

TAXONOMY AND POLLEN GRAIN MORPHOLOGY
OF THE LABIATAE OF MICHIGAN

Thesis for the Degree of M. S.
MICHIGAN STATE UNIVERSITY
Ann Herrick Waterman
1959



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AN ABSTRACT

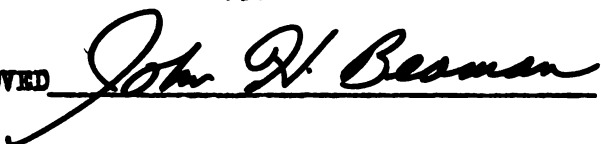
Submitted to the College of Science and Arts
Michigan State University of Agriculture and
Applied Science in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE

Department of Botany and Plant Pathology

1959

APPROVED


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ABSTRACT

The taxonomy and pollen grain morphology of the Michigan species of the Labiatae have been investigated.

Approximately 3,450 specimens at 15 herbaria have been examined. A key to 29 Michigan genera is provided, and a species treatment of the 61 recognized species contains keys, discussions of geographic distributions, habitats, and flowering periods. Of the 61 Michigan species, 20 have been introduced from the Old World, 4 are cosmopolitan in temperate regions and the remaining 37 are native in various portions in North America. A comparative analysis has been made of the species of Labiatae in Michigan with those in Wisconsin, Illinois, and Indiana. A check list for each county in Michigan gives the names of the species collected in that county. Species distributions have been indicated by symbols on outline maps of Michigan.

Pollen grain studies have been made of 52 species of the Labiatae occurring naturally in Michigan and of 3 cultivated species. The characteristics of pollen grain morphology are discussed and are also summarized in a table. For a number of species, a determination has been made of nuclear content of pollen grains at anthesis by a technique developed in this study. Two major morphological groups of grains have been recognized: those that are binucleate and tricolpate and those that are trinucleate and hexacolpate. This observation confirms a previous report of this condition. Variation in size and increase in number of colpi within individual plant specimens have been observed in 5 naturally occurring species. Comparisons have been made of untreated plants with a cultivar which was irradiated or treated with colchicine. Pollen grains with more than 6 colpi also have been found to be tri-

nucleate. A key to 48 naturally occurring species and 2 cultivated species (based on acetylated pollen grains) has been constructed. Photomicrographs of pollen grain nuclei of 14 species and acetylated grains of 41 species are included.

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Helpful assistance has been given me by the curators of herbaria where collections of Michigan specimens of Labiatae were studied. The herbaria are listed at the beginning of the taxonomic treatment.

To Dr. E. G. Voss of the University of Michigan, I am especially grateful for allowing me to examine his recently collected specimens and the Isle Royale National Park Herbarium (which was temporarily at Ann Arbor in connection with the Michigan Flora Project). He also helped me obtain the outline maps of Michigan from the Zoology Department of the University of Michigan Museum, and gave advice on various technical matters.

I should like to thank Dr. Elizabeth McClintock of the California Academy of Sciences for her notes on Michigan Physostegia.

Dr. Ray Nelson of the Department of Botany and Plant Pathology of Michigan State University has kindly let me examine plants which were irradiated with cobalt-60 or treated with colchicine.

I wish to thank my graduate committee members, Drs. G. W. Prescott and Leo W. Mericle, for their professional criticism.

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INTRODUCTION

This investigation has developed out of an initial interest in pollen grain morphology in the Labiatae. Pollen grains of species of this family in the New World have received until now practically no attention from botanists. In the initial phases of this investigation it was considered advisable to examine a wide range of species in the family. To this end the Michigan species were chosen as a base. Since the Labiatae in Michigan have received no over-all taxonomic investigation more recently than W. J. Beal's (1904) flora of Michigan, it was necessary that the taxonomic studies be carried out in conjunction with those on pollen grains.

In making available the results of the combined taxonomic and pollen grain studies it is hoped that contributions have been made to several diverse fields. Certain taxonomic problems in the Michigan species of this family have been clarified, and much information on the geographic distribution of these species within the state has been brought together. Comparative studies of pollen grain morphology and cytology have produced data that can be applied to the understanding of the taxa above the rank of genus and on the specific and infraspecific level also. Paleobotanical investigations have until the present done little with pollen grains of the Labiatae, but information from studies such as this one may aid in subsequent investigations of various fossil deposits. In Michigan, as many other areas of the United States, the honey industry is important; knowledge of these pollen grains should be useful to that industry.

Several botanical problems still await investigation in the Labiatae of Michigan. Slightly more than one-fourth of the naturally occurring

species are known from five or fewer collections. Additional field work would make available more specimens of the little known species and also provide data on distributions and habitats. Improvement in the taxonomic understanding of these species would then be possible. Further studies of pollen grain morphology should be made of additional species, and comparisons of plants within and between populations of the same species are needed. Additional techniques for preparation of pollen grains should be employed such as those used or discussed by Wodehouse (1935), Faegri (1956), and Ikuse (1956). Time has not been available in the present study to permit examination of chromosomes. Such studies would be helpful in explaining several peculiarities that have been encountered in the pollen grain work. They probably would be helpful also in clarifying certain taxonomic problems. Experimental approaches along several lines are in order, although these might more profitably be applied on a broader geographic basis to generic or smaller subgroups of the family.

TAXONOMY

Historical Aspects.

The first reports on the Labiatae in Michigan were by John Wright (1839) who included 23 species from the two southernmost tiers of counties in the state. Cooley's (1849) Catalogue listed two more species "in the primitive region south of Lake Superior", and Coleman (1874) enumerated 42 species from the Lower Peninsula. Beal's (1904) flora of Michigan has been for many years the most detailed listing of Michigan species of Labiatae. Since that publication, however, 12 more species in the mint family have been added to the Michigan flora.

Floristic studies in the Douglas Lake region (Voss, 1956 and unpublished check list), Kalamazoo Co. (Hanes and Hanes, 1947), and Isle Royale

(Brown, 1937) provide complete lists of species now known from these areas. The studies in Berrien Co. (Billington, 1925), Gogebic Co. (Darlington, 1921, 1923), Oakland Co. (Bingham, 1945, and Washtenaw Co. (Walpole, 1924; Hermann, 1936a, 1937) are of interest but do not have full listings of species of those particular areas. O. A. Farwell's reports of species of the Labiatae in papers from 1896 to 1945 (cf. McVaugh et al., 1953) have been confirmed in most but not all cases. Of the numerous county check lists published by C. K. Dodge between 1900 and 1921, only the posthumous paper (1921) (including the eastern and northern parts of the Lower Peninsula along Lake Huron, and Chippewa, Schoolcraft, and Tuscola Counties) has been examined in this study. Unfortunately herbarium specimens have not been found to verify his species reports.

Comments on Distribution and Habitat.

In Briquet's (1895) world floristic treatment of the Labiatae, nine subfamilies are delimited; three of these are represented by species in Michigan. About one-third (20) of the 61 species in Michigan have been introduced from the Old World and four are cosmopolitan in temperate regions. The remaining species have more or less restricted distributions in North America.

Although certain areas of Michigan are still poorly collected (especially Alcona, Baraga, Clare, Gladwin, Isabella, Lapeer, Mecosta, Ogemaw, Osceola, Tuscola and Wexford Counties, each of which has only one to four presently-known species) general patterns of geographic distribution can be noted from the maps. More species occur in the Lower Peninsula than in the Upper Peninsula (59 species have been collected in the Lower Peninsula and 33 in the Upper Peninsula). Only two species (Agastache

foeniculum and Ajuga genevensis) of the total state flora occur in the Upper Peninsula but not in the Lower Peninsula.

On the basis of the present study 29 genera and 61 species of the Labiatae are recognized in Michigan. Sufficiently recent detailed studies of three contiguous states are available to permit comparisons between these areas and Michigan (nomenclatural differences in these studies have been taken into account). Koeppen (1957) accounted for 29 genera and 59 species in Wisconsin. Of these, 27 genera and 48 species are common to both states, while two genera and 13 species are found in Michigan but not in Wisconsin, and two genera and 11 species are found in Wisconsin but not in Michigan. Jones and Fuller (1955) treated 30 genera and 76 species in Illinois of which 26 genera and 52 species are common to both states. Three genera and nine species are found in Michigan but not in Illinois and four genera and 24 species are found in Illinois but not in Michigan. Deam (1940) listed 28 genera and 63 species in Indiana of which 24 genera and 46 species are common to both states. Five genera and 15 species are found in Michigan but not in Indiana and four genera and 17 species are found in Indiana but not in Michigan.

