuse and obtusely toothed, thinly pubescent leaflets. In addition to the foliar characters, the two plants are distinguished by the fruit, which in the Oaxacan populations of *B. excelsa* is 8-14 mm. long, and in our collections of *B. tomentosa* only 6-8 mm. long. We have seen the following specimens of the thinly pubescent *B. excelsa*:

CHIAPAS: Savannah forest with *Haematoxylon*, *Cela*, *Erythroxylon*, 6 miles [c. 10 km.] NE. of Cintalapa, 480 m., 16 Oct. 1962 (fr.), *McVaugh* 21847.

OAXACA: Savannah-like forest on hills with *Curatella*, *Brysonima*, above Tapanatepec near the Chiapas line, 200 m., 16 Oct. 1962 (sterile), *McVaugh* 21848; *ibid.*, 120 m. (fr.), *McVaugh* 21849; tropical deciduous forest 32 miles [c. 51 km.] W. of Tehuantepec, 180 m., 17 Oct. 1962 (fr.), *McVaugh* 21858; 54 miles [c. 86 km.] NW. of Tehuantepec, 950 m., 13 Oct. 1962 (sterile), *McVaugh* 21832.

From Sinaloa to southern Nayarit or perhaps to Colima, the *excelsa*-complex is represented chiefly or entirely by a plant with 3-5 pairs of acute and rather deeply but sharply toothed leaflets. The very young herbage is pale-tomentose, but the mature leaves, although abundantly and rather stiffly pilose beneath, are green and never tomentose. The young plants are notable for their covering of stiff or somewhat crisped sordid hairs up to 1-1.3 mm. long; many of these hairs are lost as the plants mature, but a few usually persist on the inflorescence and the veins of the leaves. The fruit of this population also seems distinctive, differing from that of other known members of the *excelsa*-complex in its acute or even somewhat beak-like point. Were this taxon not connected to *B. excelsa* var. *excelsa* by such a puzzling series of apparent intermediates in the area from Colima to Guerrero, we should not hesitate to designate it as an independent species. As it is, we prefer to withhold judgment until the plants can be studied further in the field, in the meantime describing this taxon as a variety of *B. excelsa*.

a var. *excelsa* foliis acutis, acute grosseque dentatis, tohis maturis subius viridibus pilosis non tomentosis, ramulis foliisque et inflorescentiislonge pilosis, demum glabrescentibus, fructibus acutis vel subrostratis, differt, Pl. 3/4, p. 344.

Type: Mexico: NAVARR: Rocky deciduous woodlands near Planta Hidroeléctrica del Río Ingenio, c. 20 miles [32 km.] NW. of Tepic, 350 m., 8 July 1957 (immature fruit), *McVaugh* 15219 (MICH, holotype; K, isotype).

SINALOA: Lodiego, Oct. 1891 (fr.), *Palmer* 1579 (F); Las Mesas, Sierra Suretato, c. 1000 m., 25 Aug. 1941 (fr.), *Gentry* 6145; *ibid.*, 15 Sep. 1941 (vs.), *Gentry* 6629, 6648A; Baromena, c. 500 m., 24 Aug. 1941 (fr.), *Gentry* 6128; Cofradía, c. 200 m., 25 Nov. 1939 (fr.), *Gentry* 5053; Colomas, 13-20 July 1897, *Rose* 3230 (US); Culiacán, 6 Sep. 1904, *Brandege* s.n. (US); Hacienda Labradas, *Ramírez Laguna* s.n. (MEXU).

NAVARR: Acaponeta, June 1897 (imm. fr.), *Rose* 1490 (F); near Planta Hidroeléctrica del Río Ingenio, *McVaugh* 15219 (MICH, holotype; K, isotype); 10 miles [16 km.] N. of Tepic, 700 m., 8 July 1957 (fl.), *McVaugh* 15205; lava flows 6-7 miles [c. 10-11 km.] NW. of Ahuacalán, 900 m., 13 July 1957 (fl.), *McVaugh* 15384; San Blas, first hill on the old Spanish road to Tepic, 13 Oct. 1925 (fr.), *Ferris* 5491 (US); 9 miles [c. 14 km.] N. of Compostela, in the oak zone, 1000-1200 m., 13 Nov. 1959 (fr.), *McVaugh* & *Koelz* 566; 6 miles [c. 10 km.] S. of Compostela, tropical deciduous forest, 900 m., 11-12 July 1957 (fl., imm. fr.), *McVaugh* 15330.

JALISCO: Puerto Vallarta, 21 July 1932 (fr.), *Howell* 10350 (US). COLIMA: Low hills, deciduous forest, 16 miles [c. 26 km.] WNW. of Santiago, c. 30 m., 22 June 1957 (fl.), *McVaugh* 14987.

In the low coastal mountains at elevations of 500 m. or less and down to sea-level, even to the beaches of the Pacific Ocean, the *excelsa*-complex is represented from southernmost Jalisco to western Guerrero by a plant with fewer leaflets (1-3 or rarely 4 pairs). The leaflets are acute or often in the younger leaves on the same plant, obtuse; the leaves are green and not tomentose beneath at maturity, and lack the long hairs characteristic of var. *fauonialis*, but are otherwise similar (except for the smaller number of leaflets) to the leaves of that variety. The relationship to var. *excelsa* is suggested by the relatively coarse blunt teeth of the leaflets, the crisp (even though scant) pubescence, and the ovoid but blunt fruit. This plant is *Bursera acutidens* Sprague & Riley, which was described from the vicinity of Manzanillo, Colima. The type-material, and other specimens from very near the Pacific Coast, are characterized by rather thin, soft and more generally obtuse leaflets; the lateral leaflets are often only 1-2 pairs even in well-developed leaves, and apparently never as many as four pairs:

10c. **B. excelsa** (H. B. K.) Engl. var. **acutidens** (Sprague & Riley) *McVaugh* & *Rzed.*, comb. et stat. nov.

Bursera acutidens Sprague & Riley in Bull. Misc. Inf. Kew 1923: 169 (1923) (Pl. 3/1, 2, p. 344).

JALISCO: Playa de Cuastecomate, 8 km. NW. of Barra de Navidad, 6 Nov. 1960 (fl.), *McVaugh* 20745; 5 km. S. of La Huerta 500 m., 30 Oct. 1960 (fr.), *Rzedowski* 14681.

29 July 1957 (imm. fr.), *McVaugh* 15877; Manzanillo, 27 Nov. 1925 (fr.), *Ferris* 6046 (US); Manzanillo, 1-31 Dec. 1890 (fr.), *Palmer* 987 (US, isotype of *B. acutidens*).

MICHOCÁN: La Placía, 45 miles [72 km.] by air S. of Colima, 4 July 1950 (fl., imm. fr.), *Turner* 2074.

We have seen also a series of specimens that we refer to var. *acutidens*, but which differ in having somewhat thicker leaflets (as all the specimens are in fruit we cannot be sure of this), a tendency to have fewer obtuse leaflets in proportion to the pointed ones that predominate on the larger leaves, and a tendency for the leaflets to be more numerous (usually 3 pairs, occasionally 2, 1, or 4). The leaflets somewhat suggest those of var. *excelsa* in being prominently veiny beneath, but are fewer in number, and often almost glabrous beneath at maturity. All these specimens are from low mountains a short distance from the coast, at elevations from 240 to 500 m.:

COLIMA: Deciduous woodlands, summits near the pass 11 miles [c. 18 km.] SSW. of Colima, 500 m., 19 July 1957 (imm. fr.), *McVaugh* 15556.

MICHOCÁN: Distr. Coalcomán: Aquila, 240 m., 18 Nov. 1938 (fr.), *Hinton* 12600; *ibid.*, Huixtla, 420 m., 17 Nov. 1938 (fr.), *Hinton* 12592; *ibid.*, 400 m., 20 Oct. 1941 (fr.), *Hinton* 16010.

GUERRERO: Distr. Montes de Oca: Pasión, 400 m., 10 Oct. 1937 (fr.), *Hinton* 10788.

The two populations just discussed are evidently very closely related; it is possible that the extreme coastal form which is typical *B. acutidens* is a distinct ecotype. Both are evidently close on the one hand to *B. excelsa* var. *excelsa*, and on the other to *B. excelsa* var. *fauonialis*. We believe their taxonomic position is most realistically represented by regarding them as together comprising a variety of *B. excelsa*.

The plant described as *Bursera dubia* Bullock (1937: 452) seems to us to have a considerable affinity with *B. excelsa*. For example, *Hinton* 10527 (F), taken from the same tree as the type (*Hinton* 9349) and as *Hinton* 9045, would at once be determined as *B. excelsa* except that the pubescence is somewhat scanty. The leaflets of *Hinton* 9045, 9349 and 10643 (all seen at F), suggest an affinity with *B. heterostyles* Bullock, as originally noted by him. We are inclined to consider seriously a pencilled note, evidently in the hand of Hinton, on the Chicago sheet of *Hinton* 9349: "Nothing but a hybrid. G.H.". Scarcely to be confused with any of the varieties of *B. excelsa* is the following species, similar in having 3-6 pairs of leaflets and the fruit obtuse or sometimes short-apiculate, but with very differently shaped leaflets with sharply deltoïd-serrate teeth, with white rather than brownish tomentum, and quite different geographic range.

B. palmeri S. Wats. in Proc. Amer. Acad. 22: 402 (1887).

Elaphium queretarensis Rose in N. Amer. Fl. 25: 254 (1911).

This is one of the relatively few species of *Bursera* inhabiting the bluffs and upper slopes of 'barrancas' along the western boundaries of the Mexican plateau, at elevations of 1200 to 2100 m. from Durango to Jalisco and eastward to Querétaro. As far as we know its range (see Map 2/3, p. 336) does not approach closely that of any other taxon here referred to *B. excelsa*. Pl. 1/1, p. 344.

1866, according to Palmer's field-notes) (fl.), *Palmer 170* (f., US); City of Durango and vicinity, [1-25 Jul. 1866] (fl.), *Palmer 308* (US).

ZACATECAS: Bluffs 18 miles [c. 29 km.] S. of Valparaiso, 2100 m., 4-5 Sep. 1958 (fr.), *McVaugh 17692*; tropical deciduous forest c. 14 km. SW. of Jalpa, 1450 m., 25 June 1957 (sterile), *Rzedowski 9121*.

JALISCO: Between Huejuquilla and Mezquitic, 25 Aug. 1897, *Rose 2564* (US); Río Blanco, in deep cañons, June-Oct. 1886, *Palmer 609* (US, isotype); barranca of Río Verde south of Yahualica, 1450 m., 27-28 Aug. 1958 (fr.), *McVaugh 17434*; 6 miles [c. 10 km.] E. of Atonilco el Alto, 1800 m., 23 Aug. 1958 (fr.), *McVaugh 17245*; 7 miles [c. 11 km.] NW. of Jazmin, pine-oak zone, 1200 m., 31 Oct. 1962 (fr.), *McVaugh 21983*; Mesa Redonda SW. of Lagos, 2000 m., 16 June 1957 (fl.), *McVaugh 14897*; 12 miles [c. 19 km.] SE. of Lagos, 2000 m., 10 Sep. 1958 (fr.), *McVaugh 17790*.

GUANAJUATO: León, *Hartweg 261* (K, not seen; cited by Bullock (1938) as *B. excelsa*).

QUERÉTARO: Near Querétaro, *Rose 11153* (US, holotype of *E. queretarensis*); 5 miles [8 km.] W. of Querétaro, *Paxson et al. 710*.

MICHOACÁN: Morelia, Punguato, 2000 m., 26 June 1909 (leaflets narrow), *Arbela s.n. [?47]* (F); 17 miles [c. 27 km.] W. of Jiquilpan, woodland-pasture with *Forestera*, *Mimosa*, *Eysenhardtia*, 1850 m., 29 Oct. 1962 (sterile), *McVaugh 21966*.

In areas where both *B. palmieri* and *B. copallifera* grow, the occurrence of natural hybrids seems likely. We have seen two plants that may be hybrids, both planted trees on roadsides, both in localities where *B. copallifera* was abundant as a native tree, but where we saw no *B. palmieri* except for the specimens cited below. In both plants the leaflets were somewhat rugose as in *B. copallifera* and with rather small marginal teeth as in that species, but lanceolate or ovate and up to 2-3 cm. wide as in *B. palmieri*:

MICHOACÁN: Shrub-covered hills with oaks, 12 miles [c. 19 km.] NW. of Zitácuaro, 1800 m., 24 Oct. 1962 (fr.), *McVaugh 21922*.

JALISCO: Pastured hills, probably formerly oak-pine, 12 miles [c. 19 km.] N. of Zapopan, 1600 m., 11 Nov. 1962 (sterile), *McVaugh 22137*.

12. **B. sarcopoda** *P. G. Wilson* in *Kew Bull.* 13: 156 (1958).

Leica? serrata DC. in DC., *Prodr.* 2: 77 (1825), non *Bursera serrata* Colebr. (1827).

This distinctive species was described by Wilson from the vicinity of Coahuacán, Michoacán. The name *Leica? serrata* was based on a painting of a Mexican plant collected by Sessé & Mocino (Fl. Mex. Ic. ined. 199; A. DC. Calq. Dess. 196; cf. Chicago Nat. Hist. Mus. neg. 30583). According to DeCandolle the plant had been identified by Sessé & Mocino as '*Amyris ambrosiaca*'. A specimen in the original herbarium of Sessé & Mocino (No. 4936), and another in the Barbey-Boissier herbarium (G), distributed by Pavón, are labelled '*Amyris ambrosiaca*'; we should refer both to *B. sarcopoda*. The plate cited above seems to represent the same species, although the characteristic thickened pedicels are not shown, and the leaves appear in the drawing to be glabrous. The original specimens of '*Amyris ambrosiaca sensu Sessé & Mocino* (1893: 54) were collected presumably near Mazatlán, Guerrero.

COLIMA: In slate-gypsum hills near the pass 10-11 miles [c. 16-18 km.] SSW. of Colima, 400-500 m., 7-8 Dec. 1959 (fl., fr.), *McVaugh & Koelz 1564*; deciduous forest on limestone ridge, 10 miles [16 km.] SE. of Colima, 400-450 m., 5 Dec. 1959 (fl., fr.), *McVaugh & Koelz 1452*.

MICHOACÁN: Distr. Coahuacán, Aguila, 230 m., 'tecomaca', 4 Aug. 1941, *Hinton 15953* (MICH, US).

GUERRERO: Distr. Aldama, Barranca de las Juntas, Achohla, streamside, 570 m., 'tecomaca', *Mexia 8901* (F, US); Achohla, July 1926, 'nogal', *Reko 4942* (US), *ibid.*, Feb. 1927, *Reko 9095* (US); Rincón de la Vía [Carretera México-Acapulco], 750-800 m., 3 Sep. 1961 (fl.), *Krusse 675* (IPN), *ibid.*, 19 Nov. 1961 (fr.), *Krusse 675* (IPN).

WITHOUR DEFINITE LOCALITY: N[ueva] E[spaña], [Sessé & Mocino] ex herb. Pavón (G); Sessé & Mocino 964, 4936 (MA) (see Chicago Nat. Hist. Mus. negs. 47925, 47931).

Some specimens from Guerrero have smaller leaflets, but there seems little doubt that they belong to the same species. The specimens collected by Reko have been annotated by Standley as a new species dedicated to the collector. These presumably form the basis for the reference to the *nomen nudum* *Elaphium reko* Standl., in a paper by Reko (1948).