Habitats of the Michigan species range from xeric sandy areas to mesic open woods, pastures, roadsides and lawns, river and stream banks, floodplains, and damp lake shores. None of the species are aquatic although several species may be found with roots of the plants submerged.

Material Studied.

The taxonomic aspects of this study are based primarily on an examination of approximately 3,450 herbarium specimens. A month of field work (July, 1958) was spent in counties known to be poorly collected. This field trip has helped augment the distributional data for a number of

species, to provide living material for pollen grain studies, and to contribute to the knowledge about the living plants and their environment.

Only non-cultivated plants or escapes from cultivation are considered in the taxonomic treatment although some cultivated species are considered in the pollen grain studies.

When specimens are cited in the taxonomic treatment and in the pollen grain studies, the herbarium abbreviations are those listed by Lanjou and Stafleu (1959). Specimens in the herbaria listed below have been examined:

Albion College, Albion
 Aquinas College, Grand Rapids
 Bailey Hortorium, Ithaca, New York
 Chicago Natural History Museum, Chicago, Illinois
 Cranbrook Institute of Science, Bloomfield Hills
 Gray Herbarium of Harvard University, Cambridge, Massachusetts
 Isle Royale National Park Herbarium, Houghton
 Michigan State University, East Lansing
 Missouri Botanical Garden, St. Louis, Missouri
 National Museum, Smithsonian Institution, Washington, D. C.
 University Herbarium, University of Michigan, Ann Arbor
 University of Michigan Biological Station Herbarium, Douglas
 Lake, Cheboygan
 Wayne State University, Detroit
 Western Michigan University, Kalamazoo
 Wiegand Herbarium of Cornell University, Ithaca, New York

The symbols on the distribution maps show actual localities with the exception of open circles which indicate county records only. The latter are from herbarium specimens with insufficient locality data. In certain instances on these maps it should be noted that the known species distributions illustrate much collecting activity in several local areas.

Nomenclature.

Where possible the nomenclature employed here follows that of the most recent comprehensive treatments such as monographs, revisions, or chromosomal studies. These are cited where pertinent in the text. In taxa

for which no intensive studies are available, the nomenclature of Fernald (1950) or Gleason (1952) is employed. The keys to genera and species are mostly adapted from Fernald although in several cases aid in key construction has been obtained from the following papers: DeWolf (Satureja, Clinopodium, Calamintha, and Acinos, 1954), Epling (Scutellaria, 1942), Epling and Stewart (Hedeoma, 1939), Grant and Epling (Pycnanthemum, 1943), Hermann (Lycopus, 1936b), Lewis (Trichostema, 1945), Lint and Epling (Agastache, 1945), and McClintock and Epling (Teucrium, 1946).

No attempt has been made to list full synonymy. The synonyms that are listed in the species treatment are names used by Fernald (1950) but not employed in this study. The sequence of genera and species follows Fernald's arrangement.

KEY TO GENERA

- A. Ovary shallowly 4-lobed; style not gynobasic; nutlet scar lateral and large. B
- AA. Ovary deeply 4-lobed; style gynobasic; nutlet scar basal and small. D
- B. Lobes of corolla nearly regular; flowers on axillary 1- to 3-flowered peduncles. 1. Trichostema
- BB. Lobes of corolla irregular, lower lip 2 times as large as upper; flowers in close terminal verticils or spiciform racemes. C
- C. Flowers in close terminal verticils; corolla with very short upper lip, not cleft, blue; bracts obovate, leaflike. 2. Ajuga
- CC. Flowers in spiciform racemes; corolla deeply cleft between the two small lobes of upper lip, dark pink to white; bracts linear, acuminate and not leaflike. 3. Teucrium
- D. Calyx with distinct protuberance on upper side. 4. Scutellaria
- DD. Calyx without distinct protuberance on upper side. E
- E. Calyx teeth 10, spiny pointed, spreading at maturity; plants white tomentose. 5. Marrubium
- EE. Calyx teeth 5, not spiny pointed nor spreading at maturity; plants not white tomentose. F
- F. Antheriferous stamens 4, all with 2-locular anthers; upper lip of corolla galeate or concave. G
- FF. Antheriferous stamens 2 or 4, upper pair shorter; upper lip of corolla not galeate nor concave. P
- G. Upper (posterior) stamens longer than lower (anterior). H
- GG. Upper stamens shorter than the lower. K

- H. Anther sacs parallel; stamens exceeding corolla. 6. Agastache
- HH. Anther sacs strongly divergent; stamens not exceeding the
corolla. I
- I. Calyx distinctly 2-lipped, upper tooth much broader than the others,
notched between some of the sinuses; flowers blue. .9. Dracocephalum
- II. Calyx regular or oblique. J
- J. Stem erect; flowers many in each whorl, forming a terminal
inflorescence, white; leaves ovate to ovate-oblong; anther
locules merely divergent. 7. Nepeta
- JJ. Stem weak, trailing; flowers 2-6 in each whorl, in the axils of
leaves, purplish-blue; leaves rounded to reniform; anthers of
perfect flowers with locules at angles, each pair forming a
cross. 8. Glechoma
- K. Calyx deeply bilabiate, 10-nerved, reticulately veined, closed in
fruit, upper lip flat and 3-toothed; pollen grains hexacolpate. .
10. Prunella
- KK. Calyx not strongly bilabiate, obscurely 5-10 nerved, open in fruit,
teeth subequal; pollen grains tricolpate. L
- L. Flowers opposite; calyx obscurely nerved, membranaceous,
globose or enlarged after flowering. 11. Physostegia
- LL. Flowers in compact spikes, whorls or panicles; calyx 5-nerved,
firm, not enlarged nor inflated after flowering. M
- M. Cauline leaves palmately veined, deeply cleft or incised; calyx
teeth divergent; whitish upper lip of corolla densely woolly. . .
12. Leonurus
- MM. Cauline leaves pinnately veined (except Lamium) and crenate, dentate,
or serrate; calyx teeth ascending; upper lip of corolla glabrous or

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- pilose. N
- N. Anther sacs without trichomes; flowers interruptedly spicate, the upper or all bracteal leaves reduced; upper lip of corolla concave. 15. Stachys
- NN. Anther sacs with trichomes; flowers in axils of well developed leaves; upper lip of corolla galeate. 0
- O. Trichomes within the anther sacs; calyx lobes sharply spinose-tipped. 13. Galeopsis
- OO. Trichomes on outer surface of anther sacs; calyx lobes not sharply spinose-tipped. 14. Lamium
- P. Antheriferous stamens 2, ascending and parallel; anther sacs linear; corolla strongly 2-lipped. Q
- PP. Antheriferous stamens 2 or 4; anther sacs ovoid; corolla slightly 2-lipped. S
- Q. Anthers with lower locules deformed; flowers mostly interruptedly spicate, with upper bracteal leaves reduced. . . . 16. Salvia
- QQ. Anthers with both locules fertile; flowers verticillate, capitate, with leafy outer bracts. R
- R. Calyx equally 5-toothed, 15-nerved. 17. Monarda
- RR. Calyx 2-lipped, 13-nerved, upper lip with three awned teeth. 18. Blephilia
- S. Corolla 2-lipped, the upper lip erect, entire, or shallowly notched (except Pycnanthemum). T
- SS. Corolla not bilabiate, less equally 4-lobed (upper lip of Collinsonia fringed). a
- T. Fertile stamens 2; calyx gibbous on lower side. . 19. Hedeoma
- TT. Fertile stamens 4; calyx not gibbous (except Acinos). . . U

U. Calyx

UU. Calyx

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W. Calyx

WV. Calyx

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U. Calyx 15-nerved, naked in throat; inflorescence a dense spike . .

24. Hyssopus

UU. Calyx 10 to 13-nerved, villous or naked in throat; inflorescence not a dense spike. V

V. Flowers in dense or loose axillary and terminal cymes or verticils; filaments converging, ascending parallel or curved. . W

VV. Flowers in loose racemes or dense corymbs; filaments diverging, not curved. W

W. Calyx campanulate, 10-nerved, not bilabiate. 20. Satureja

WW. Calyx tubular, 13-nerved and bilabiate. X

X. Calyx gibbous. 21. Acinos

XX. Calyx not gibbous. Y

Y. Calyx straight, bearded at throat; bracts of inflorescence leaf-like. 22. Calamintha

YY. Calyx curved, slightly bearded at throat; bracts of inflorescence setaceous-hirsute. 23. Clinopodium

Z. Calyx bilabiate, densely villous in throat; flowers in loose to dense racemes; corolla purple. 25. Thymus

ZZ. Calyx not bilabiate, naked in throat; flowers in dense corymbs; corolla white with purple spots. 26. Pycnanthemum

a. Flowers solitary in loose terminally branched racemes, yellow, stamens 2. 29. Collinsonia

aa. Flowers crowded in dense whorls or spicate; corolla whitish to pink-purple and bluish; stamens 2 or 4. b

b. Stamens 2; flowers whitish, not with mint fragrance. 27. Lycopus

bb. Stamens 4; flowers pinkish-purple to white; with mint fragrance.

28. Mentha

Treatment of Species

1. Trichostema L. False Pennyroyal; Bastard Pennyroyal.

Reference: Lewis, 1945.

- a. Calyx nearly actinomorphic; stamens barely exserted, nearly straight. 1. T. brachiatum
- aa. Calyx zygomorphic; stamens long exserted and strongly arched. . .

2. T. dichotomum1. T. brachiatum L. No map.

Known in Michigan from only two collections: Alpena Co., Thunder Bay Island, Wheeler s.n., (flowering) 18 July 1895 (GH, MSC, US); and Chippewa Co., Drummond Island, shallow soil over limestone pavement, Hiltunen 1817, (flowering) 29 August 1958 (WUD).

These northern specimens are like the small depauperate plants described as Isanthus brachiatus var. linearis Fassett (1933), and Lewis states, "These may represent a northern ecotype, but this can only be determined by further investigation."

2. T. dichotomum L. Bastard Pennyroyal. No map.

Known in Michigan from four collections: Kalamazoo Co., Texas Twp., Hanes s.n., (unopened buds) 14 August 1951 (WMU); Texas Twp., Hanes 5650, 31 August 1950 (WMU); Oshtemo Twp., Hanes 1739, 19 September 1939 (WMU); Oakland Co., Drayton Plains, open grassy field, Chandler s.n., 15 September 1916 (BIH, MICH, WUD). There are no habitat data with the Kalamazoo Co. specimens, however, Hanes and Hanes (1947) report that their Oshtemo Twp. collection is from sterile sandy fields bordering oak woods.

2. Ajuga L. Bugleweed.

- a. Plants stoloniferous; leaves glabrous. 1. A. reptans

aa. Plants not stoloniferous; leaves pubescent. . . 2. A. genevensis

1. A. reptans L. No map.

Known in Michigan from only two collections: Berrien Co., Brandywine Acres, bridge over St. Joseph River, Herbert 4222, (flowering) 15 May 1954 (MICH); Ionia Co., Ionia, weed in lawn, Haslick s.n., (flowering) 22 May 1953 (MSC). Introduced from the Old World.

2. A. genevensis L. No map.

Known in Michigan from only one collection: Marquette Co., Huron Mt. Club, Lake Superior dunes, Bingham s.n., (no date) (BLE). Introduced from the Old World.

3. Teucrium L. Germander; Wood Sage.

Reference: McClintock and Epling, 1946.

1. Teucrium canadense L. American Germander. Map 1.

Scattered throughout the state but not frequently collected in the Upper Peninsula. In moist sand, clay, and swampy soils in open and shaded areas. Flowering from June to September.

At the time of Beal's (1904) Flora this species was known only from the Lower Peninsula.

4. Scutellaria L. Skullcap.

Reference: Epling, 1942.

a. Flowers in terminal or axillary racemes. b

aa. Flowers solitary in axils of ordinary foliage leaves. c

b. Flowers in terminal racemes; cauline leaves deltoid-ovate,
margins crenate; corolla galea plus tube 14-21 mm. long. . .

1. S. elliptica var. hirsuta

bb. Flowers in lateral racemes; cauline leaves ovate, margins
crenate-serrate; corolla galea plus tube 5-7 mm. long. . .

2. S. lateriflora

c. Galea and tube of corolla 14-21 mm. long; leaves cordate at base,
2.5-5 cm. long; stem 2-6 dm. high. 3. S. galericulata

d. Basal hairs of leaves eglandular, leaves entire, revolute. .

4. S. leonardi

dd. Basal hairs of leaves glandular, leaves irregularly sub-
dentate. 5. S. parvula

1. S. elliptica Muhl. var. hirsuta (Short) Fern. Hairy Skullcap. Map 2.

The northern extent of the range of this variety is Kalamazoo, Cass and St. Joseph Counties. Epling reports the variety (as subspecies) from Berrien Co., but no Berrien collection has been seen in this study. The only recorded habitats are oak woods. Flowering from July to August.

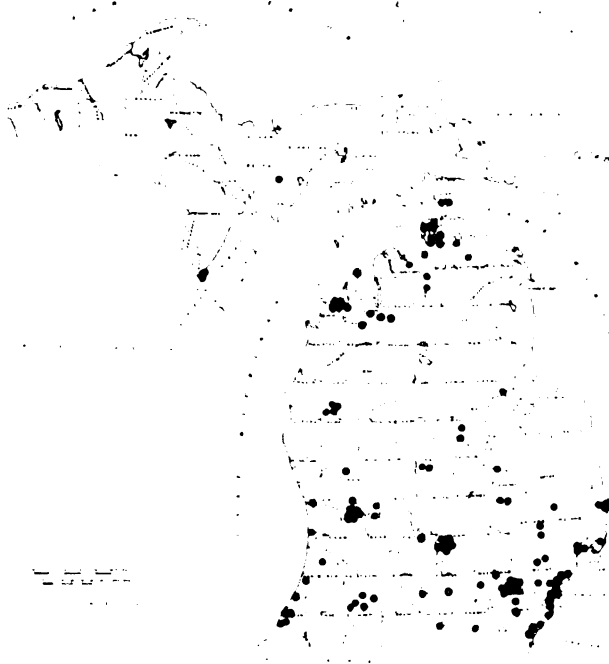
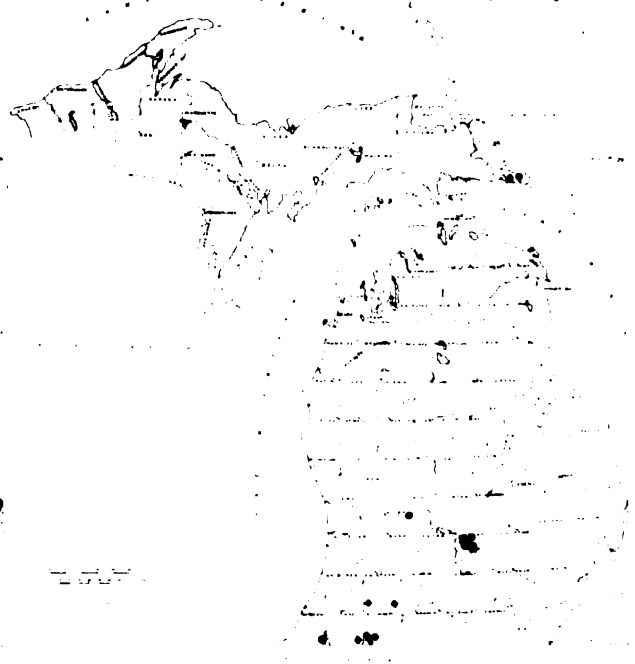
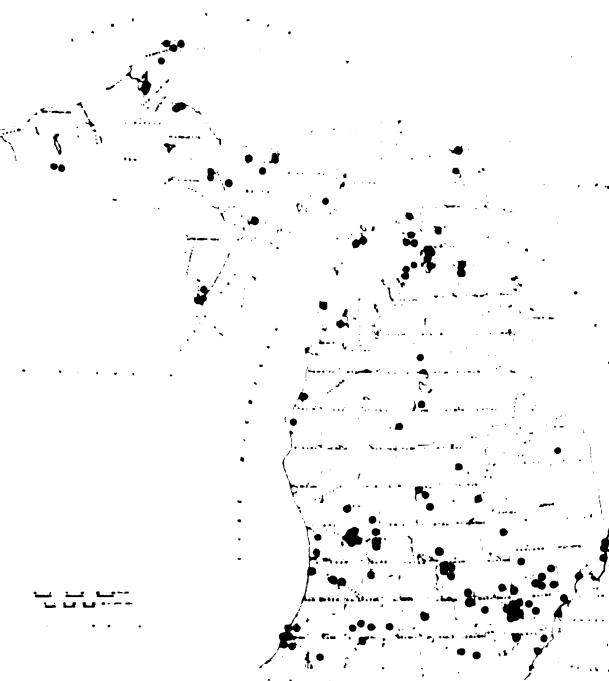
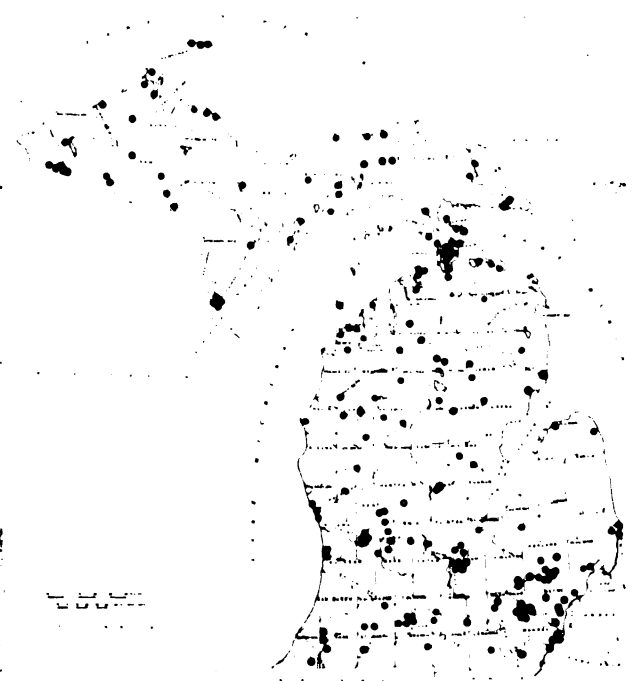
2. S. lateriflora L. Mad-dog Skullcap. Map 3.