The bark of this plant is reported by Wilson as 'papyraceo rubro-brunneo'. *McVaugh & Koelz 1452* is reported as having bark 'reddish, the outer layers papery'; in *McVaugh & Koelz 1564* the bark is described as 'faking, oaklike'.

13. **B. fragrantissima** *Bullock* in *Bull. Misc. Inf. Kew* 1937: 454 (1937). Known to Bullock from Guerrero only, this plant can now be reported from western Michoacán:

MICHOACÁN: Distr. Apatzingán, Aguilla, 800 m., 20 Sep. 1939 (fr.), *Hinton 15207*; *ibid.*, 950 m., 14 Nov. 1939 (sterile), *Hinton 15390*; Distr. Coahuacán, Parucho, 18 Oct. 1939, *Hinton 15338* (US).

The leaflets of *B. fragrantissima* are sometimes no more than 5-6 cm. long, although on shoots they may be as much as 12-15 cm. long. The smaller ones may be distinguished from those of *B. citronella* by the slenderly acuminate tips and by the more numerous and somewhat sharper teeth. The leaf-rachis in *B. citronella* is consistently but often rather narrowly winged, whereas the wing is essentially wanting in *B. fragrantissima*. In some specimens of the *exelsa*-complex the leaflets may be only 2-3 pairs and may resemble those of *B. fragrantissima* in being rather narrowly acute, but the margins are usually plainly double serrate (those of *B. fragrantissima* being at most obscurely so, or with an occasional tooth double), and the rachis is rather broadly winged.

14. **B. heteresthes** *Bullock* in *Bull. Misc. Inf. Kew* 1937: 454 (1937).

This species proves to range far more widely than was suspected when it was first described. It was known to Bullock from the state of Mexico and from the valley of the Río Balsas in Guerrero; Hinton's later collections extended the known range to the coastal hills of Guerrero and to the region of Apatzingán, Michoacán. In 1962 we found it a common plant in the dry hills, in subtropical deciduous forest on the mountains of the Pacific slope leading down from Oaxaca City to the Isthmus of Tehuantepec. It occurs also in tropical forest in Chiapas, where it is associated with the species we

very much like *B. heterothes*, and perhaps conspecific, is *B. steyermarkii* Standl., a Guatemalan species [Field Mus. Publ. Bot. 22: 147 (1940)]. We have seen the type (*Steyermark* 30068, at F), and one additional specimen (Standley 74396, at F).

The original material of *B. heterothes* was reported as having either 3 or 5 leaflets, but in all the specimens we have seen the leaflets are invariably three except on one vigorous shoot of *Hinton* 14537, where a few leaves are 5-foliate. Contrary to the condition found in most collections, the petioles in *Leavenworth* & *Hoogstraal* 1468 are pubescent like the blades. In *Hinton* 12010 the leaflets suggest those of some form of *B. exzelata*; they are rather markedly doubly crenate-serrate. In *Hinton* 14584 they are broader, thinner and more sparingly toothed, and suggest those of *B. chiriquilla*. The leaflets in this species vary from obtuse to acute or short-acuminate, as suggested in the illustrations published by Bullock (1939, t. 3994).

COLIMA: Tropical deciduous forest 5 km. E. of Colima, road to Pihuamo, 500 m., 27 June 1961 (sterile), *Rzedowski* 15380.

MICHOACÁN: Distr. Apatzingán, 350 m., 13 Aug. 1938 (fr.), *Hinton* 12010; *ibid.*, 300 m., 15 Aug. 1938 (fr.), *Hinton* 12024; *ibid.*, Hacienda California, c. 360 m., 12 Aug. 1941 (fr.), *Leavenworth* & *Hoogstraal* 1468 (F).

GUERRERO: Distr. Galeana, Atoyac, 25-100 m., 11 Aug. 1939 (imm. fr.), *Hinton* 14537; *ibid.*, 25-300 m., 30 Aug. 1939 (imm. fr.), *Hinton* 14584.

OAXACA: 5 miles [8 km.] NW. of El Camarón (c. 115 km. SE. of Oaxaca), 700 m., 17 Oct. 1962 (fr.), *McVaugh* 21872; 54 miles [c. 86 km.] NW. of Tehuantepec (c. 150 km. SE. of Oaxaca), 950 m., 13 Oct. 1962 (sterile), *McVaugh* 21836; 38 miles [c. 61 km.] W. of Tehuantepec, 450 m., 17 Oct. 1962 (fr.), *McVaugh* 21868; 13 miles [c. 21 km.] NW. of Tehuantepec, 150 m., 16 Oct. 1962, (sterile), *McVaugh* 21855.

CHIAPAS: 14 miles [c. 22 km.] W. of Ocozocoautla, 650 m., 16 Oct. 1962 (sterile), *McVaugh* 21846.

15. ***B. tecomaca*** (DC.) Standl. in Field Mus. Publ. Bot. 4: 217 (1929). *Amyris?* *tecomaca* DC. in DC., Prodr. 2: 82 (1825).

The type of this species is presumably the Sessé & Mocino plate reproduced by Alphonse DeCandolle as No. 195 of his 'Calques' (Pl. 4/1, p. 345). There can be little doubt that this is in turn based on specimen No. 4932 of the Sessé & Mocino herbarium (Fig. 1/1, p. 351; Pl. 4/2, p. 345). The specimen consists of three detached leaves and a number of detached and broken inflorescences, obviously representing the same species as that shown in DeCandolle's plate, but a species quite different from *B. tecomaca* in the sense of Bullock (i.e. *B. kerberi* Engl.). The latter is well shown in Bullock (1939, t. 3395); it differs from the true *B. tecomaca* in the tricarpellate ovary, in the more prominent, straighter and more numerous foliar veins, more regularly and more finely toothed margins, caudate rather than short-acuminate tips of the leaflets, much longer inflorescences and very differently shaped perianth parts. In *B. tecomaca* the ovary has two carpels, both sepals and petals are broad, and the sepals are 2 mm. long, and more than half as long as the petals. The Sessé & Mocino specimen bears three 'original' labels, two of which bear the name 'Tacamaca', and one of which bears the name *Amyris sibatia*, the latter crossed out and an unpublished new name substituted. This label

the 'type' of *Amyris sibatia* Sessé & Mocino (1894), as the description precisely applies to the parts of the specimens that remain. Strictly speaking the name *Amyris sibatia* should not be credited to Sessé & Mocino, as in (1893) they correctly attributed the name to Jacquin. In the 'Flora Mexicana' Sessé & Mocino (1894: 93) changed the spelling from *sibatia* to *sibatica* and Jacquin is not mentioned, but the character as quoted from Jacquin is taken over verbatim, and the description in the two accounts is essentially the same. There is no reason to suppose the authors intended to propose a new name.

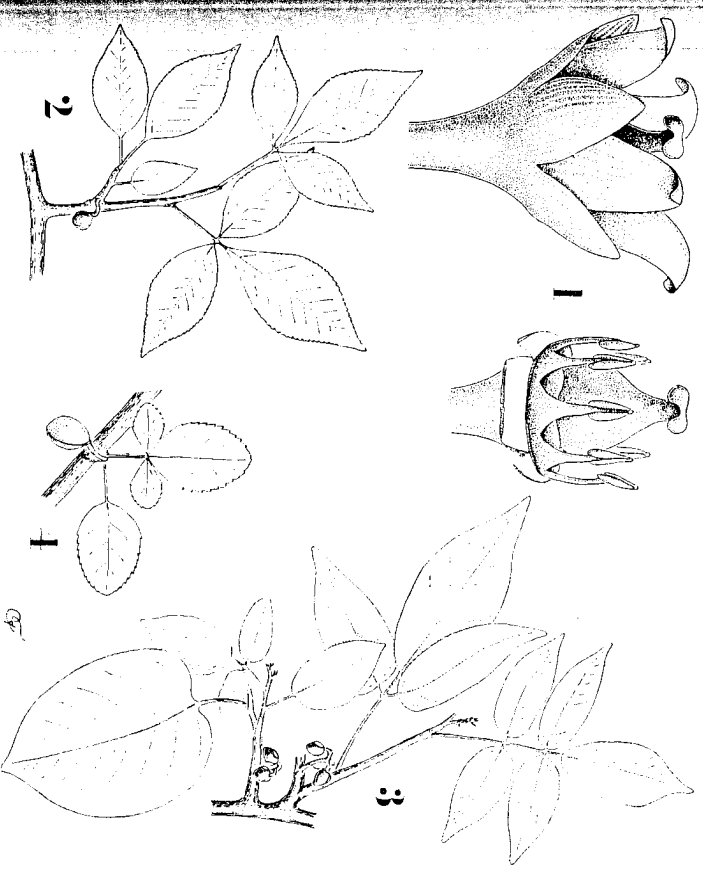


FIG. 1. Fruiting branchlets and details of flowers in *Bursera*. 1, *B. tecomaca*, flowers, one on right with perianth removed, $\times 8$; 2, *B. staphyleoides*, fruiting branchlet, $\times \frac{2}{3}$; 3, *B. instabilis*, fruiting branchlet, $\times \frac{2}{3}$; 4, *B. subtrifoliata*, fruiting branchlet, $\times \frac{2}{3}$; 5 from Herb. Sessé & Mocino No. 4932; 2 from *Hinton* 12073, type of *B. staphyleoides*; 3 from *McVaugh* 15878, type of *B. instabilis*; 4 from *Rose* 3014, type of *B. subtrifoliata*.

The Sessé & Mocino specimen presumably came from Mazatlán, Guerrero, as stated in the 'Flora Mexicana' and the 'Plantae Novae Hispaniae'. We have seen no other specimens referable to the same species.

On the preceding page Sessé & Mocino (1894: 92) describe another *Amyris* species characterized by the same words quoted from Jacquin ('*Amyris foliis ternatis, crenatis, acutis*'), but described in such a way as to make us question the authors' intention to publish it at all: 'foliolis ovatis, lanceolatis, acuminate, obtusis, subrotundis obcordatisque, integerrimis, nitidis, crenatis . . .'. The description seems impossibly inclusive for a single species, and the published account may be reasonably dismissed, in the words of Sprague (1926), as a 'description bearing a purely provisional

or Chiapas, provisionally identified by the authors with *Amyris sylvatica* Jacq.

16a. ***B. attenuata*** (Rose) Riley in Bull. Misc. Inf. Kew 1923: 167 (1923).
Terebinthus attenuata Rose in Contr. U.S. Nat. Herb. 12: 278 (1909).

This was placed among 'doubtful species' by Bullock, who had seen the type only. On the basis of somewhat more material we suppose it to comprise a natural population with a restricted range in western Mexico. The most obviously distinguishing marks are the tufts of hairs at the bases of the otherwise glabrous leaflets.

There is a specimen of this plant (No. 4701) in the collection of Sessé & Mocino; the label bears an unpublished name in *Schinus*, the specific epithet referring to the acuminate leaves.

SINALOA: Colomas, Rose (US, type); tropical deciduous forest, c. 2 km. NE. of Copala, km. 73 on the Mazatlán-Durango highway, 700 m., 17 July 1959 (imm. fr.), *Rzedowski* 9205; Las Mesas, Sierra Suretato, c. 900 m., 15 Sep. 1941 (fr.), *Gentry* 6640, 6640a.

NAVARRIN: Between Pedro Paulo and San Blasito, 4 Aug. 1897, *Rose* 3419 (US); Mirador del Aguilá, 13-14 miles [c. 21-22 km.] NW. of Tepic, 600 m., 15 Nov. 1959 (fr.), *McVaugh* & *Koelz* 710; lava flows from Volcán Cebruno, 900 m., 13 July 1957 (fl.), *McVaugh* 15382; deciduous forest 6-7 miles [c. 10-11 km.] S. of Compostela, 900-1000 m., 11-12 July 1957 (fl.), *McVaugh* 15317; *ibid.*, 5 Sep. 1960 (fr.), *McVaugh* 18760.

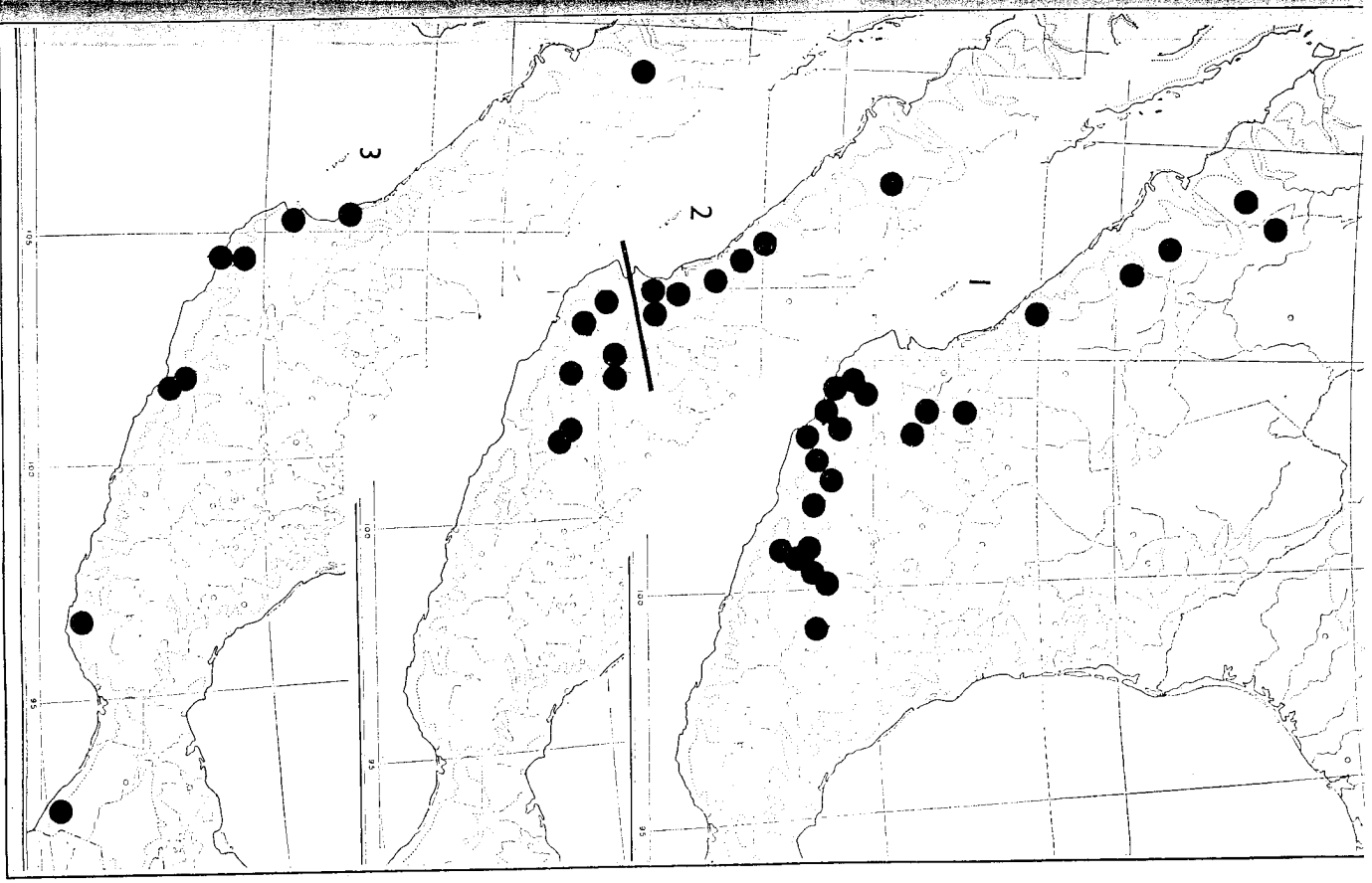
The trunk in this species, like that of *B. grandifolia*, may be grey and somewhat rough in old trees, or varying to reddish- or orange-brown, without any evident outer papery layers. On the branches, however, and the trunks of younger trees, the inner bark is smooth and red or greenish-red and the outer papery layers are pale copper colour.

We have seen *B. attenuata* from Sinaloa and Navarrit only, and then always from moderately low elevations, viz. 600-1000 m. (see Map 3/2, p. 353). Farther toward the southeast, and mostly at somewhat higher elevations (1200-1800 m.), *B. attenuata* is replaced by the following, from which it may not be specifically distinct:

16b. ***Terebinthus acuminata*** Rose in Contr. U.S. Nat. Herb. 12: 278 (1909), non *Bursera acuminata* Willd. (1806).

B. ovalifolia sensu Bullock, saltem pro parte., fortasse non *Elaphrium ovalifolium* Schlechtend. in Linnaea 17: 248 (1843).

Our specimens have in common the 2-3(-4) pairs of nearly glabrous and subauriculate leaflets, and the generally glabrous herbage and inflorescence. Notes on bark colour indicate that the inner bark varies from greenish-red to red, and that the outer papery layers peel off in small fragile red or reddish-brown flakes. The young leaves are noticeably pilose beneath along the veins, especially toward the bases of the leaflets, but most of the hairs have fallen by the time fruit matures. We cannot distinguish this population from *Bursera attenuata* except that the leaflets are often (but not always) 2 pairs rather than 3, and the hairs at the base of the leaflets are wanting or, if present, scattered and not collected in a dense axillary tuft as in *B. attenuata*. In the uplands of Jalisco and Michoacán the principal representative of the



MAP 3. Distribution of *Bursera* in western Mexico. 1, *B. grandifolia*, 2, *B. attenuata* and (below the heavy line), *Terebinthus acuminata*; 3, *B. aff. sinuata*.

3/2, p. 353). It is possible that this is the same plant as *Bursera ovalifolia* (Schlechtend.) Engl., but we prefer not to take up that name on the basis of the original description alone. The type of *Elaphium ovalifolium* presumably came from eastern Mexico, but was a sterile fragment from an unknown locality ('Nonnisi fragmenta suppetunt, nec locus natalis arboris notus est, quam amicis. Schiede legit'). According to Schlechtendal the leaves were glabrous or with a few hairs on the mid-vein beneath, the leaflets 1-2 pairs, rather abruptly, acutely and narrowly acuminate, the lateral ones on petioles 2-3 mm. long. This applies well enough to our material, including the type of *Terebinthus acuminata*, and we suppose also to the Hinton specimens from the State of Mexico, cited by Bullock (1936); of these we have seen at Chicago (F) Hinton 730, 6141, 7140, 7299, 7830, and 7831.

Because the distinction between *B. attenuata* and *T. acuminata* may be quite subjective in densely pubescent individuals with 3 pairs of leaflets, we think it unwise to provide a new name in *Bursera* for the taxon called *Terebinthus acuminata*; and provisionally we treat it as conspecific with *B. attenuata*. Further investigation, especially when more flowering material becomes available, may show that these populations, and the Pacific Lowland species treated below as *Bursera* sp., should all be taxonomically united with other representatives of an inclusive *B. simaruba*.

We have seen the following additional specimens of '*T. acuminata*':

JALISCO: 5-8 miles [8-c. 13 km.] above La Cuesta, road to Talpa, 1200-1500 m., 16 Oct. 1960 (fr.), *McVaugh* 20323; above the pass 10 miles [16 km.] S. of Autlán, [c. 1500 m.], 28 June 1949 (fl.), *Wilbur* & *Wilbur* 1410; *ibid.*, 1 Nov. 1962 (fr.), *McVaugh* 21995; subtropical forest on limestone, 6 miles [c. 10 km.] SW. of Pihnamo, 650 m., 29 Oct. 1962, *McVaugh* 21975; Puente San Pedro, 5 miles [8 km.] SW. of Tecalitlán, 1200 m., 2 Dec. 1959 (fr.), *McVaugh* & *Koelz* 1306; 5.5 miles [c. 9 km.] N. of Tecalitlán, 1200 m., 21 June 1957 (imm. fr.), *McVaugh* 14955; Cuesta de San Marcos, c. 30 miles [48 km.] SW. of Guadalaajara, 1700 m., 24 June 1957 (imm. fr.), *McVaugh* 15095; near Chapala, [c. 1500 m.], 5 Oct. 1903 (fr.), *Rose* & *Painter* 7656 (US, holotype of *T. acuminata*).

MICHÓACÁN: Corru Station [c. 1800 m.], 12 Oct. 1904 (fr.), *Pringle* 8898; deep stream-valley in pine-oak zone 15 miles [24 km.] S. of Arto de Rosales, 1250 m., 25 Oct. 1962 (fr.), *McVaugh* 21939; river-gorge, oak-pine zone 10 miles [16 km.] S. of Uruapan, 1200 m., 28 Oct. 1962 (fr.), *McVaugh* 21958.

WITHOUT LOCALITY: *Sessé* & *Mocino* 4935 (Chicago Nat. Hist. Mus. neg. 41826).

17. *Bursera* sp. aff. *B. simarubae* (L.) Sarg.

We use this name provisionally for a distinctive plant with relatively numerous leaflets and tufted-hirsute petiole-bases. The plant in question is known from a series of localities in the Pacific Lowlands of Mexico (see Map 3/3, p. 353). Presumably it is the same plant as that called *Bursera longipes* by Bullock (1938: 167), who states that the latter species may be distinguished from *ovalifolia* by the 'fairly dense, villous indumentum at the extreme base of the petiole and adjacent part of the young stem, and a similar though less dense hairiness... in the lower part of the inflorescence rachis'. Bullock's observations were based on a number of Hinton's collections from

(Hinton 10210, 10212, 10220, 10309) at Uruapan (1938). We doubt, Hinton's later collections, cited below, belong to the same taxon. We doubt, however, that it is the same as *B. longipes* (Rose) Standl. Our plant occurs chiefly near the Pacific coast, at elevations of 400 m. or less, in tropical bar-ranca forests, where it is an understory tree 10-20 m. high (Gentry says 'a magnificent tree 25-30 m. high') with a straight trunk up to 50 cm. in diameter. It ranges beyond our limits, apparently nearly or quite to the borders of Guatemala; cf. *Maldia* 16608, from Escuintla, Chiapas, 21 June 1947, in fruit, which we cannot distinguish from specimens collected further west. In its habit, its habitat preference, and the dense patches of hairs on the shoots it suggests some of the Central American representatives of the *simaruba*-complex.

Typical *Bursera longipes*, on the other hand (as already noted by Bullock), is a glabrous, small short-trunked much-branched tree 4-8 m. high. It has an inland range; it is abundant in parts of Puebla and Morelos, where it comprises a characteristic element of the arid deciduous woodland vegetation, the so-called 'cuajotal' as described by Miranda (1941). As far as we know it does not occur in western Mexico. It is like our representative of *B. simaruba* in having rather numerous leaflets, but neither this nor the feature of long-petiole leaflets seems to be distinctive in the *simaruba*-complex.

We have seen the following additional specimens from western Mexico:

SONORA: Rio Mayo, Arroyo Gochico, 300-600 m., 3 Apr. 1938, *Gentry* 3621 (F).

SINALOA: Baromena, c. 450 m., arroyo in short-tree forest, 16 Sep. 1941 (fr.), *Gentry* 6678.

NAVARRR: Near San Blas, Oct. 1931, *Bravo* 139-4150 (MEXU).

JALISCO: Puerto Vallarta, 21 July 1932 (imm. fr.), *Howell* 10335 (US); near La Resolana, c. 300 m., 8 July 1949 (fr.), *Wilbur* & *Wilbur* 1596.

COLIMA: Palm forest near Playa de Santiago, 21 July 1957 (imm. fr.), *McVaugh* 15579.

GUERRERO: Distr. Montes de Oca, Pasión, 400 m., 10 Oct. 1937 (fr.), *Hinton* 10787; *ibid.*, Vallecitos, 23 Nov. 1937 (fr.), *Hinton* 11588; *ibid.*, 8 Jan. 1938 (fr.), *Hinton* 11731; *ibid.*, San Antonio, 21 Apr. 1938 (fl.), *Hinton* 14033. OAXACA: Cafetal El Calvario y orilla del Tolepec, Departamento de Pochnita, 700 m., 9 Apr. 1917, *Conzatti* 3060, 3098 (MEXU).

WITHOUT LOCALITY: *Sessé* & *Mocino* 4700 p.p. (Chicago Nat. Hist. Mus. neg. 41816).

The following specimens are in some respects intermediate between this taxon and the *Terebinthus acuminata*; the petioles are hairy about the bases as in the lowland plant, but the leaflets are 2 or 3 pairs only, and either glabrous or with a few hairs along the mid-vein as in *T. acuminata*:

MICHÓACÁN: Distr. Coalcomán, Pto. Zazamora, 1 July 1939 (imm. fr.), *Hinton* 13865 (US); *ibid.*, Coalcomán, 1080 m., 6 Sep. 1938 (fr.), *Hinton* 12142 (MICH, US); *ibid.*, San José, 800 m., 16 June 1939 (fl.; lvs. glabrous), *Hinton* 13805 (US).

The group of *B. simaruba* L. has been the subject of some taxonomic discussion. Standley (1946) considers most of the Mexican, Central American, and West Indian and South American representatives of this group to belong to

1957 (fr.), *McVaugh* 15971.

COLIMA: Gorge of Río Chhuatlán, N. of Santiago, 200–300 m., 27 July 1957 (fr.), *McVaugh* 15825; rocky hills, Playa de Santiago, 30–40 m., 22 July 1957 (fr.), *McVaugh* 15639; bluffs of Río Salado, 5 miles [8 km.] S. of Colima, 400 m., 26 Nov. 1959 (fr.), *McVaugh* & *Koelz* 1101; floodplain, 18 miles [c. 29 km.] by road E. of Colima, 300 m., 17 July 1957 (imm. fr.), *McVaugh* 15488; Paso del Río, Nov. 1906, *Emrick* 148 (F.).

MICHOACÁN: Distr. Apatzingán, 4 miles [c. 6 km.] W. of Apatzingán, c. 360 m., 8 Aug. 1941 (sterile), *Leavenworth* & *Hoogstraal* 1396; *ibid.*, 16 Sep. 1958, *McVaugh* 17919; *ibid.*, below Acahuate, c. 750 m., 5 Aug. 1941, *Leavenworth* & *Hoogstraal* 1546; Cañón El Marqués, 6 miles [c. 10 km.] N. of Nueva Italia, 400 m., 18 Sep. 1958 (fr.), *McVaugh* 18005; road to Aguilla, 16 miles [c. 26 km.] S. of Río Tepalcatepec, 450 m., 14 Sep. 1958 (fr.), *McVaugh* 17823; Distr. Coalcomán: Aquila, 120 m., 21 Nov. 1938 (fr.), *Hinton* 12639; *ibid.*, Coahuayana, 10 Jan. 1942 (fr.), *Hinton* 16279; La Playa, 18 miles [c. 29 km.] S. by air of Arrio de Rosales, 18 June 1950 (imm. fr.), *B. L. Turner* 1916.

GUERRERO: Distr. Mina, Carrizeras, 30 Apr. 1937 (fl.), *Hinton* 10408.

To the synonymy of *Bursera grandifolia* we refer with some doubt the *Schinus hexander* Sesse & Moc., Fl. Mex., ed. 2: 232 (1894). The plant is described as having 5 or 7 ovate sessile inequilateral tomentose leaflets, 6 stamens in the hermaphrodite flowers, and 3-carpellate fruit; the vernacular name is given as 'xiote'. As far as we can tell the Sesse & Mociño herbarium contains no material of the plant with 6 stamens. In specimen No. 4934, however, labelled 'Bursera tomentosa [N]ova. ic[on]', and 'Flores polygami hexandri', the staminate flowers are 5-merous as described for *S. hexander*, and the leaves, although immature and rather narrowly pointed, are similar to those of *Bursera grandifolia*. This specimen may be regarded as a lectotype for *S. hexander*.

20. ***Bursera instabilis*** *McVaugh* & *Rzedl.*, sp. nov.; arbor 7-metralis, 30 cm. diametro, foliis subtus in axillis versus basin barbatis, cetera glabra. Truncus laevis, nitidus, viridis, cortice exteriori exfoliantis papyraceo, rufo-brunneo. Folia vel simplicia vel 3- vel 5-foliolata, lamina ovatis integris, apice acutis vel brevicauminatis, basi cordatis vel subcordatis vel rotundatis, marginibus basi saepe inaequaliter perbreviterque decurrentibus. Folia simplicia 4–8 cm. longa, 2.5–4 cm. lata, petiolis 1–2 cm. longis, nervis lateralibus quoque latere 5–7, arcuatum adscendentibus; folia pinnata (praesertim surculorum nodis oriunda) similia, foliolis plerumque 3, paulo minoribus, petiolis 2–4 cm. longis, petiolulis lateralibus 1–2 mm. longis, rhachi exalata. Flores non visi. Infructescentiae 1–2 cm. longae, ramulorum foliosorum nodis approximatis infimis oriundae, ut videtur irregulariter racemosae, pauciflorae; pedicelli 2–3 mm. longi; drupae trivalvatae 6–8 mm. longae, basi rotundatae, ambitu oblique ovoidae, triangulares, apice subcautae. Pyrenae 5–6 mm. longae, trigonae, mesocarpio arilliforme pallido omnino indutae. Fig. 1/3, p. 351.

COLIMA: Western end of Bahía Santiago, opposite Santiago, between the ocean beach and the coastal lagoons, 29 July 1957 (fr.), *McVaugh* 15878 (MICH, holotype; K, isotype); near Manzanillo, W. side of Cuyutlán

soil c. 10 km. SW. of Tecoman, 50 m., 29 June 1961 (fr.), *Rzedowski* 15450. MICHOACÁN: E. of Punta S. Juan de Alima, on coastal dunes, 14 Mar. 1965 (fr.), *McVaugh* 22983.

Although superficially similar in some respects to the groups of *B. sinaruba* and *B. grandifolia*, this species may indeed have little in common with these. Flowering material is needed to establish its actual relationships.

21. ***B. crenata*** *P. G. Wilson* in *Kew Bull.* 13: 156 (1958).

This is apparently a plant of much restricted distribution, known only from the upper valley of the Río Tepalcatepec near Apatzingán, at elevations of from 300 to 600 m. To the specimens cited by Wilson in the protologue may be added the following:

MICHOACÁN: Distr. Apatzingán, east of Apatzingán, 600 m., 22 Aug. 1941, *Leavenworth* & *Hoogstraal* 1761; lava flows 4 miles [c. 6 km.] NW. of Apatzingán, 300 m., 16 Sep. 1958, *McVaugh* 17949.

22. ***B. trimera*** *Bullock* in *Bull. Misc. Inf. Kew* 1936: 379 (1936), & in *Hook. Ic. Pl.* 34, t. 3393 (1939).

To the specimens cited by Bullock we can add the following:

MICHOACÁN: Distr. Zitacuaro, Tuzantla–Tiquicheo, 700 m., 1 Oct. 1938 (fr.), *Hinton* 13299 (F; many lvs. unifoliolate); Distr. Apatzingán, Tepalcatepec, 400 m., 24 Aug. 1938 (lvs.), *Hinton* 12094 (F), 12095 (F); *ibid.* (fr.), *Hinton* 12096 (F; some lvs. unifoliolate); Cañón El Marqués, 6 miles [c. 10 km.] N. of Nueva Italia, 400 m., 18 Sep. 1958 (fr.), *McVaugh* 18004; 19 miles [c. 21 km.] SW. of La Huacana, dry hills in tropical deciduous forest, 180 m., 26 Oct. 1962 (fr.), *McVaugh* 21949.