Abundant throughout the state. In swampy and wet sandy soils on lake shores and river and stream banks. Flowering from May to September.

Occasionally white-flowered forms of this species are collected; var. albiflora Farwell is one of these. The type of this variety, not located by McVaugh et al. (1953), is at MICH, Farwell 4285.

3. S. galericulata L. Common or Marsh Skullcap. Map 4.S. epilobiifolia A. Hamilton

A Eurasian and North American species, abundant throughout the state. In the same habitats as S. lateriflora but frequently flowering earlier. Flowering from May to August.

1. *TEUCRUM CANADENSE*2. *SCUTELLARIA PARVULA* ●
S. LEONARDI +
S. ELLIPTICA VAR. *HIRSUTA* ◆3. *SCUTELLARIA LATIFLORA*4. *SCUTELLARIA GALERICULATA*

4. S. leonardi Epling. Smooth Skullcap. Map 2.

S. parvula Michx. var. leonardi (Epling) Fern.

Known in Michigan from only two collections from Ingham Co.: East Lansing, Grand Trunk RR east of Okemos crossing, Walpole 1218 (fruits only) 10 June 1922 (ALBC, BLH, MSC); and Billington s.n., (same locality as the first collection), dry gravelly bank, (with fruits only) 9 July 1923 (BLH, WMU, WUD).

5. S. parvula Michx. Small Skullcap. Map 2.

A widely distributed but poorly collected species in Michigan. In dry limestone soils and along railroads. Flowering from June to July.

5. Marrubium L. Horehound.

1. Marrubium vulgare L. Common Horehound. Map 5.

Introduced from the Old World, sometimes escaping from cultivation and becoming a weed. Flowering from June to August, and in November.

6. Agastache Clayt. Giant Hyssop.

Reference: Lint and Epling, 1945.

a. Calyx teeth ovate-obtuse, lobes at anthesis 1-1.5 mm. long; corolla yellowish. 10. A. nepetoides

aa. Calyx teeth deltoid-acute, lobes at anthesis 2-2.5 mm. long; corolla rose to purple or blue. b

b. Leaves and stems generally conspicuously pubescent; calyx teeth glabrous; corolla rose to purple. 2. A. scrophulariaefolia

bb. Leaves and stems essentially glabrous, whitish beneath; calyx teeth pubescent; corolla blue. . . . 3. A. foeniculum

5. *MARRUBIUM VULGARE* ●
DRACOCEPHALUM PARVIFLORUM ◆



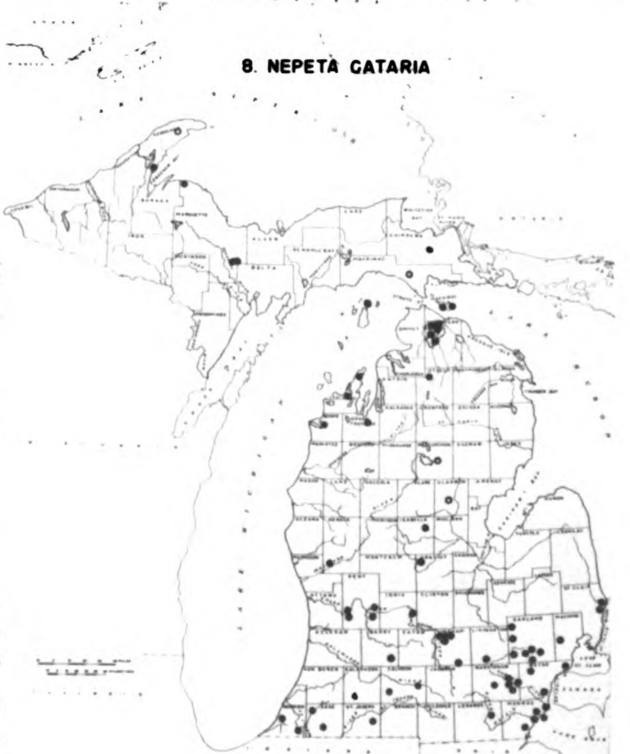
6. *AGASTACHE NEPETOIDES*



7. *AGASTACHE SCROPHULARIAEFOLIA*



8. *NEPETA CATARIA*



1. A. nepetoides (L.) Ktze. Yellow Giant Hyssop; Hedge Hyssop. Map 7.

Found in the southern part of the Lower Peninsula. In open woods and meadows. Flowering from July to September.

2. A. scrophulariaefolia (Willd.) Ktze. Purple Giant Hyssop. Map 7.

Distribution in Michigan same as A. nepetoides. Occasionally cultivated as an ornamental. Flowering from August to September.

3. A. foeniculum (Pursh) Ktze. No map.

Known from only one collection in Michigan: Houghton Co., prairie, Farwell 10323, 15 August 1934 (BLH), (Farwell, 1938).

7. Nepeta L. Catmint.

1. Nepeta cataria L. Catnip. Map 8.

Introduced from the Old World and established throughout the state except on Isle Royale. In rich, damp to dry soils, on roadsides, in pastures and near buildings. Flowering from June to October.

8. Glechoma L. Ground Ivy.

1. Glechoma hederacea L. Gill-over-the-ground. Map 9.

Including var. micrantha Moricand and var. parviflora (Benth.) Farwell.

Introduced from the Old World and frequent throughout the state. In rich, damp to dry soils, on roadsides, in lawns, cemeteries, and pastures. Flowering from May to July.

9. Dracocephalum L. Dragonhead; Lion's Heart.

1. Dracocephalum parviflorum Nutt. American Dragonhead. Map 5.

Scattered throughout the state. In sandy, open areas. Flowering

from June to August.

10. Prunella L. Heal-all; Selfheal; Carpenter-weed.

1. Prunella vulgaris L. Map 10.

Including var. lanceolata (Bart.) Fern.

Abundant and widespread in Michigan. In wooded areas and as a weed along roadsides and in pastures and lawns. Flowering from June to October.

11. Physostegia Benth. False Dragonhead.

a. Leaf margin undulate, firm. 1. P. aboriginorum

aa. Leaf margin serrate, membranaceous. b

b. Cauline leaves subtending inflorescence greatly reduced in size, 1.5-3.5 cm. long. 0.2-0.6 cm. wide; mid-cauline leaves 6.5-9.0 cm. long, 1-2.5 cm. wide; corolla 1.5-2 cm. long.

2. P. virginiana var. virginiana

bb. Cauline leaves subtending inflorescence not greatly reduced,

5-11.5 cm. long, 0.6-2.5 cm. wide; mid-cauline leaves 9-15 cm.

long, 1.6-4.0 cm. wide; corolla 1.6-2.0 cm. long (in cultivated

specimens 2.8 cm. long). 3. P. virginiana var. speciosa

1. P. aboriginorum Fern. Map 11.

Known in Michigan from one collection from Wayne Co., Detroit, waste ground, "probably an escape from cultivation", Farwell 5093¹ (determined by him as Dracocephalum denticulatum Ait. and D. virginianum var. denticulatum Ait.), 14 July 1918 (BLH, GH).