This species is extraordinarily close to *B. crenata*, and unifoliolate forms may be indistinguishable from that species unless fruit is present. Usually, however, the two may be distinguished by the shape of the blade, which in *B. crenata* is consistently narrowed toward base from the middle or above; the blade at the junction with the petiole may be somewhat abruptly contracted into the petiole but the base as a whole may be described as approximately cuneate, as noted by Wilson in the protologue. In unifoliolate forms of *B. trimera*, however, as far as we have noted (e.g. in *Hinton* 7743, 12096 and 13299), the blades tend to be oblong, the sides parallel and the base rather broadly rounded.

The following specimen would key out to *B. trimera* but seems atypical in that the leaflets are unusually long (4–7 cm.) and thin, and in the following features noted at the time of collection: 'Bark rough, checked, dark grey; plant with odour of citronella';

JALISCO: Below Presa de Sta. Rosa, in the 'barranca' of Río Santiago N. of Amatlán, 750–800 m., in ravines, 1 Sep. 1960 (fr.), *McVaugh* 18536.

23. ***B. subtrifoliata*** (*Rose*) *Standl.* in *Field Mus. Publ. Bot.* 4: 217 (1929).

Trebintlus subtrifoliata *Rose* in *Contr. U.S. Nat. Herb.* 10: 122 (1906).

Bullock suggested a possible relationship between this species and *B. trimera*, distinguishing the latter by its moderately long petiole and oblong

Bolaños, Jalisco, September 1897 (fr.), *Rose* 3014 (US) (Fig. 1/4, p. 351). After study of the type we suppose that *B. subtrifoliolata* belongs to the group of *B. fagaroides* rather than with *B. trinera*; *B. fagaroides* is common in the *barranca* country near Bolaños, and forms with one pair of leaflets are not unknown. The leaf-margins in Rose's specimen are more finely toothed than is usual in *B. fagaroides*, but in other respects it is not obviously different. Additional collections from the vicinity of Bolaños are needed to clarify this situation.

24. **B. staphyleoides** *McVaugh & Reel*, sp. nov.; arbor glabra, 3-5 metrals. Truncus laevis atroviridis, cortice exteriore probabilliter papyraceo. Folia vel simplicia vel trifoliolata, lamina breviuminatis, crenatis, dentibus haud prominentibus, utroque latere (15-)25-35; folia simplicia ovata vel elliptico-ovata, 3-5.5 cm. longa, 1.5-3 cm. lata, basi rotundata vel subacuta, petiolis tenuibus 1-2 cm. longis, nervis lateralibus quoque latere 5-8 sub-rectis adscendentibus; folia trifoliolata (praesertim surculorum nodis oriunda) similia sed angustiora; foliolum terminale 4.5-6.5 cm. longum, 2.3-3.5 cm. latum, ellipticum, basi plerumque paullo prolongatum cuneatumque; foliola lateralia 2, quam terminale paullo minora, elliptico-ovata, 3.5-4.5 cm. longa, 1.5-2.5 cm. lata, ad basin rotundata sed basi ipsa subacuta, sessilibus. Flores non visi. Infructescentiae pauciflorae 5-7 mm. longae (pedicellis 2-4 mm. longis inclusis), ramulorum foliosorum nodis approximatis infimis orundae. Stammodia 1.5-2 mm. longa, filamentis subulatis antherisque sterilibus linearibus subaequalongis. Drupae 5-6 mm. longae lataeque, obtuse triangulares vel late obovatae, trivalvatae. Pyrenae late convexo-triangulares, 4-4.5 mm. altae, 5 mm. latae, mesocarpio arilliforme pallide omnino indutae. Fig. 1/2, p. 351.

MICHOACÁN: Distr. Apatzingán, Buena Vista, chaparral on 'malpais'; 400 m., 22 Aug. 1938 (fr.), *Hinton* 12073 (MICH, holotype; K, isotype); *ibid.*, steep side of canyon below Acahuato, c. 750 m., 15 Aug. 1941 (fr.), *Leavenworth & Hoogstraal* 1596 (F).

This plant is associated in our treatment with *B. trinera* and *B. subtrifoliolata* because each may have unifoliolate or trifoliolate leaves, but *B. staphyleoides* differs from the other two in having finely crenate, acuminate leaflets unlike those of any other species known to us.

25. **B. trifoliolata** *Bullock* in Bull. Misc. Inf. Kew 1936: 378 (1936).

This species, known to Bullock only from the State of Mexico and from the Balsas Valley in Guerrero, can now be reported from the valley of the Rio Tepalcapec in Michoacán:

MICHOACÁN: Between San Juan de los Plátanos and Amatán, 275 m., a tree 6 m. high with persistent thick peeling reddish bark, 17 Sep. 1958 (fr.), *McVaugh* 17958; Distr. Apatzingán, Buena Vista-Tomatán, 400 m., 22 Aug. 1938 (fr.), *Hinton* 12074 (F, US); *ibid.*, 10 miles [18 km.] S. of Apatzingán, 360 m., 21 Aug. 1941 (sterile), *Leavenworth & Hoogstraal* 1742 (F); *ibid.*, 4 miles [c. 6 km.] W. of Apatzingán, c. 360 m., 8 Aug. 1941 (sterile), *Leavenworth & Hoogstraal* 1385 (F).



PLATE 5. Fruiting branchlets of *Bursera* sect. *Bursera*. 1, *Bursera ocellata*; 2, *B. denticulata*. Both $\times \frac{1}{2}$. 3 from *Hinton* 12555, type of *B. ocellata*, Univ. of Mich. neg. 1541; 2 from *Hinton* 1921, type of *B. denticulata*, Univ. of Mich. neg. 1543.

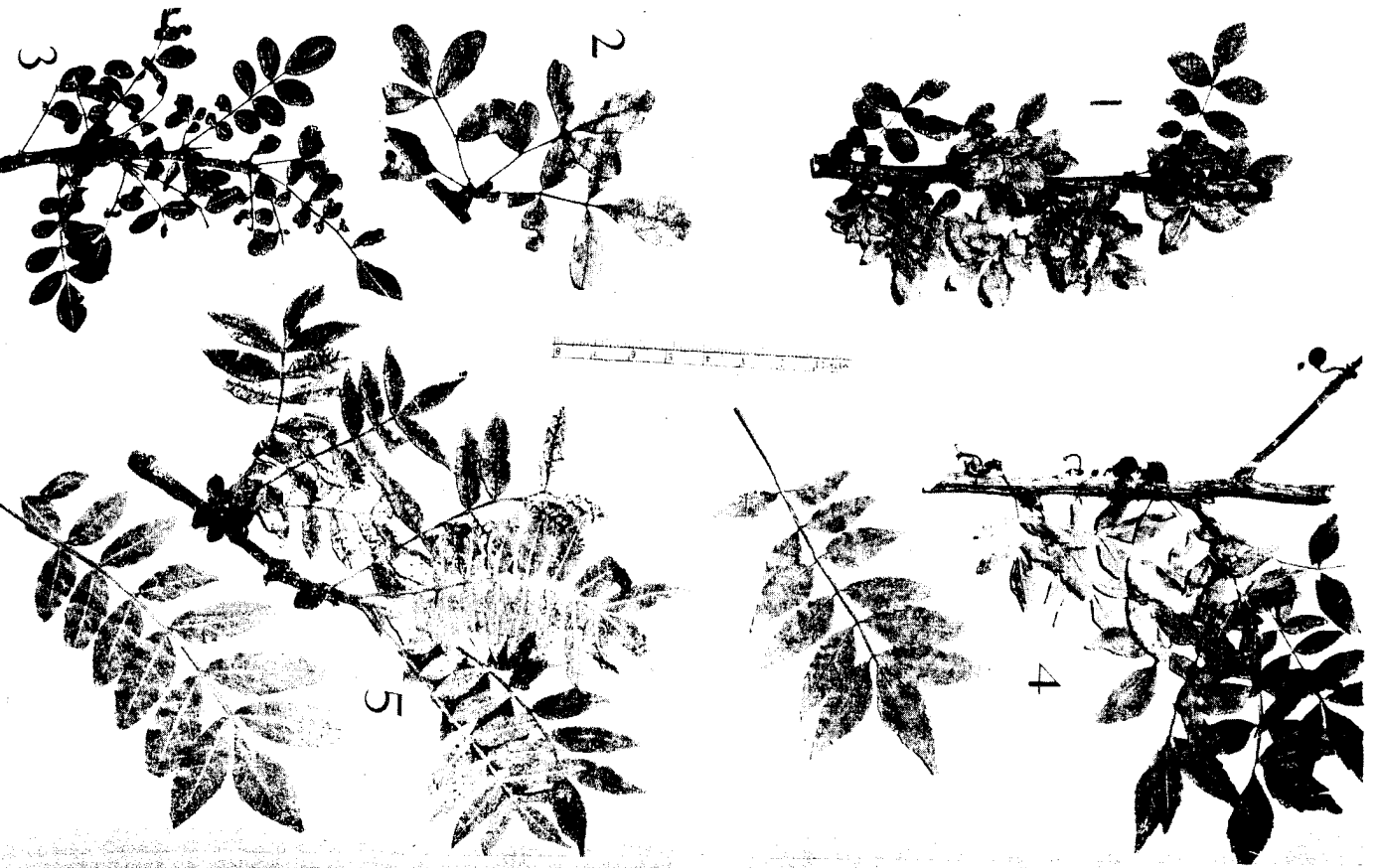


PLATE 6. Fruiting branchlets of *Bursera fagaroides-artsensis* complex. 1, *Bursera fagaroides* var. *fagaroides*; 2, *B. fagaroides* var. *purpusii*; 3, *B. fagaroides* var. *purpusii*, a form with smaller and more numerous leaflets; 4, *B. fagaroides* var. *elongata*; 5, *B. artsensis*. All $\times \frac{1}{2}$. 1 from McVaugh 21927; 2 from McVaugh 21942; 3 from McVaugh 21890; 4 from McVaugh 21752, type of var. *elongata*; 5 from McVaugh 21956.

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whereas the large obovate terminal ones are mostly dentate; the number of leaflets is usually 3 but occasionally 5, whereas according to Bullock the number is consistently 3.

26. ***B. schlechtendalii*** Engl. in DC., Monogr. Phan. 4: 41 (1883).

B. jonesii Rose in Contr. U.S. Nat. Herb. 3: 314 (1895).

This species, known to Bullock from a few 'mere scraps' only, actually ranges rather widely on the Pacific Slope from northern Central America to western Mexico. It is known also from Yucatán and from several localities in eastern Mexico. As suggested by Bullock it seems to be very distinct and without near allies. It is very common on the dry hills in subtropical deciduous forest between Oaxaca and the Isthmus of Tehuantepec, where it is often a tree 5–10 m. high with trunk up to 30 cm. in diameter and leaves up to 8–10 cm. long. We have seen specimens from Puebla and Hidalgo also, and from as far north as San Luis Potosí, but none from the valley of the Río Balsas or indeed from anywhere in Guerrero or Michoacán. In Jalisco and Colima it is usually not abundant even at the localities where it is found, and often the plants are shrublike or no more than 3–5 m. high:

ZACATECAS: 17 km. S. of Moyahua, 1500 m., 25 June 1957 (H.), *Rzedowskii* 9132.

JALISCO: Bolaños, 10–19 Sep. 1897, *Rose* 2877 (MEXU, US); steep summit slopes of the 'barranca', 8 miles [c. 13 km.] N. of S. Cristóbal de la Barranca, 1350 m., 11 Nov. 1962 (fr.), *McVaugh* 22149; 'barranca' below Huentitán, NE. of Guadalaajara, c. 1400 m., 8 Nov. 1962 (fr.), *McVaugh* 22091; limestone hills with *Acacia, Zyzyphus*, 2 miles [c. 3 km.] NW. of Apulco, road to Tonayá, 870 m., 31 Oct. 1962 (fr.), *McVaugh* 21992.

COLIMA: Gypsum hills 11 miles [c. 18 km.] SSW. of Colima, on grassy slopes and on rock faces, bark dark red-brown, peeling, a shrub 1 m. high, 2 m. broad, 500 m., 19 July 1957 (fr.), *McVaugh* 15559; Colima, 2 July 1892, *Jones* 73 (US, holotype of *B. jonesii*).

It is probable that the type of *B. jonesii* came from the same locality as *McVaugh* 15559, although Rose gave the locality as 'near the city of Colima'. About 10 miles [16 km.] from Colima the Manzanillo road crosses a rough range of hills made up primarily of gypsum and slate, and here on the pass at an elevation of about 500 m. a number of gypsophilous species are concentrated. It seems likely that Jones collected here on July 2 1892, for in his diary for that day is the following entry: 'Went to see a coal, mica and gypsum mine, only gypsum there. *Hot*. Botanized.' We are indebted to Dr. Lyman Benson for permission to quote from the diary.

The herbarium of Sessé & Mocino contains 3 sheets (No. 4687) of a plant we should call *B. schlechtendalii*. Two of the specimens are referred by the collectors to *Schinus*, with a specific epithet alluding to the simple leaves.

27. ***B. multifluga*** Engl. in DC., Monogr. Phan. 4: 42 (1883).

B. pingletii S. Wats. in Proc. Amer. Acad. 25: 145 (1890).

Terebinthus rubra Rose in Contr. U.S. Nat. Herb. 10: 121 (1906).

Bursera rubra (Rose) Riley in Bull. Misc. Inf. Kew 1923: 168 (1923).

This is a moderately large tree, up to 10–12 meters high with red trunk up to 30 cm. in diameter. It is a plant of ravines and bluffs at moderate eleva-
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not readily confused with other species except that individual specimens may have fewer leaflets than usual, or sparingly toothed leaflets, suggesting in these respects a transition to *B. confusa*. (Fig. 2/6, 7, p. 365).

The type of *Terebinthus rubra* Rose is a fruiting specimen with 5-7 pairs of leaflets, fewer than the average for *B. multiligata*. The inflorescence, however, is slender-pedunculate as in *multiligata*, and the bark was described by Rose as red, so we do not think the specimen can represent *B. confusa*, the only other species for which it might be mistaken.

SINALOA: Near Colomas, 14 July 1897 (fr.), Rose 1670 (US, holotype of *T. rubra*); 4 miles [c. 6 km.] SW. of Sta. Lucía (50 miles [80 km.] E. of Mazatlán), in oak zone, 1200 m., 2 Oct. 1962 (sterile), McVaugh 21749.

ZACATECAS: 14 km. SW. of Jalpa, 1450 m., 25 June 1957 (fl.), Rzedowski 9127.

NAVARRA: Arroyo de la Fundición, SE. of Ahuacatlán, 1300 m., 6 July 1957 (fl.), McVaugh 15133; SE. of Ahuacatlán, 1100-1300 m., 7 July 1957 (fl.), McVaugh 15162; lava flows from Volcán Ceboruco, 900 m., 13 July 1957 (fl.), McVaugh 15380; 9 miles [c. 14 km.] N. of Compostela, 1000-1200 m., 28 Aug. 1957 (fr.), McVaugh 16505; 12 miles [c. 19 km.] W. of Tepic, c. 1200 m., 12 Sept. 1960 (fr.), McVaugh 18974.