This collection was annotated by Elizabeth McClintock in 1947 as D. virginianum. These plants, however, do not fit the description in

Gleason's (1952) treatment which is based on Dr. McClintock's findings; the uppermost leaves are longer than the internodes which they subtend, the calyx is 0.75 cm. long, and the corolla is 2.3 cm. long.

2. P. virginiana (L.) Benth. var. virginiana Map 11.

P. parviflora Nutt.

Known from a few collections scattered throughout the state; sometimes cultivated. On river banks and lake shores. Flowering from July to September.

One specimen, Farwell 621, July 1888 (BLH), has uppermost leaves which are longer than the internodes they subtend. The other specimens examined coincide with the character as stated in the key (lead b) above.

3. P. virginiana (L.) Benth. var. speciosa (Sweet) Gray. Map 11.

Scattered throughout the state; occasionally cultivated. In low areas on damp, rich soil. Flowering from July to October.

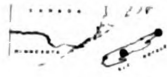
12. Leonurus L. Motherwort.

- a. Lower two calyx lobes strongly reflexed; cauline leaves palmately lobed to subentire or 3-cleft; corolla pale purple, tube bearded within. 1. L. cardiaca
- aa. Lower calyx lobes not strongly reflexed; cauline leaves coarsely toothed; corolla whitish, tube naked within. . 2. L. marrubiastrum

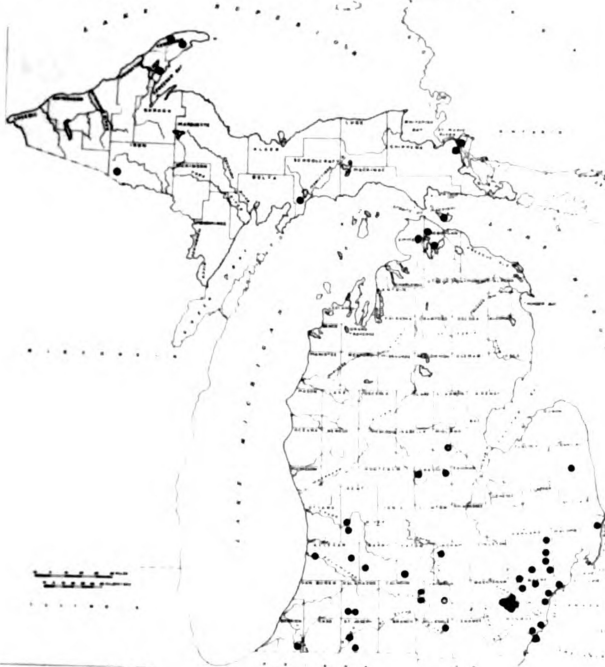
1. L. cardiaca L. Common Motherwort. Map 12.

Naturalized from the Old World, and abundant throughout the state. In mucky to sandy soils. Flowering from June to October.

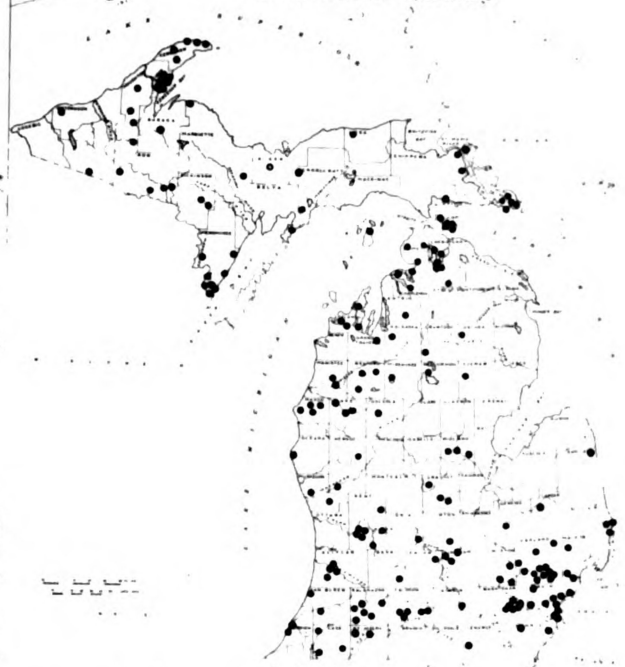
2. L. marrubiastrum L. Map 12.



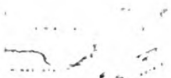
9. GLECHOMA HEDERACEA



10. PRUNELLA VULGARIS



11. PHYSOSTEGIA VIRGINIANA P. VIRGINIANA VAR. SPECIOSA ● P. ARBORIGINORUM ◆



12. LEONURUS CARDIACA ● L. MARRUBIASTRUM ◆



Introduced from the Old World, and known in Michigan from only one collection: Ingham Co., floodplain of Red Cedar River, Parmelee 3293, (flowering) 15 September 1953 (MSC).

13. Galeopsis L. Hemp-Nettle

1. Galeopsis tetrahit L. Map 13.

Including var. bifida (Boenn.) Lej. & Court. and forma alba Farwell (Farwell, 1945).

Naturalized from the Old World; most of the Michigan records are from the northern part of the state. In marshes, open woods, lake shores, and roadsides. Flowering from July to September.

14. Lamium L. Dead Nettle.

- a. Corolla 18-30 mm. long; perennials with creeping stems bearing offshoots. 1. L. maculatum
- aa. Corolla 8-18 mm. long; winter or summer annuals, without creeping stems. b
- b. Upper leaves sessile and clasping, reniform; corolla tube naked within. 2. L. amplexicaule
- bb. Upper leaves petioled, cordate-ovate; corolla tube with a ring of hairs within. 3. L. purpureum

1. L. maculatum L. Variegated Dead Nettle. Map 14.

Introduced from Europe and escaping from cultivation, scattered in the southern part of the Lower Peninsula. Flowering from May to August.

2. L. amplexicaule L. Henbit. Map 14.

Naturalized from Europe; known from the Lower Peninsula only. In

cultivated fields, gardens, moist woods, and roadsides. Flowering from April to June.

3. L. purpureum L. Purple Dead Nettle. Map 14.

Naturalized from Europe; probably common but poorly collected in Michigan. On sandy lake shores, woods, and gardens. Flowering from April to June.

15. Stachys L. Hedge Nettle.

- a. Upper stems pubescent on sides. b
- aa. Upper stems glabrous on sides. c
 - b. Hairs on angles longer than hairs on the sides of stem; leaves not densely pilose. 1. S. palustris var. palustris
 - bb. Hairs of nearly equal length on both angles and sides of stem; leaves densely pilose. 2. S. palustris var. homotricha
- c. Calyx lobes hirsute or hirsute-ciliate; leaves more or less pubescent above. 3. S. hispida
- cc. Calyx lobes entire; leaves glabrous above. d
 - d. Principal leaves on petioles 2-3 cm. long, leaves elliptic-lanceolate. 4. S. tenuifolia
 - dd. Principal leaves sessile, oblong-lanceolate. 5. S. hyssopifolia

1. S. palustris L. var. palustris. Map 15.

Introduced from Europe and occurring throughout the state except on Isle Royale. On barrier beaches, damp roadside ditches, and in pastures. Flowering from July to September.

2. S. palustris var. homotricha Fern. Map 15.

Known in Michigan from Cheboygan, Emmet, and Keweenaw Counties. On

damp, sandy lake shores. Flowering from July to August.

3. S. hispida Pursh. Map 16.

S. tenuifolia Willd. var. hispida (Pursh) Fern.

Reference: Gleason, 1952.

Scattered throughout the Lower Peninsula, and in three counties in the Upper Peninsula. On wooded river banks, lake shores, and in swamps.

Flowering from June to September.

4. S. tenuifolia Willd. Hedge Nettle. Map 17.

Known only in the southern half of the Lower Peninsula. On moist ground in wooded areas and on floodplains. Flowering from July to September.

5. S. hyssopifolia Michx. Map 13.

Primarily an Atlantic Coastal Plain species, found in Michigan in the southwestern counties of the Lower Peninsula. In abandoned fields, on lake shores, and in marshes. Flowering from June to August.