JALISCO: Head of barranca c. 25 miles [40 km.] N. of Guadalajara, with *Ficus*, *Vitex*, 1350 m., 9 Nov. 1962 (fr.), McVaugh 22124; barranca of Rio Verde N. of Tepatlán, 1450 m., 27-28 Aug. 1958 (fr.), McVaugh 17369; El Molino, 25 miles [40 km.] SW. of Guadalajara, 1650 m., 2 Sep. 1960 (sterile), McVaugh 18607; E. of S. Luis Soyatlán, S. side of Lake Chapala, 1500-1600 m., 28 June 1957 (fl., imm. fr.), McVaugh 15083; south-facing summits, oak zone 7 miles [c. 11 km.] SW. of Ayutla, 1500 m., 2 Nov. 1962 (sterile), McVaugh 22002; N. of La Cuesta, road to Talpa de Allende 800-1400 m., 15-16 Oct. 1960 (fr.), McVaugh 20251; near Guadalajara 29-30 Sep. 1903, Rose & Painter 7441, 7446 (US); near Tequila, 5-6 July 1899, Rose & Hough 4745 (US); near-vertical slopes below the oak zone, 15 miles [24 km.] SW. of Autlán, 1100 m., 1 Nov. 1962 (sterile), McVaugh 21996.

Among the plants of the Sessé & Mociño herbarium is a specimen (No. 4666) labelled 'Schinus copallifera N.', and on the back of the label 'Schinus angustifolius N.'. The specimen is incomplete, but from the 7-10 pairs of narrowly lanceolate serrate leaflets we suppose it to represent *B. multiligata*. The leaflets are quite unlike those of *Elaphrium copalliferum* Sessé & Moc. ex DC. (see p. 342), and the name *Schinus copallifera* (if no error in labelling is involved) may be assumed to be a provisional name later abandoned. On this particular specimen the epithet *angustifolius* probably represents a mis-identification on the part of the collectors. The true *Schinus angustifolius* Sessé & Mociño, first published in Pl. Nov. Hisp.: 173 (1890), was described as having 12 pairs of linear, entire leaflets, and the red bark that gave it the name 'Xiole colorado'. There is apparently no specimen of such a plant in the Sessé & Mociño collection, but the description strongly suggests *B. moralesii* Ramirez (see p. 367), or *B. galeottiana* Engl. In October 1963 one of us (Rzedowski) visited the type-locality of *Schinus angustifolius*, namely the old hacienda of Ixtla, in south-eastern Guanajuato ('in aridis montibus Ixtlae haereditatis prope Queretarium'), and found the plant, still known

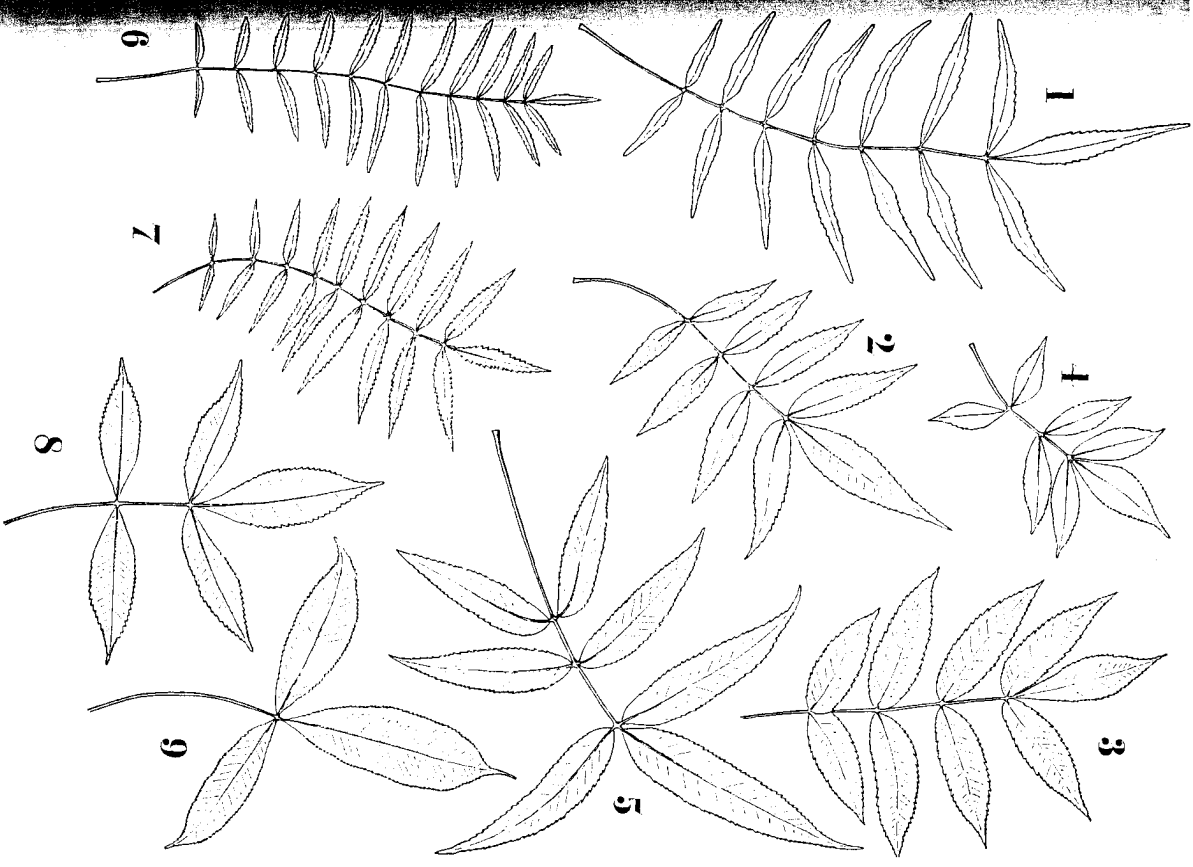


FIG. 2. Leaves of species and putative hybrids in one group of *Bursaria* sect. *Bursaria*. 1, *Bursaria angulata*; 2, hybrid, perhaps involving *B. kerberi* and *B. multiligata*, more resembling the latter; 3, putative hybrid between yellow-barked and red-barked species; 4, putative hybrid involving *B. fagaroides* and some red-barked species; 5, *B. lanifolia*; 6, *B. multiligata*; 7, *B. multiligata*, form with differently shaped leaflets; 8, hybrid resembling *B. kerberi* but having 5 leaflets; 9, *B. kerberi*. All × c. $\frac{1}{2}$. 1 from McVaugh 22131; 2 from McVaugh 21977; 3 from McVaugh 21976; 4 from McVaugh 22076; 5 from McVaugh 21835; 6 from McVaugh 22124; 7 from McVaugh 21996; 8 from McVaugh 22132; 9 from McVaugh 21988. For discussion see text, p. 365.

locally as 'sioxole colorado', growing under the same conditions as *B. lancifolia* (Engl.), thus confirming our guess at 17304) proved to be *Bursera galeottiana* Engl., the identity of *Schinus angustifolius* and at the same time extending the known range of *B. galeottiana* considerably to the north-west.

Except for a very young specimen collected by Hinton in the State of Mexico, we have not seen *B. multilinga* from anywhere east of Lake Chapala. It is abundant on the dry hills of central Jalisco, where it is often found with *B. kerberi* (see Map 4, p. 368). Further east, in Puebla and Oaxaca, the equivalent ecological niche seems to be occupied by *B. moreletensis* or *B. lancifolia* (Schlechtend.) Engl. Occasional trees with no more than 3-4 pairs of lanceolate but not linear leaflets suggest the existence of hybrids between *B. multilinga* and *B. kerberi* or *B. lancifolia*; see discussion below, under *B. lancifolia*. It has also been supposed that *B. multilinga* may hybridize with one of the yellow-barked species of the *fagaroides* group to produce something like the type of *B. confusa*, q.v.

28. **B. lancifolia** (Schlechtend.) Engl. in Engl., Bot. Jahrb. 1: 43 (1881).

Elaphrium lancifolium Schlechtend. in Linnaea 17: 247 (1843).

?*Bursera fragilis* S. Wats. in Proc. Amer. Acad. 21: 422 (1886).

Typical *Bursera lancifolia* is a common plant of the subtropical deciduous forest on the mountains of the Pacific Slopes of Mexico from the Isthmus of Tehuantepec to the vicinity of Chihpancingo and the upper valley of the Rio Balsas, in Guerrero and Morelos. We have not seen any undoubted specimens of this species from further west. The tree is easily recognized by the short, few-flowered inflorescence 1-3 cm. long including the fruit, by the usually two or three pairs of lanceolate leaflets with very numerous teeth (Fig. 2/5, p. 363), and by the bark, which is unusual among the red-barked species because the outer papery layers tend to peel off in small brittle flakes which are light copper colour within and much paler without.

A superficially similar plant, *Bursera fragilis* S. Wats., was considered by Bullock to be conspecific with *B. lancifolia*. The type of *B. fragilis* came from southwestern Chihuahua; modern collections extend the range to the arid ranges of Sonora, and to northern Sinaloa. We have not seen this plant in the field, nor have we seen flowering material of *B. fragilis* or *B. lancifolia*. Herbarium specimens of *B. fragilis* seem to have slightly smaller leaves and leaflets and fruits than equivalent specimens of *B. lancifolia*. According to field-notes by Gentry, *B. fragilis* in Sinaloa is a tree with 'light' or 'grey' bark. We consider that the question of the relationship between *B. fragilis* and *B. lancifolia* must be resolved by further field work.

In the region of the 'Flora novo-galiciana' we have not found any plants that may be referred with certainty to either of the above. We do find, however, occasional plants simulating these species but perhaps of hybrid origin. We suppose that these involve *B. multilinga* and *B. kerberi*, or *B. multilinga* and one of the yellow-barked species of the *fagaroides* complex. At a locality about 40 km. N. of Guadalajara, for example, in a heavily pastured area of broken rocks below the upper cliffs of the barranca of the Rio Grande de Santiago growing with *Vitex mollis* H.B.K. and *Ficus petiolaris* H.B.K., we found in 1962 an abundance of *Bursera multilinga*, associated with *B. kerberi*. In the same habitat were occasional trees that we took to be hybrids, e.g., one with all the appearance of *kerberi* except that the leaflets were 4 or 5 in number

most unusual. Further search disclosed the presence of individual trees with 2 or 3 pairs of lanceolate leaflets like those of *lancifolia* or *fragilis* (McVaugh 22125); trees with 3-5 pairs of lanceolate leaflets like those of McVaugh 22125, and with pedunculate inflorescences 3-5 cm. long, like those of *B. multilinga* (McVaugh 22130); and trees with 4, or usually 5 pairs of somewhat narrower, lanceolate leaflets, the whole leaf rather suggestive of *B. multilinga* (McVaugh 22131) (Fig. 2/2, p. 363). In all these putative hybrids the bark peeled off freely in large sheets, as in both *B. kerberi* and *B. multilinga*, but in McVaugh 22125 and 22131 it was noted as 'orange-brown' inside, and paler without; that is, it was similar in colour to that of *B. lancifolia*, but rather unlike that of either *B. multilinga* or *B. kerberi*, both of which usually have conspicuously red bark.

To sum up, we know of no way to distinguish individual specimens like those of McVaugh 22125 from *Bursera fragilis* or *B. lancifolia*, but in view of the peculiar circumstances under which the plants occur in nature we suppose their resemblance to these species is merely coincidental, and we urge the necessity of more field work, particularly in early summer when the plants are in flower, to settle the question.

Also easily to be confused with *B. fragilis* and *B. lancifolia* are the occasional species, e.g., between *B. multilinga* or *B. kerberi* and one of the *fagaroides* complex. The type of *Bursera confusa* Rose we believe to have been of hybrid origin, although similar plants now seem to form a local population in southern Jalisco and adjoining states. These ordinarily have 5-8 pairs of narrow leaflets suggesting those of *B. multilinga*, but the congested few-flowered inflorescence of the *fagaroides* group. The greenish-red trunks and the straw-coloured or the coppery brown papery layers of bark suggest a condition intermediate between the red- and yellow-barked species. Because of the number of leaflets these plants are not to be confused with the *fragilis-lancifolia* alliance. The same general geographical area, however, there are occasional trees with 2-4 pairs of lanceolate leaflets, the leaves thus superficially much like those of *B. fragilis* or *B. lancifolia*. The leaves turn red in the fall like those of *B. fragilis* in these same species, but in two known instances the peeling papery bark is recorded as 'brown' or 'yellow straw colour', in McVaugh 2076 (Fig. 2/4, p. 363) the inner bark is recorded as 'greenish-blue', and in one known fruiting collection (McVaugh 21977) (Fig. 2/3, p. 363) the inflorescence is congested as in the *fagaroides* group. We suggest, therefore, that the following, because of the anomalous features described above, are to be referred to the *fragilis-lancifolia* alliance but are to be regarded as of undoubted origin:

JALISCO: Deciduous forest on creviced limestone 6 miles [c. 10 km.] SW. Pihnamo, 650 m., abundant, 29 Oct. 1962 (fr.), McVaugh 21977; 2 m. N. of roadside trees 1.5 miles [c. 2.5 km.] W. of San Clemente, road to San Clemente, 1300 m., 5 Nov. 1962 (sterile), McVaugh 22076.

Bursera denticulata McVaugh & Rzedl., sp. nov., arbor glabra, ramulis, fragrans; truncus laevis nitidus, cortice exteriore exfoliantia, ramulis atroruflo-brunneo; folia imparipinnata 3-5-juga, foliolis subtus

lanceolata), subaequalibus vel superioribus paulo majoribus, apice plerumque acutis, nonnumquam obtusis vel acuminatis, basi acutis vel saepe inaequaliter rotundatis; marginibus crenato-serratis, dentibus utroque latere 15-20 (vel foliis majoribus paulo numerosioribus), tota longitudine fere praeditis (vel basin versus saepe integris); dentibus plerumque minutis 0.5 mm. altis, 0.5-1.5 mm. longis. Foliorum laminae 1.5-3(-4.5) cm. longae, 0.7-1.2(-1.6) cm. latae, 2.5-4-plio longiores quam latiores, terminalium paulo longiores; nervis lateralibus quoque latere 10-20, inconspicuis, ascendentibus; interstitia inter juga 0.5-1.5 cm. longa, rhachidibus anguste alatis, alis usque ad 1.5 mm. latis, vel fere nullis; foliola lateralissa sessilia vel petiolulis 0.5 mm. longis praedita, foliolum terminale nunc sessile, nunc rhachidis partem anguste alatum, 3-6 mm. longam, ultra jugam summam, terminante; flores vix visi (flore delapso solitario trimero; calycis lobis deltoideis 3, 0.5 mm. longis latisque, petalis anguste ovatis 3, 2.5 mm. longis, 1.5 mm. latis, staminodis 6, 2 mm. longis, antheris 0.8 mm. longis, ovario trigono trilobulato 1.5 mm. longo, 6-ovulato). Inflorescentia e nodis infimis approximatis ramulorum foliosorum orlunda, 1-3 cm. longa, 1-3-flora, ut videtur racemosa, pedicellis crassis 4-7 mm. longis, rectis vel nutantibus; drupae trivalvatae, late gibboso-fusiformes, basi angustatae, apice acutae, 4.5-6.5 mm. diametro, 7-9.5 mm. longae; pyrenae ovoideo-triangulares, 5.5 mm. longae, 3.5 mm. latae, mesocarpio arilliforme pallido omnino indutae. Pl. 5/2, p. 360.