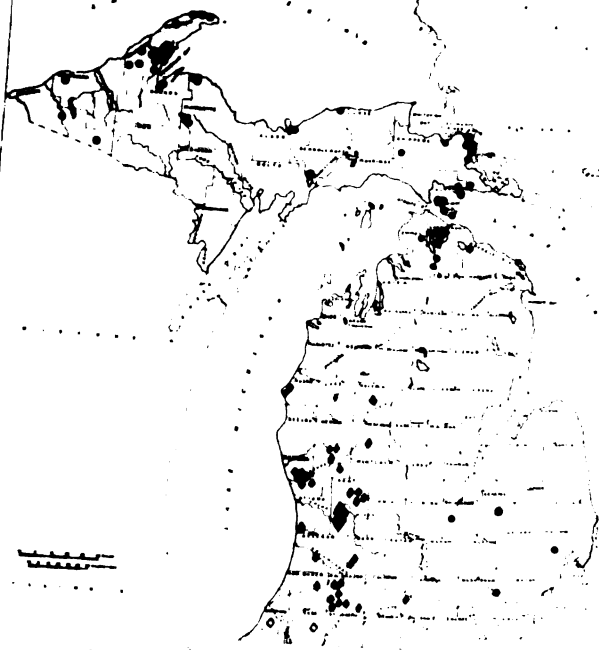
16. Salvia L. Sage.

- a. Plants perennial; calyx slightly bilabiate; corolla strongly exserted from the calyx. 1. S. azurea var. grandiflora
- aa. Plants annual; calyx strongly bilabiate; corolla slightly exserted from the calyx. 2. S. reflexa

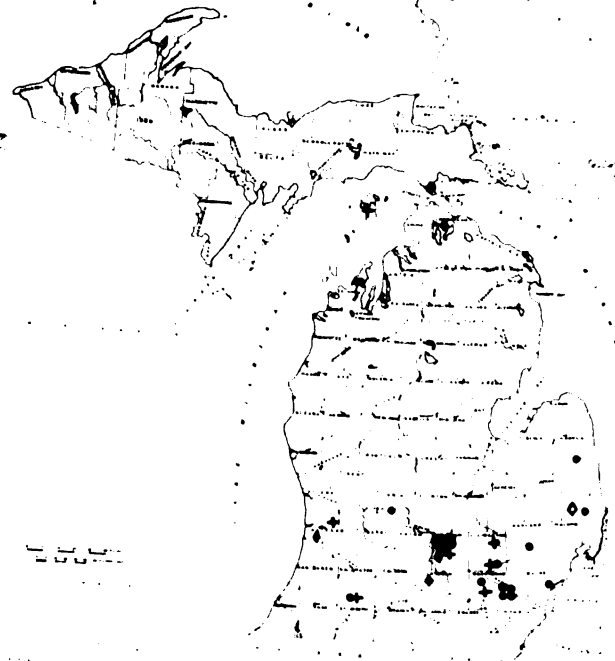
1. S. azurea Michx. ⁱⁿ ~~ex~~ Lam. var. grandiflora Benth. No map.

Known in Michigan from only two collections: Kalamazoo Co., North of Vicksburg, Hanes & Hanes 2476, (flowering) 15 September 1934 (WMU); Kent Co., Grand Rapids, waste place, probably introduced from the Southwest,

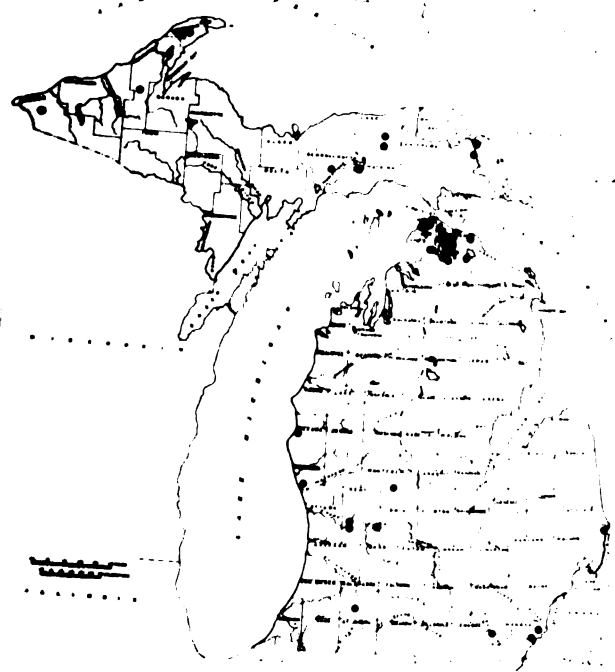
13. *GALEOPSIS TETRAHT* ●
STACHYS MYSSOPHOLIA ◆



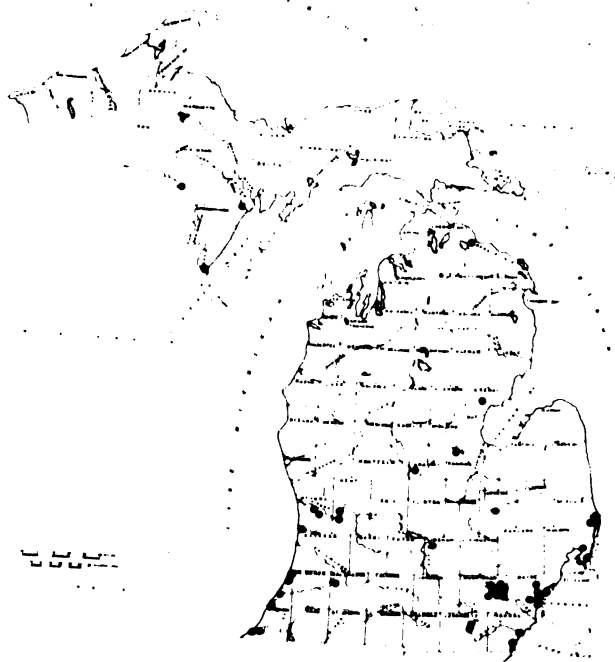
14. *LAMIUM AMPLEXICAULE* ●
L. PURPUREUM +
L. MACULATUM ◆



15. *STACHYS PALUSTRIS* ●
S. PALUSTRIS VAR. *HOMOTRICHA* +



16. *STACHYS HESPIDA*



Cole s.n., (flowering) September 1898 (MSC).

2. S. reflexa Hornem. No map.

Introduced from the western United States and known from Kalamazoo, Monroe, and Wayne Counties. Flowering from August to September.

17. Monarda L. Horsemint; Wild Bergamont.

a. Flowers in axillary and terminal glomerules; corolla creamy-yellow with purple spots. 1. M. punctata var. villicaulis

aa. Flowers in terminal solitary glomerules; corolla red, purple or pink. b

b. Cauline leaves deltoid-ovate; corolla pink or rarely white.

2. M. fistulosa

bb. Cauline leaves deltoid-lanceolate; corolla red-purple. . . c

c. Bracts vividly red; corolla vermillion to scarlet; calyx without dense crown of stiffly divergent bristles. 3. M. didyma

cc. Bracts dark purple; corolla deep red-purple; calyx with a dense crown of stiffly divergent bristles. 4. M. media

1. M. punctata L. var. villicaulis (Pennell) Shinnars. Horsemint. Map 18.

Reference: Shinnars, 1953.

Widely collected in the western part of the Lower Peninsula; known also from southeastern Michigan and from one station in Chippewa Co. On sand dunes and in dry pastures. Flowering from July to September.

2. M. fistulosa L. Wild Bergamont. Map 19.

Occurring throughout the state except on Isle Royale. In damp and dry muck to light soils, in open woods and grassy areas. Flowering from July to September.

3. M. didyma L. Oswego Tea; Bee-Balm. Map 18.

Introduced from the eastern United States, and scattered in the southern part of the Lower Peninsula. Along roadsides and in cemeteries.

Flowering from July to August.

4. M. media Willd. No map.

Known in Michigan only from St. Clair Co. from C. K. Dodge collections (at MSC). Flowering from July to August.

18. Blephilia Raf.

a. Lobes of lower calyx lip extending beyond the sinuses of the upper calyx lip; cauline leaves sub-sessile to sessile. . 1. B. ciliata

aa. Lobes of lower calyx lip not extending to the sinuses of the upper lip; cauline leaf petioles 1-2 cm. long. 2. B. hirsuta

1. B. ciliata (L.) Benth. Downy Blephilia. Map 21.

Occasional in the southern half of the Lower Peninsula. In dry open woods and prairies, on light sandy soil. Flowering from June to August.

2. B. hirsuta (Pursh) Benth. Woodmint; Hairy Blephilia. Map 21.

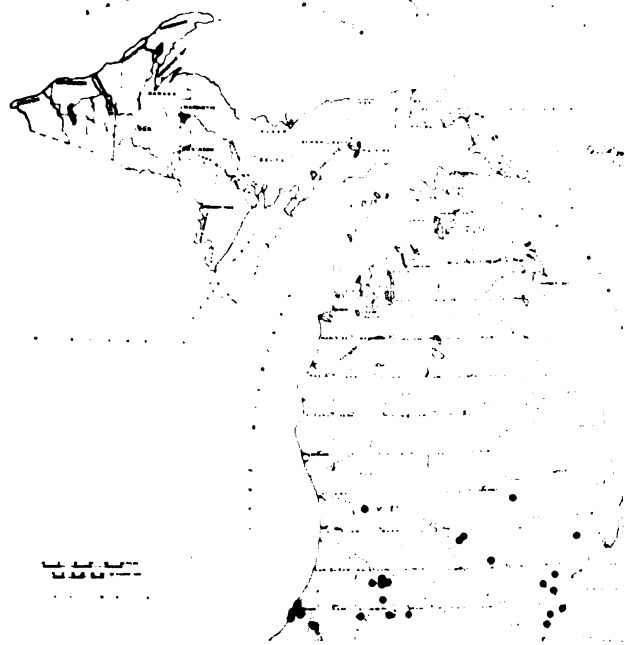
Fairly common in the southern part of the Lower Peninsula and known also from one collection in Ontonagon Co. (Darlington in 1923, MSC). In swamps, beech-maple woods, floodplains and river banks. Flowering from June to September.

19. Hedeoma Pursh. Mock Pennyroyal.

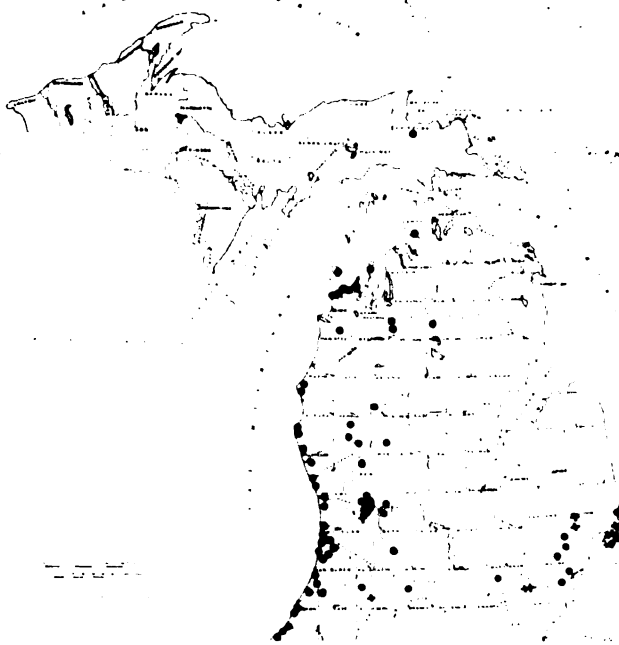
Reference: Epling and Stewart, 1939.

a. Cauline leaves petiolate, lanceolate and serrate; calyx lobes entire; sterile stamens obvious. 1. H. pulegioides

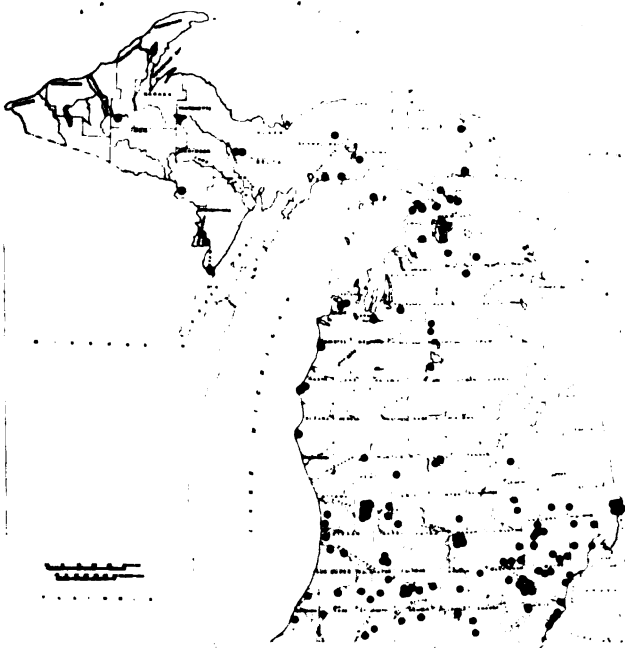
17. STACHYS TENUIFOLIA



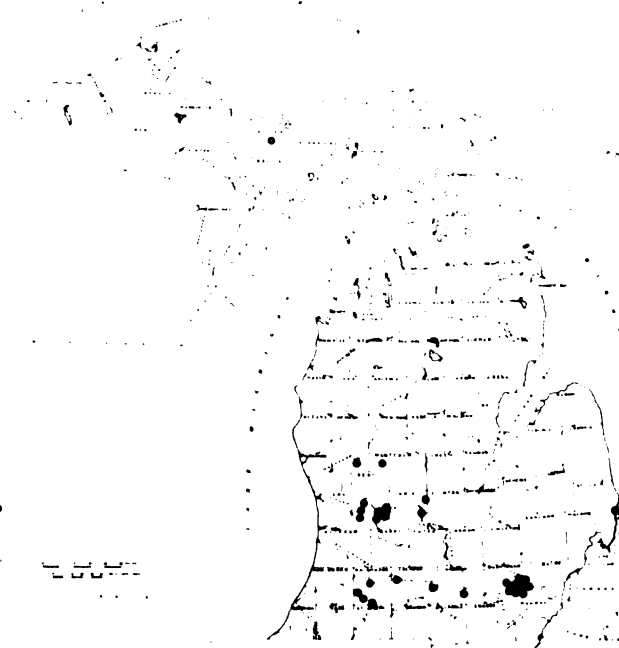
18. MONARDA DIDYMA +
M. PUNCTATA VAR. VILICAULIS ●



19. MONARDA FISTULOSA



20. BLEPHILIA GLIATA



- aa. Cauline leaves sessile, linear and entire; calyx lobes ciliate;
sterile stamens degenerate. 2. H. hispida

1. H. pulegioides (L.) Pers. American Pennyroyal. Map 22.

Occasional in the Lower Peninsula. Epling and Stewart report that the range of this species extends through Dickinson, Menominee, and Delta Counties in the Upper Peninsula, but no collections from this area have been seen in the present study. In dry sandy soils, in pastures, swamps, and open woods. Flowering from June to September.

2. H. hispida Pursh. Rough Pennyroyal; Mock Pennyroyal. Map 23.

Scattered throughout the Lower Peninsula and known from one collection in Dickinson Co. (Fernald 3501, GH, MICH) in the Upper Peninsula. Epling and Stewart reported this species from the southern Lower Peninsula only, In sandy loam fields and on sandy roadsides. Flowering from June to August.