Type: MEXICO: MICHUACÁN: Distr. Apatzingán, Apatzingán, llano, spreading tree 6 m., unripe fruit orange-red, 'coral', alt. 300 m., 15 Aug 1938, *Hinton* 12021 (MICH, holotype; F, K, isotypes).

This plant seems to be distinct from other species and species-groups in its finely toothed leaflets. The lateral leaflets also may tend to be oblong rather than lanceolate or strictly elliptic. The foliar teeth of *B. denticulata* are smaller, fewer and less distinct than those of *B. occulta*. From *B. occulta* and from *B. arvensis* the present species differs in having the papery layers of the bark dark red rather than yellow.

COLIMA: Low hills 14 miles [c. 22 km.] WNW. of Santiago, 50 m., 25 July 1957 (imm. fr.), *McVaugh* 15740; gypsum-slate hills 10-11 miles [16-c. 18 km.] SW. of Colima, 450-500 m., 18 July 1957 (imm. fr.), *McVaugh* 15525; *ibid.*, 10 Aug. 1957 (fr.), *McVaugh* 16046.

MICHUACÁN: Distr. Apatzingán, above Apatzingán, c. 600 m., 13 Aug. 1941 (fr.), *Laessleworth* & *Hogstraal* 1515; *ibid.*, 300 m., 15 Aug. 1938 (fr.), *Hinton* 12021 (MICH, holotype; F, isotype), 12022; *ibid.*, Buena Vista-Tomatán, 750 m., 22 Aug. 1938 (fr.), *Hinton* 12081; Distr. Coalcomán, Aguila, 15 Nov. 1941 (fr.), *Hinton* 16150.

GUERRERO: Distr. Coyuca, Pungarabato, 6 June 1935, *Hinton* 7849 (MEXU).

The description of the pistillate flower was drawn entirely from a single detached flower found among the leaves of *McVaugh* 15525.

30. **B. kerberi** Engl. in DC., Monogr. Phan. 4: 41 (1883).

[*Bursera leomaca* sensu Bullock (1936), non *Amyris?* *leomaca* DC. in DC., Prodr. 2: 82 (1825).]

at middle elevations from Nayarit to the State of Mexico (Map 4/2, p. 368). The bright brownish-red papery bark, the presence of considerable amounts of resin, and the trifoliate leaves with caudate leaflets (Fig. 2/9, p. 363) make the plant easy to recognize in the field. In November and December before the leaves fall they turn bright red, a colour reminiscent of the maples of temperate North America.

NAVARRO: On the lava flows from Volcán Ceboruco, 900 m., 19 June 1957 (imm. fr.), *McVaugh* 14913.

JALISCO: E. of S. Luis Soyatlán, S. of Lake Chapala, 1500-1600 m., 28 June 1957 (imm. fr.), *McVaugh* 15079; vicinity of Autlán, 1000-1200 m., June 1949 (fl.), *Wilbur* & *Wilbur* 1981; *ibid.*, July 1949 (imm. fr.), *Wilbur* & *Wilbur* 1997; above Ahuacapan, 10 miles [16 km.] SSE. of Autlán, 1100-1200 m., 29 Sep. 1960 (fr.), *McVaugh* 19542; hills N. of Tecalitlán, 1200 m., 21 June 1957 (fl.), *McVaugh* 14953; *ibid.*, 2 Dec. 1959 (fr.), *McVaugh* & *Kelz* 1327; near La Venta, Oct. 1922, *Reko* 4444 (US); near Tequila, 5-6 July 1899, *Rose* & *Hough* 4772 (US); on road between Bolaños and Guadalupe, 21 Sep. 1897, *Rose* 3048 (US); Guadalupe, *Pringle* 2337 (F); Santa Cruz, 4 June 1892, *Jones* 45 (US).

MICHUACÁN: Distr. Apatzingán, below Acahuato, c. 750 m., 14 Aug. 1941, *Laessleworth* & *Hogstraal* 1526 (F); Distr. Coalcomán, Coalcomán, Oct. 1938, *Hinton* 12318 (F).

31. **B. multifolia** (Rose) Engl. in Engl. & Prantl, Nat. Pflanzenfam., ed. 2: 19a: 424 & 426 (1931).
Trebintus multifolia Rose in Contr. U.S. Nat. Herb. 10: 120 (1906).

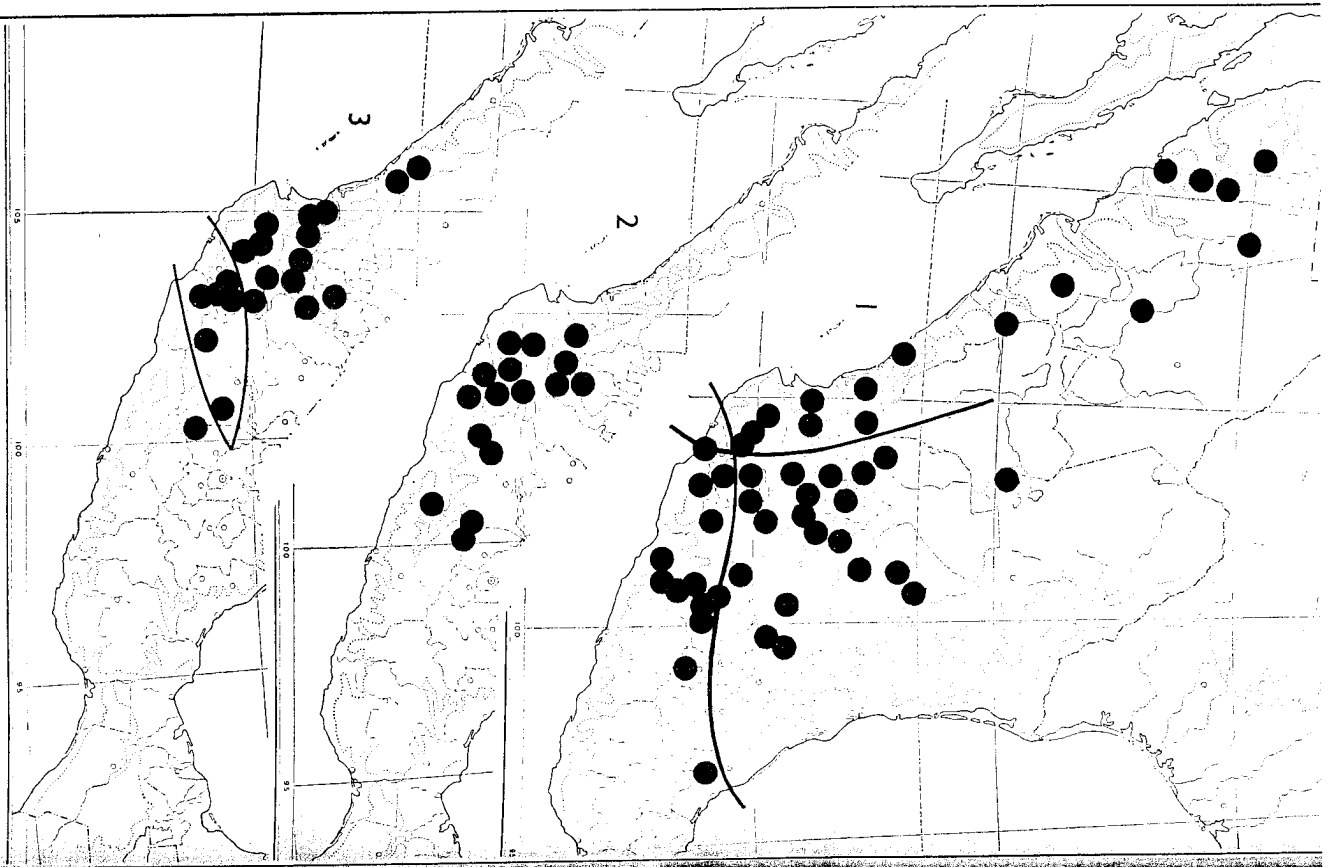
Bullock (1936: 386) regarded this (and *B. moreletis* Ramirez) as synonyms of *B. microphylla* A. Gray. The latter is a plant of deserts and near-deserts in Sonora, Arizona and Baja California; its bark is yellow, grey or tan. In Morelos and Puebla, on the other hand, *B. moreletis* is a well known constituent of the 'cuajital', and is known there as 'cuajote colorado' because of its red bark. Neither of these species is known to occur in Nueva Galicia, but we mention them here because in habit and in the numerous narrow leaflets, as well as in the morphology of the inflorescence, *B. moreletis* suggests relationships to *B. multifolia*.

As Bullock (1936: 371) suggested, final decision on the specific status of *B. microphylla* and *B. moreletis* (and, it may be added, *B. multifolia*), must await the completion of field-study of variability, and more material of each. In the meantime we recognize *B. multifolia* because of its relatively long and widely spaced leaflets, a feature noted by Rose.

ZACATECAS: San Juan Capistrano, [1000-1200 m.], 21 Aug. 1897 (fr.), *Rose* 2455 (US, holotype).

MICHUACÁN: 2.6 miles [c. 4 km.] N. of Capirio, 1250 [feet?], 14 July 1955 (fr.), *W. E. Duellman* s.n.; *ibid.*? (6 miles [c. 10 km.] NW. of Zicután, 20 miles [32 km.] SW. of La Huacana in dry arroyos with legumes, 200 m.), 26 Oct. 1962 (fr.), *McVaugh* 21951.

32. **B. confusa** (Rose) Engl. in Engl. & Prantl, Nat. Pflanzenfam., ed. 2, 9a: 426 (1931).



MAP 4. Distribution of *Bursaria* in western Mexico. 1, *B. fagaroides*. The heavy lines mark the approximate boundary between var. *fagaroides* (to the northeast), var. *purpusii* (to the south) and var. *elongata* (to the west and northwest). Between the point of intersection of the heavy lines and the Pacific Coast, the vars. *purpusii* and *elongata* are not readily distinguishable. 2, *B. kerberi*. 3, *B. multijuga* and (within the heavy lines), *B. confusa*.

As noted above in the discussion of *B. lanceolata*, the type and a number of other specimens of *B. confusa* combine in several ways the characters of *B. multijuga* (e.g. the leaflets 5-7 pairs or more numerous, long and narrow, often 3-6 cm. long and several times as long as wide, with fairly prominent teeth) and the characters of some member of the *fagaroides* complex (e.g. yellowish or straw-coloured peeling bark, and very short and congested inflorescences). The so-called *B. confusa* varies slightly in bark-colour (which ranges from yellowish straw-colour to pale reddish or coppery in the papyery layers) and in the shape of the leaflets (which may be very narrowly or rather broadly lanceolate) (Fig. 2/1, p. 363). In the field we have not always found individuals of *B. confusa* growing with the putative parents; the situation has indeed been quite the reverse; in the limited area in southern Jalisco and adjacent Michoacán where we have found *B. confusa* as a wild tree in natural populations, it has usually been abundant and more or less uniform. We do not suppose, therefore, that *B. confusa* represents a series of F_1 hybrids; we take it to be rather a naturally reproducing population, perhaps ultimately of hybrid origin but usually recognizable in the field as a distinct entity. For distribution of *B. confusa* see Map 4/3, opposite.

Our concept of *B. confusa* is thus narrower than that of Bullock, who included in this species not only *confusa* in the present strict sense, but also that we call *B. fagaroides* var. *elongata*, and some specimens that we should refer to other varieties of *fagaroides*.

JALISCO: Steep canyon in oak zone, 17 miles [c. 27 km.] NE. of Tamazula de Gordiano, 1500 m., 29 Oct. 1962 (papyery bark-layers straw-colour), *McVaugh* 21969; *ibid.*, (papyery bark-layers copper-brown), *McVaugh* 21973; lava beds near Zapotlán [c. 1500 m.], 27 May 1893 (fl., fr.), *Pringle* 4372 (US, holotype of *E. confusum*; F, isotype); Puente San Pedro, 5 miles [8 km.] SW. of Tecalitlán, in oak forest, 1200 m., 9 Aug. 1957 (fr.), *McVaugh* 6019; 4 miles [c. 6 km.] N. of Tecalitlán, on a disturbed hillside with other *Bursaria*, 1100-1200 m., 2 Dec. 1959 (fr.), *McVaugh* & *Koelz* 1328.

MICHOACÁN: Cañón El Marqués, 6 miles [c. 10 km.] N. of Nueva Italia, 600 m., 18 Sep. 1958 (fr.), *McVaugh* 18003; Distr. Coalcomán, Coalcomán, 100 m., 5 Sep. 1938 (sterile), *Hinton* 12137; *ibid.*, 6 Sep. 1938 (fr.), *Hinton* 1144; Distr. Zitácuaro, Zitácuaro-Los Guajes, 1350 m., 30 Sep. 1938 (fr.), *Hinton* 13290 (F).

For description and discussion of somewhat similar plants, but with fewer leaflets, from the same general geographical region, see under *B. lanceolata* p. 364, where is considered the possibility of hybridization between species of the red-barked group, and those of the yellow-barked, or *fagaroides*, group. Plants of the latter group are very widespread in western Mexico (see Map 4, opposite) and in fact are rivalled in abundance only by *B. bipinnata*. Opportunities for natural hybridization presumably are many, but although we have repeatedly searched in localities where the red-barked and yellow-barked species grow in close proximity we have never found anything suggesting a hybrid except the few plants described here under *B. confusa*, and those described above under *B. lanceolata*. We suppose that natural hybridization in this group of species is infrequent or rare.

***B. fagaroides* (H.B.K.) Engl.** in Engl., Bot. Jahrb. 1: 44 (1881).

The plants that we refer to this species belong to a complex of weakly differentiated populations that ranges from Sonora and Baja California southward throughout most of Mexico to the Isthmus of Tehuantepec (Map 4/1, p. 368). The populations are represented by many individuals almost everywhere they are found. Taxonomically the group as a whole seems to be the most difficult in *Bursera*, as attested by the large number of published epithets in the group, and by the widely different ways the group has been treated by different authors.

In our area we recognize two species in this complex, viz. *B. fagaroides* (H.B.K.) Engl. and *B. arizensis* (H.B.K.) McVaugh & Rzed. We have not given detailed attention to these plants as they occur in Sonora and Baja California, but provisionally we refer them to *B. fagaroides*; the synonymy is given on p. 371, under *B. fagaroides* var. *elongata*. East of our area of study, in Puebla and Morelos, another representative of the same complex seems to be an independent species; this is *B. aphera* Ramirez in Dat. Mat. Med. Mex. 1: 379, cum fig. (1894), a species with 3-5 pairs of small obtuse and entire or subentire leaflets. This, and *B. obovata* Turcz., were referred by Bullock (1936: 383, 384) to the synonymy of *B. fagaroides*. We cannot comment on the identity of *B. obovata*.

Plants of the complex that includes *B. arizensis* and *B. fagaroides* are small short-trunked trees up to 5-7(-10) m. tall and 30 cm. in trunk-diameter, or sometimes shrubs no more than 0.5 m. high. They are at once recognizable by the smooth bluish-green (or sometimes yellowish-green) inner bark of the trunk and main branches, and the thin extensively peeling straw-coloured or greyish-yellow papery outer bark. The cut branchlets are sparingly resinous but neither strongly turpentine-scented nor very fragrant. The inflorescences are short and sessile or essentially so, the usually 1-3 fruits at a node sessile and somewhat deflexed. The foliage is a pale yellowish-green, often turning bright yellow (but not red) in the fall; the leaflets are relatively small, and broad, often 1-2(-4) cm. long, mostly 1.5-3 times as long as wide, varying from subentire to denticulate, the teeth if present usually 12 or fewer on each side. The number of leaflets varies from 1 to about 7 pairs. A number of 'new species' have been recognized on the basis of variation in number, size and shape of leaflets in this group of plants.

It seems to us, after study of the geographical distribution of the whole group, and the inter-relationships of what seem to be weakly distinguished local taxa in the group, that the direction of evolution has been toward reduction of the number of leaflets, reduction in the size of leaflets and a change in leaflet-shape from lanceolate or elliptic and acute to oval or obovate and obtuse. In several lines, including some in which the number of leaflets has not been reduced, the marginal teeth of the leaflets have been reduced in size and/or number, or have disappeared completely.

If interpreted in this way, the present distribution of the group may be reasonably explained. Along the whole extent of the range, at middle elevations on the Pacific slope of Mexico, plants of what may be called a generalized type occur in most of the local populations; these are plants with 4-7 pairs of toothed, acute, lanceolate or elliptic leaflets, the largest of which are 2-3(-4) cm. long. From Oaxaca to Jalisco most of these are strongly pubescent; because of this and other associated minor differences these plants are here referred to a distinct species, *B. arizensis*. From western Michoacán and

of the group has about an equal number of somewhat narrower and only obscurely denticulate leaflets; the plants are glabrous. This taxon is described below as *B. fagaroides* var. *elongata*. Occasional glabrous plants may be found as far east as Oaxaca. Toward the upper altitudinal limits of the range of this glabrous plant, that is, above about 1500 m., from Zacatecas to Jalisco, Michoacán and Guanajuato, many individual plants have 2-4 pairs of leaflets only; a little further east the leaflets may be 1-2 pairs only. The leaflets in these upland plants are prevalently obtuse (or acute only on vigorous branchlets), often reduced in length, relatively broader and usually plainly toothed. This upland plant with few, small, obtuse toothed leaflets is the type of *B. fagaroides*; the original specimens came from near Querétaro.

At middle elevations, indeed mostly below 1000 m. from Veracruz westward through much of the valley of the Río Balsas, another variant has the leaflets entire or nearly so, somewhat reduced in size and number, but the terminal leaflet larger than the others. This is *B. purpusii* Brandg., here regarded as a variety of *B. fagaroides* (see p. 374).

As we interpret the evolution of this whole group of pale-barked taxa, therefore, it has resulted in the development of two recognizable species that reach the area of our study. These are *B. arizensis* and *B. fagaroides*, the latter with three regionally differentiated varieties in our area. These varieties are contrasted in the key (see p. 331). In eastern and southeastern Mexico there appear to be other representatives of the *fagaroides* complex; the most distinct of these, as implied above, seems to be *B. aphera* Ramirez. Several leaf-forms, mostly from the vicinity of Mexico City, were named by Engler (*B. fagaroides* forma *bourgeauana*, forma *crenulata*, forma *elliptica*, forma *yamossissima*; in DC. Monogr. Phan. 4: 48 (1883)). For want of adequate study-material we have not attempted to evaluate these and other *fagaroides*-like taxa that seem to be confined to eastern Mexico.

33a. **Bursera fagaroides** (H.B.K.) Engl. var. **elongata** McVaugh & Rzed., var. nov., a var. *fagaroides* foliis saepe 4-5 jugis, foliis elongatis 1-3(-4) cm. longis plerumque acutis serrato-denticulatis apicibus exceptis, vel integris, inflorescentiis paullo longioribus, usque ad 2-4 cm. longis recedit. Pl. 6/4, p. 361.

Type: Mexico: NAYARIT: 12 miles [c. 19 km.] SE. of Acaponeta, rocky hills in palm savannah, 50 m., 3 Oct. 1962 (fr.), McVaugh 21752 (MICH, holotype; K, isotype).

To this variety we refer with some confidence the following:

Bursera tenuifolia Rose in Contr. U.S. Nat. Herb. 3: 314 (1895), non Engl. ex Kuntze, Rev. Gen.: 107 (1891). Type, Lodiego, Sinaloa, Palmer 1581 (US).
B. lonchophylla Sprague & Riley in Bull. Misc. Inf. Kew 1923: 168 (1923). Type, Choix, Sinaloa, González 896, (K, holotype not seen; US, isotype).
Elaphrium covillei Rose in N. Amer. Fl. 25: 250 (1911). Type, Torres, Sonora, Coville 1640 (US, not seen).

B. odorata T. S. Brandeg. in Proc. Calif. Acad. ser. 2, 2: 138 (1889). Type, San Gregorio, Baja California, (?UC, not seen).

In Bullock's treatment *B. tenuifolia* and *B. lonchophylla* were referred to the synonymy of *B. confusa*, whereas *E. covillei* and *B. odorata* were regarded as

conyza to a local population that seems to be of hybrid origin. Our var. *elongata*, some leaf-forms of which may bear a superficial resemblance to *confusa*, is a far more widely-ranging plant than in the field is habitually similar to the other varieties of *B. fagaroides*.

Among the specimens cited below, the specimens from Sonora have mostly four pairs of leaflets or fewer, and somewhat larger fruits than specimens from farther south, suggesting in these respects and sometimes in the shape and number of the foliar teeth a relationship to *B. fagealis* S. Wats. (see under *B. lanceolata*, p. 364).

SONORA: Guaymas, 23 Oct. 1939 (fr.), *Gentry* 4718; region of Río Bavispe, 30 June 1938 (fl.), *White* 384; *ibid.*, 30-31 Aug. 1940 (fr.), *White* 3693; *ibid.*, c. 1100 m., 16 Aug. 1941 (sterile), *White* 3959; 10 miles [16 km.] S. of Sta. Ana, 15 Sep. 1934 (fr.), *Wiggins* 7205; 10 miles [16 km.] S. of Carbo, 16 Sep. 1934 (fr.), *Wiggins* 7257; 10 miles [16 km.] from Ures, road to Babicora, c. 660 m., 20 Sep. 1934 (fr.), *Wiggins* 7340; between Mazatlán and Colorado, 6 Sep. 1941 (fr.), *Wiggins* & *Rollins* 329.

CHIHUAHUA: La Bufa, SE. of Creel, 16 Sep. 1957 (fr.), *Knobloch* 521.

SINALOA: Lodiago, 9-15 Oct. 1891 (fr.), *Palmer* 1581 (isotype of *B. tenuifolia*); Los Labradores, 5 m., low jungle woods, 15 Oct. 1926 (fr.), *Maxia* 949; Sierra Surrotato, Las Mesas, c. 900 m., 15 Sep. 1941 (fr.), *Gentry* 6622; *ibid.* (sterile), *Gentry* 6647; *ibid.* (fr.), *Gentry* 6664; Baromena, 450 m., 24 Aug. 1941 (fr.), *Gentry* 6129; 5-6 miles [c. 8-10 km.] SW. of S. José de las Delicias, 450 m., 23 Aug. 1941 (fr.), *Gentry* 6106.

NAVARR: Jesús María, 600-700 m., 19 Sep. 1960 (fr.), *Fedema* 1289; 12 miles [c. 19 km.] SE. of Acaponeta, 50 m., *McVaugh* 21752 (MICH. holotype; K, isotype); lava flows from Volcán Ceboruco, 900 m., 13 July 1957 (imm. fr.), *McVaugh* 15386; 9 miles [c. 14 km.] N. of Compostela, in oak zone, 1000-1200 m., 28 Aug. 1957 (imm. fr.); leaflets prominently toothed, *McVaugh* 16504; 6 miles [c. 10 km.] S. of Compostela, tropical deciduous woodland, 900 m., 11-12 July 1957 (past fl.), *McVaugh* 15332; 10 miles [16 km.] SE. of Ahuacatlán, 1100-1300 m., 11-12 Aug. 1959 (fr.); leaflets broad, subentire), *Fedema* 360; *ibid.*, 7 July 1957 (fl.); leaflets broad, subentire), *McVaugh* 15158.

JALISCO: Corcovado Canyon 10-16 miles [16-c. 26 km.] NE. of Autlán, c. 1200-1400 m., 27 June 1949 (imm. fr.), *Wilbur* & *Wilbur* 1384; *ibid.*, 2 Oct. 1960 (fr.), *McVaugh* 19753; *ibid.*, 3 July 1949 (imm. fr.); lvs. small, toothed), *Wilbur* & *Wilbur* 1491; deciduous forest on creviced limestone 6 miles [c. 10 km.] SW. of Pihuamo, 650 m., 29 Oct. 1962 (fr.; lfts. subentire), *McVaugh* 21976; thorn-shrub association 2 miles [c. 3 km.] NW. of Totolimspa, road to Apulco, 1000 m., 'cajiote blanco', 31 Oct. 1962 (fr.), *McVaugh* 21989; oak zone 14 miles [c. 22 km.] W. of Ayudá, 1600 m., 5 Nov. 1962 (fr.), *McVaugh* 22077.

COLIMA: Tropical deciduous forest near La Salada, 22 km. S. of Colima, 400 m., 29 June 1962 (fr.), *Rzedawski* 15431; mountain summits, deciduous woodland 11 miles [c. 18 km.] SSW. of Colima, 500 m., 19 July 1957 (fr.), *McVaugh* 15560.

GUERRERO: Distr. Coyuca, Pungarabato, 6 June 1935 (imm. fr.), *Hinton* 7847 (F); Distr. Mina, Placeres, 400 m., 8 July 1936 (imm. fr.), *Hinton* 9062 (F).

(F.), *Hinton* 7792 (F).

93b. **B. fagaroides** (H.B.K.) Engl. var. **fagaroides**.

B. schaffneri S. Wats. in Proc. Amer. Acad. 22: 469 (1887).

The range of var. *fagaroides* seems to be a natural one; its habitat is characteristically on the bluffs, broken rocks and talus on and around the central plateau of Mexico, at elevations of from 1500 to 2300 m., from southern Zacatecas and San Luis Potosí to Michoacán and Hidalgo. The type came from near Querétaro. This variety is relatively uniform in leaflet-size, -shape and -number, and in the rather poorly developed marginal teeth of the leaflets (Pl. 6/1, p. 361). Occasional plants, especially from the eastern part of the range, have entire leaflets; *Bursera schaffneri* seems to have been one of these.

In the protologue of *B. schaffneri*, Watson cited '90 and 91 *Schaffner*'. A fragment of *Schaffner* 90, seen by Bullock from the collection at Washington, was cited by him as the type of *schaffneri*. The holotype, or more properly lectotype, we have seen at Harvard (GH). The other specimen cited by Watson, *Schaffner* 91 (also GH), represents a species of *Fraxinus* L.

We have seen an isotype of *Bursera purpusii* Brandeg., and on the basis of this we have taken up this name for the third variety of *B. fagaroides*, treated on p. 374. Specimens from the States of México, Michoacán, Guerrero, Morelos and Veracruz, cited as *B. fagaroides* by Bullock (1936), we refer to var. *purpusii* (p. 374) as far as we have seen them.

The following we take to represent var. *fagaroides*:

ZACATECAS: On bluffs N. of Potrero de las Yeguas, 13 miles [c. 21 km.] S. of Valparaiso, 2000 m., 5 Sep. 1958 (fr.), *McVaugh* 17771; 14 km. SW. of Jalpa, 1450 m., 25 June 1957 (fl.), *Rzedawski* 9125.

AGUASCALIENTES: 2 miles [c. 3 km.] S. of Calvillo, 1700 m., 2 Nov. 1959 (fr.), *McVaugh* & *Koelz* 61; km. 40 W. of Aguascalientes, steep broken hills, 1890 m., 25 Aug. 1960 (fr.), *McVaugh* 18319.

JALISCO: 5 miles [8 km.] SW. of Huacasco, 1950 m., 15 Apr. 1951 (fr.), *McVaugh* 11996; Paso de la Troje, at km. 36 SW. of Ojuelos, 2100-2300 m., 9-12 Aug. 1958 (fr.), *McVaugh* 16748; summits 8 miles [c. 13 km.] SE. of Jalostotlán, on cliffs, 1900 m., 30 Aug. 1958 (fr.), *McVaugh* 17536; Mesa Redonda 10 km. SW. of Lagos, 2000 m., 16 June 1957 (fl.), *McVaugh* 14866; 'barranca' of Río Verde N. of Tepatlán, 1450 m., 27-28 Aug. 1958 (fr.), *McVaugh* 17367; 'barranca' below Huentitán, NE. of Guadalajara, 1200-1500 m., 8 Nov. 1962 (2-4 pairs of ± pointed lfts.), *McVaugh* 22108, 22110; 9 km. E. of Tizapán el Alto, S. of Lake Chapala, 1500 m., 26 June 1957 (fr.), *McVaugh* 15042; 6 km. E. of S. Luis Soyatlán, S. of Lake Chapala, 1500-1600 m., 28 June 1957 (fr.), *McVaugh* 15080.

MICHOACÁN: Morelia, Rincon, 14 May 1919 (fr.), *Ariseñe* s.n. (F); 8 miles NW. of Sahuayo, above Lake Chapala, 1600-1850 m., 23 Sep. 1958 (fr.), *McVaugh* 18175; bluffs of Río Lerma 7 miles [c. 11 km.] NW. of La Piedra, 1700 m., 6 Oct. 1962 (fr.), *McVaugh* 21776; Zitácuaro-La Florida, 1550 m., 17 Oct. 1938 (fr.), *Hinton* 13378.

SAN LUIS POTOSÍ: 11 miles [c. 18 km.] S. of Matehuala, c. 1400 m., 11 Sep. 1938 (fr.), *Shreve* 8697; Charcas, top of Zapatlilla Mt., 1 Aug. 1934

Hidalgo: Zimapan, 5 July 1943 (fr.), *Lundell* & *Lundell* 12196; on bluffs 14 miles [c. 22 km.] NE. of Huichapan, 2150 m., 7 Oct. 1962 (fr.), *McVaugh* 21788.

QUERÉTARO: Cerro de Cañada, pr. Querétaro, *Juzepczuk* 713 (F); without locality, *Bonpland* 4200 (F, fragment of type).

GUANAJUATO: N. of Celaya, 5 km. E. of Empalme Escobedo, 1800 m., 26 May 1957 (fl.), *Rzedowski* 8722.

COAHUILA: Jimulco, 27 Apr. 1885 (fr.), *Pringle* 231 (GH).

It is probable that *Schinus occidentalis* Sessé & Moc., Pl. Nov. Hisp., ed. 2: 161 (1893), and Fl. Mex., ed. 2: 233 (1894) is a synonym of *B. fagaroides* var. *fagaroides*. A specimen in the Sessé & Mocino herbarium (No. 4668; Chicago Nat. Hist. Mus. neg. 41814), identified as 'Schinus crenulata N.' is apparently referable to var. *fagaroides*, and fits well enough the description of *S. occidentalis*: 'Foliolis quinque ad septem, ovato-subrotundis, dentatis, utrinque glabris'. In the protologue the fruit is said to be 'obsolete trigona', and the pistillate flowers are said to be 'in distincta planta subsessile, solitarii'. The inscription on the specimen reads 'flor. hermaphrod. hexandr. mascul. oclandr. in distincta planta'. Two twigs, perhaps from the same gathering, are mounted on sheet No. 4700 (neg. 41816) with a twig of *B. aff. simabae*.

The following specimens, from a lowland habitat near the Pacific coast, where they are associated with *Crescentia* L., are anomalous in having but 8 leaflets, but evidently belong with *B. fagaroides*. In shape and tootching the leaflets resemble those of var. *fagaroides*, whereas the somewhat enlarged terminal leaflets suggest var. *purpusii*:

COLIMA: Mun. de Tecoman, c. 3 km. W. of Cerro de Ortega, 50 m., 28 June 1961 (sterile), *Rzedowski* 15396; 15 miles [24 km.] SE. of Tecoman, 10 Aug. 1957 (fr.), *McVaugh* 16072.

33c. ***B. fagaroides* (H.B.K.) Engl. var. *purpusii* (Brandeg.) McVaugh & Rzed., comb. nov.**

B. purpusii Brandeg. in *Zoe* 5: 249 (1908).

This variety seems to grade into var. *fagaroides* along the northern edge of its range, and in the area from Michoacán to southern Nayarit it may be separable with difficulty from var. *elongata*. On the whole, however, it forms a recognizable entity, particularly throughout the valley of the Río Balsas. Pl. 6/2, 3, p. 361.

MORELOS: Near Jojutla, c. 900 m., 18 Oct. 1902 (fr.), *Pringle* 8700 (F).

VERACRUZ: Barranca de Zacatlapan, June 1906, *Purpus* 2045 (F, isotype).

GUERRERO: Distr. Coyuca, Coyuca, 12 June 1935, *Hinton* 7866 (F; cited by Bullock as *fagaroides*); Distr. Mina, Placeres-Bejucó, 400 m., 13 July 1936, (imm. fr.), *Hinton* 9076 (F); *ibid.*, Placeres-Braziles, 400 m., 20 July 1936 (imm. fr.), *Hinton* 9120 (F); *ibid.*, Guayameo, 560 m., 10 Sep. 1936 (vs.), *Hinton* 9374 (F); *ibid.*, Placeres-Rancho Bejuco, 400 m., 24 Sep. 1936 (fr.), *Hinton* 9517 (F), 9518 (F); *ibid.*, Anonas, 300 m., 13 Apr. 1937 (fr. only), *Hinton* 10052 (F).

MICHOACÁN: Distr. Apatzingán, Barranca of Río Cancita 9 miles [c. 14

in pale tan papyery layers), *McVaugh* 17980; *ibid.* (fr.), *McVaugh* 17991; *ibid.*, Tepalcatepec, 460 m., 27 Aug. 1938 (fr.), *Hinton* 12113 (F); *ibid.*, Apatzingán, c. 600 m., 13 Aug. 1941 (fr.), *Leavenworth* & *Hoogstraal* 1518 (F); 20 Aug. (fr.), *Leavenworth* & *Hoogstraal* 1708 (F); *ibid.*, near Acahuato, *ibid.*, c. 750 m., 14 Aug. 1941, *Leavenworth* & *Hoogstraal* 1547; *ibid.*, c. 900 m., 23 Aug. 1941 (vs.), *Leavenworth* & *Hoogstraal* 1765a (F); *ibid.*, Apatzingán, 350 m., 13 Aug. 1938 (vs.), *Hinton* 12001, *Hinton* 12002 (F, MICH); Distr. Huétamo, Mal Paso, 13 Dec. 1934 (fr. only), *Hinton* 7122 (F; cited by Bullock as *fagaroides*); Distr. Zitácuaro, Tiquicheo, 450 m., 10 Apr. 1938 (fr.), *Hinton* 13316 (F); Distr. Coalcomán, Villa Victoria, 720-740 m., 10 Feb. 1938 (fr.), *Hinton* 12306 (F), 12309 (F, US); *ibid.*, 740 m., 12 Nov. 1938 (fr.), *Hinton* 12550.

Edo. DE MEXICO: Distr. Temascaltepec, Limones, 3 June 1935 (fl.), *Hinton* 7839 (F; cited by Bullock as *fagaroides*).

34. ***Bursera arimensis* (H.B.K.) McVaugh & Rzed., comb. nov.**

Elaphrium arimensis H.B.K., Nov. Gen. & Sp. 7: 31 (1824).

Bursera pamosa Engl. in DC., Monogr. Phan. 4: 54 (1883).

B. sessiliflora Engl. in DC., Monogr. Phan. 4: 55 (1883).

?*Elaphrium brachypodum* Rose in N. Amer. Fl. 25: 253 (1911).

Bursera sessiliflora var. *puberulis* Bullock in Bull. Misc. Inf. Kew 1937: 451 (1937).

A photograph of the presumed type-specimen of *Elaphrium arimensis* (Field Mus. neg. 35856) shows a sterile branch with several leaves; the leaflets are mostly elliptic, 2.5-3.5 cm. long, acute or acuminate, with about 10-12 shallow but distinct serrulations on each side. According to the original description the plant is rather heavily pubescent ('ramulis . . . molliter villosis-hirtis, foliis 5-7-jugis, . . . supra hirtellis, subtus molliter canescens-hirtis; rhachi subalata'). The specimen came from near Arrio, Michoacán, where the elevation is about 2000 m.

Comparison of the photograph with modern specimens from near the type-locality, from the vicinity of Uruapan (Pl. 6/5, p. 361) and from Apatzingán leaves little doubt that they represent the same species. Some (e.g., *Leavenworth* & *Hoogstraal* 1825) have the leaflets as prominently toothed as those in the type of *B. arimensis*. Other specimens from the vicinity of Uruapan (e.g., *Hinton* 15634, or *Hinton* 2807) have some leaflets serrate and others on the same plant almost entire. A specimen from Coalcomán, Michoacán (*Hinton* 12803) has most of the leaflets entire. In *Lundell* & *Lundell* 12598, from Guerrero, and in the types of *B. sessiliflora* (Field Mus. neg. 19248) and *B. pamosa* (neg. 22037), only the larger, terminal leaflets show a tendency to be serrate.

The type of *Elaphrium brachypodum* Rose & Painter 7534, US is a weather-beaten fruiting specimen much less copiously pubescent than most other specimens we have seen; another specimen from the same general region, *McVaugh* 15131, was much younger when collected, but perhaps would have been no more strongly pubescent at maturity.

In the field *Bursera arimensis* occupies much the same habitat as does *B. fagaroides*, viz. moderately dry hillside and pastures among other deciduous trees. The plants of the two species are indistinguishable at a little distance,

and are two are evidently very narrow; strongly velutinous, however, whereas that of *B. fagaroides* is quite glabrous; the leaflets in *B. arizensis* number 4-8 pairs (usually 5 or 6 pairs), and the inner bark of the trunk is often noticeably yellow-green rather than blue-green as in *fagaroides*.

NAVARRI: Arroyo de la Fundición, 5 miles [8 km.] SE. of Ahuacatlán, 1300 m., 6 July 1957 (fr.), *McVaugh* 15131.

JALISCO: Near Etzatlán, [c. 1400 m.], 2 Oct. 1903 (fr.), *Rose* & *Painter* 7534 (US, type of *E. brachybotan*).

MICHOCÁN: Distr. Coacomanán, Sierra Torricillas, 1950 m., 21 Dec. 1938 (fr.), *Hinton* 12803; Distr. Apatingán, above Acahuato, pine forest, 900-1200 m., 23 Aug. 1941 (sterile), *Leavenworth* & *Hoogstraal* 1825 (F); Distr. Uruapan, Tancitaro, 1500 m., 5 Nov. 1940 (fr.), *Hinton* 15634; *ibid.*, 'Rodilla del Diablo' propre Uruapan, 21 Jan. 1926 (sterile), *Woronow* 2807 (F); *ibid.*, 2 miles [c. 3 km.] W. of Uruapan, c. 1800 m., 2 Aug. 1941 (fr.), *Leavenworth* & *Hoogstraal* 1277 (F); *ibid.*, 13 miles [c. 21 km.] S. of Uruapan, steep river gorge in oak zone, 1050 m., 28 Oct. 1962 (fr.), *McVaugh* 21956; 12 miles [c. 19 km.] S. of Ario de Rosales, in oak zone, 1350 m., 25 Oct. 1962 (fr.), *McVaugh* 21935.

GUERRERO: Distr. Mina, Tejuqueta, 1200 m., 9 July 1939 (fr.), *Hinton* 14415; mountain pinelands, km. 344.5 on Taxco-Acapulco road, 21 Oct. 1943 (fr.), *Lundell* & *Lundell* 12598 (MICH; '*B. sessiliflora* var. *pubinervis*'); steep rocky hills near highway pass 8 miles [c. 13 km.] by road S. of Chilpancingo, 3 miles [c. 5 km.] N. of Mazatlán, 1300 m., 20 Oct. 1962 (fr.), *McVaugh* 21898.

OAXACA: 18-25 km. WSW. of Zempatlépetl, 1400 m., 16 Aug. 1950 (fr.), *Hallberg* 981; hills, transition-zone of pine and tropical forest, 42 miles [c. 67 km.] W. of Tehuantepec, 700 m., 17 Oct. 1962 (fr.), *McVaugh* 21870.

WITHOUT LOCALITY: *Haenke* 1668 in 1791 (F).

35. **Bursera occulta** *McVaugh* & *Rzedl.*, sp. nov.: arbor glabra, fragrantissima 5-10-metralis, foliis imparipinnatis 3-5-jugis, cortice exteriore probabiliter papyraceo, flavo; foliola elliptica vel lanceolata, subaequalia vel superiora paullo majora, omnia plerumque 2.5-4.5 cm. longa, (0.8-1)-1.5(-2) cm. lata, 2-3-plo longiora quam latiora, apice conspice acutae acuminate, basi rotundata vel acuta, petioli nulli; nervis lateralibus quoque latere 10-15, pallidis, utrinque conspiciis, patentibus vel arcuatum ascendentibus; marginibus grossiuscule serratis, dentibus utroque latere 20-30 tota longitudine fere praeditis (vel basin versus dentibus minoribus vel nullis), dentibus triangularibus 0.5-1.5 mm. altis subpatentibus, apice subobtusis. Interstitia inter juga 1-1.5 cm. longa, rhachidibus bicanaliculatis sed vix alatis, alis usque ad 1.5 mm. latis; petioli 2.5-5 (rarissime-8) cm. longi; foliolum terminale saepe oblanceolatum, basi cuneatum. Inflorescentia 3-5 cm. longa, petularum axillis ramulorum foliosorum nodis infimis oriunda, subsimpliciter racemosa, pedicellis alternis vel inferioribus suboppositis, 4 mm. longis filiformibus, bracteis triangulari-subulatis glandulosis 1 mm. longis. Flores ♂ 5-meri; calycis lobi triangulares 1 mm. longi, petala 4-5 mm. longa cucullata, 1-2 mm. lata, lineari-oblanceolata; filamenta subulata 2 mm. longa, corum 5 basi et petala coacta; antherae oblongo-sagittatae 1-5 mm. longae; discus irregularis, tenuis; ovarium abortivum. Infructes-

5-6 mm. longis sud truncis clavatum truncatus, utriusque ramulorum rotundato-triangulares, ambitu oblique ovales vel ellipticae, obtusae vel oblique apiculatae, 5-6.5 mm. longae lataeque; pyrenae crasse lenticuliformes, usque ad 6 mm. longae, 5 mm. latae, 3-5 mm. crassae, dorso convexae, mesocarpio arilliforme pallido omnino indutae. Pl. 5/1, p. 360.

Type: MEXICO: MICHOCÁN: Distr. Coacomanán, Villa Victoria, wooded hill, tree 5 m., vernacular name 'copal'; 760 m., 12 Nov. 1938 (fr.), *Hinton* 12555 (MICH, holotype; K, isotype).

The description of the staminate flowers is taken from *Hinton* 13813.

We know this plant only from the Hinton collections cited below. The leaflets vary from 2 to 5 pairs. In aspect, venation and serration they suggest those of *B. kerberi* but they are relatively broader, and somewhat smaller, than those of that species. The inflorescences suggest those of *B. kerberi*: The fruiting inflorescences are short and the fruits tardily dehiscent, and the staminate inflorescences are equally short. The perianth parts are long and narrow as in *B. kerberi*.

The material is not entirely uniform. The leaves in *Hinton* 12310 are narrow and somewhat inconspicuously toothed. The outer papery bark-layers (as shown in Nos. 12307, 12552, and 12555) are apparently yellow rather than red as in *B. kerberi*.

MICHOCÁN: Distr. Coacomanán: Villa Victoria, 740 m., 2 Oct. 1938 (sterile), *Hinton* 12307; *ibid.* (fr.), *Hinton* 12310; *ibid.*, 760 m., 12 Nov. 1938 (fr.), *Hinton* 12552, 12554, 12555 (MICH, holotype; K, isotype); *ibid.*, 700 m., 14 Nov. 1938 (fr.), *Hinton* 12566; San Pedro, 550 m., 19 June 1939 (fl.), *Hinton* 13813.

SUPPLEMENTARY NOTES ON THE BURSERIA SPECIMENS OF Sessé & Mocino

Not listed above are a few specimens, chiefly as it seems from eastern and southern Mexico. These are noted briefly below:

Nos. 4695, 4937. Two specimens, apparently precisely alike, and very likely from the same tree or at least the same gathering. We refer these to *B. lancifolia* (Schlechtend.) Engl. Both bear the determination '*Amyris opobalsamum*', and one (No. 4695) is also labelled as a species of *Schinus*, the unpublished specific epithet referring to the willow-like leaves. The source of the specimen, according to the locality given for *A. opobalsamum* in the 'Flora Mexicana' and the 'Plantae Novae Hispaniae', was presumably a locality near Mazatlán, Guerrero.

No. 4697 (2 sheets). The plants suggest a form of *B. lancifolia* with rather small, broad leaflets. We cannot identify the specimen further. The leaflets are 1-3 pairs, 1.5-3 cm. long, ovate-lanceolate, acuminate or the smaller ones obtuse, all crenate, glabrous. One specimen is named by the collectors as a species of *Schinus*, with an unpublished epithet referring to the serrulate leaves.

No. 4703 (2 sheets). The plants superficially resemble *B. grandifolia* (Schlechtend.) Engl. The broad, entire, and tomentose leaflets are 2-3 pairs. The leaflets are somewhat less abruptly pointed than usual in *B. grandifolia*. No. 4933. One specimen labelled (in the hand of Longinos Martínez): [Glase] Octandria Ordo Monoginia Gen[er]o Amyris? The plant is refer-

specimen presumably was obtained by Longinus in the course of his trip up the peninsula in 1792.

No. 4699. Specimens with staminate inflorescences, apparently to be referred to *Bursera longipes* (Rose) Standl.; the leaflets are about 4 pairs, glabrous, and the petioles about 1 cm. long. This is labelled by the collectors as a species of *Schinus*, the unpublished epithet referring to the lustrous surface of the leaflets. The vernacular names 'palo Xioli' and 'copal' are both noted by the collectors.

INDEX OF COLLECTORS AND OF CITED SPECIMENS

Arsène, Bro.:s.n. [47?] = 11; s.n. = 33b.
Barkley, F. A.:17M865 = 9; 17M826 = 10a.
Blimek, D.:85 = *cinetia*, sub 9.
Bonpland, A.:3890 = 10a; 4200 = 33b.
Bourgeau, E.:338 = *cinetia*, sub 9.
Brandegee, T. S.:s.n. = 10b; s.n. = 33a.
Bravo:139-4150 = 17.
Conzatti, C.:1924 = 7; 3060, 3098 = 17.
Coville, F. V.:1640 = 33a.
Dignet, L.:s.n. = 4.
Duellman, W. F.:s.n. = 31.
Emrick, G. M.:148 = 19.
Feddena, C.:360 = 33a; 414, 719 = 4; 1263 = 33a; 1310 = 9; 1368 = 4.
Ferris, R. S.:5491 = 10b; 6046 = 10c; 6163 = 20.
Field, H.:s.n. = 7.
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