20. Satureja L. Savory.

1. Satureja hortensis L. Summer Savory. Map 24.

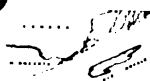
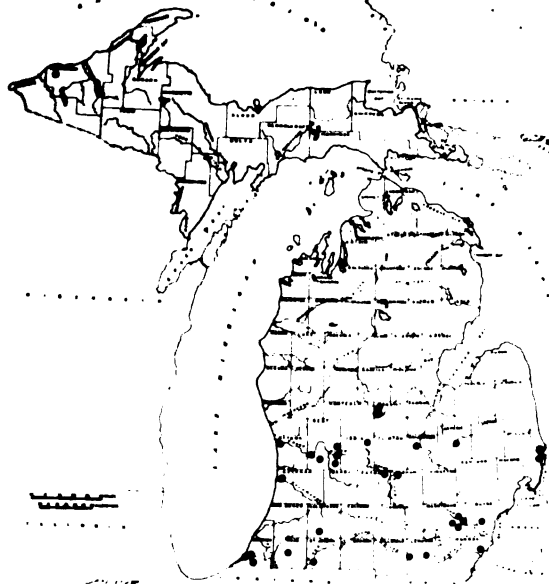
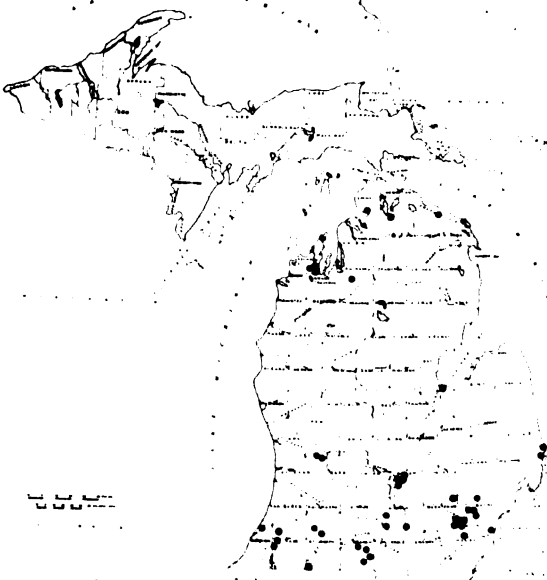
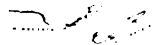
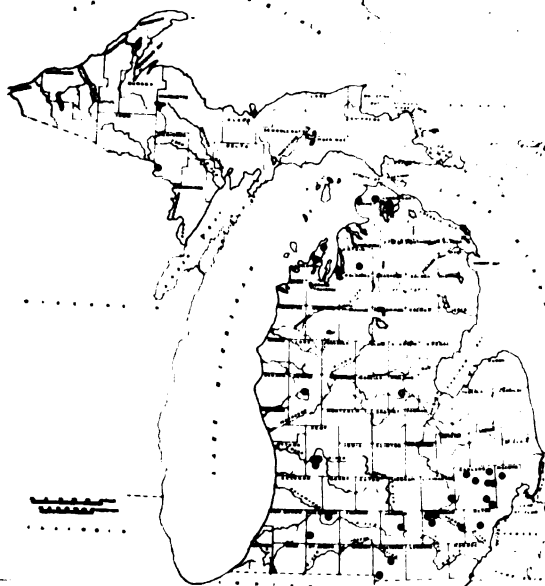
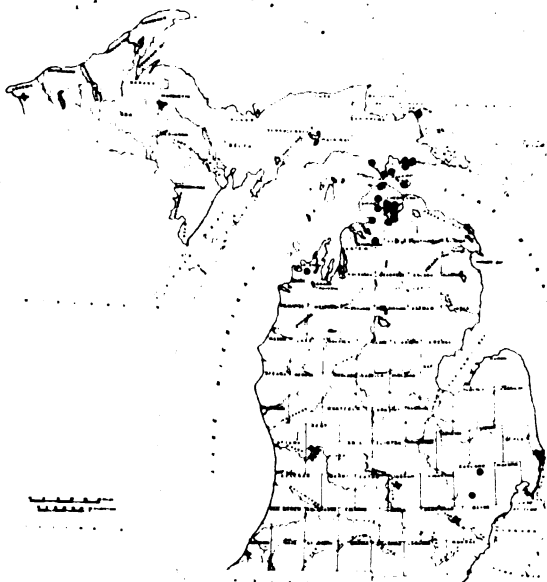
Introduced from Europe, cultivated in gardens and rarely an escape. Flowering from August to September.

21. Acinos Mill. Mother-of-thyme.

Reference: DeWolf, 1954.

1. Acinos arvensis (Lam.) Dandy. Map 24.

Naturalized from Europe and found in both the Upper and Lower Peninsulas; most collected at the northern tip of the Lower Peninsula and adjacent Upper Peninsula. On calcareous and sandy soils, Flowering from July to September.

21. *BLEPHILIA HIRSUTA*22. *HEDEOMA PULEGIODES*23. *HEDEOMA HISPIDA*24. *ACINOS ARVENSIS* ●
SATUREJA HORTENSIS +

22. Calamintha Mill. Calamint.

References: DeWolf, 1954, 1955.

1. Calamintha glabella (Michx.) Benth. var. angustifolia (Torr.) DeWolf.

Map 25.

Satureja arkansana (Nutt.) Briq.

Frequent in the northern counties bordering Lakes Michigan and Huron. On wet limestone and sandy shores. Flowering from July to August.

23. Clinopodium L. Basil.

Reference: DeWolf, 1954.

1. Clinopodium vulgare L. Wild Basil. Map 26.

Satureja vulgaris (L.) Fritsch var. neogaea Fern.

A circumboreal species found throughout most of the state in calcareous and alluvial soils. On lake shores, in deciduous and coniferous woods, and in meadows. Flowering from May to September.

24. Hyssopus L. Hyssop.

1. Hyssopus officinalis L. Map 27.

An escape from herb gardens, known from collections in five counties. Flowering from July to September.

25. Thymus L. Thyme.

1. Thymus serpyllum L. Wild Thyme; Creeping Thyme. Map 27.

Introduced from the Old World and established in areas scattered over the state; planted by the State Highway Dept. on sandy road banks in the central part of the state. Flowering from June to September.

26. Pycnanthemum Michx. Mountain Mint.

Reference: Grant and Epling, 1943.

- a. Calyx teeth 1-1.5 mm. long, lanceolate to subulate, the tips sharp-pointed. 1. P. flexuosum
 - aa. Calyx teeth 0.7-1.0 mm. long, deltoid, pubescent, the tips not sharp-pointed. b
 - b. Sides of stem glabrous, angles pubescent; leaves sessile, 6-11 mm. broad. 1. P. virginianum
 - bb. Sides of upper half of stem pubescent; cauline leaves short-petioled, 10-18 mm. broad. c
 - c. Lower surface of leaves pubescent chiefly on veins; heads pedicillate.
3. P. verticillatum
- cc. Lower surface of leaves pubescent over most of the surface; heads nearly sessile. 4. P. pilosum

1. P. flexuosum (Walt.) BSP. Narrow-leaved Mountain Mint. Map 28.

Scattered in the Lower Peninsula; its northern range in Michigan was previously reported by Lint and Epling as Allegan (erroneously printed Allegany) and Wayne Counties. Recent collections extend its range to Emmet (Yoss 1058, MICH) and Leelanau (Thompson L-335, BLH) Counties. On roadsides, golf links, and old fields. Flowering from June to August.

2. P. virginianum (L.) Durand & Jackson. Mountain Mint. Map 29.

Abundant in the southern half of the Lower Peninsula; known also from Leelanau and Menominee Counties. In dry, sandy areas, open woods and marshes. Flowering from July to September.

3. P. verticillatum (Michx.) Pers. Map 28.

25. *CALAMINTHA GLABELLA* VAR.
ANGUSTIFOLIA ●
COLLINSONIA CANADENSIS ◆



26. *CLINOPODIUM VULGARE*



27. *THYMUS SERPYLLUM* ●
HYSSORUS OFFICINALIS +



28. *PYCNANTHEMUM FLEXUOSUM* ●
P. VERTICILLATUM +
P. PILOSUM ◆



Collected on Saginaw Bay in Huron Co., and along the southeastern side of Lake Michigan. In open, sandy areas. Flowering from August to September.

4. P. pilosum Nutt. Map 28.

Known in Michigan from only three collections: Berrien Co., Niles, shaded bank of St. Joseph River, Dodge 546, 25 August 1917 (MICH); Monroe Co., La Salle, upland roadsides and fields, Farwell 6023, (flowering) 26 July 1922 (GH, MICH); Washtenaw Co., five miles NW of Dexter, Rogers 6217, (flowering) 8 August 1948, (WUD).

27. Lycopus L. Water Horehound.

Reference: Hermann, 1936b.

- a. Calyx teeth shorter or equalling nutlets, calyx lobes broadly triangular without midnerve. b
- aa. Calyx teeth surpassing nutlets, lobes narrowly triangular with prominent midnerve. c
- b. Leaf margins concave from lowest tooth to stem; main stem usually tuberous; usually large robust plants; top of nutlets with numerous, acute tubercles, nutlets when mature concealing the calyces. 1. L. virginicus
- bb. Leaf margins usually convex to straight (infrequently concave); main stem usually tuberous; plants not large and robust; top of nutlets with 3 to 5 rounded tubercles, nutlets when mature not concealing the calyces. 2. L. uniflorus
- c. Leaves sessile. 3. L. asper
- cc. Leaves petiolate. d
- d. Corolla surpassing calyx lobes by 2-3 mm.; leaves shallowly

serrate; ridge of nutlets not entire, verrucose to tuberculate. 4. L. rubellus

dd. Corolla surpassing calyx lobes by 1 mm. or less; leaves irregularly cleft or pinnatifid; ridge of nutlets entire. .

5. L. americanus

1. L. virginicus L. Map 32.

Known in Michigan from one collection: Ingham Co., Meridian Twp., Red Cedar floodplain forest, Parmelee 3053, (mature nutlets only) 20 September 1952 (MSC). This species is easily confused with L. uniflorus.

2. L. uniflorus Michx. Map 30.

Abundant throughout the state. In wet areas. Flowering from July to September. The tuberous stolons of this species are infrequently collected.

3. L. asper Greene. Map 32

Local along the southern margins of Lakes Huron and Michigan and also from Cheboygan Co. On sandy or swampy lake shores, occasionally with the roots submerged. Flowering from July to September.

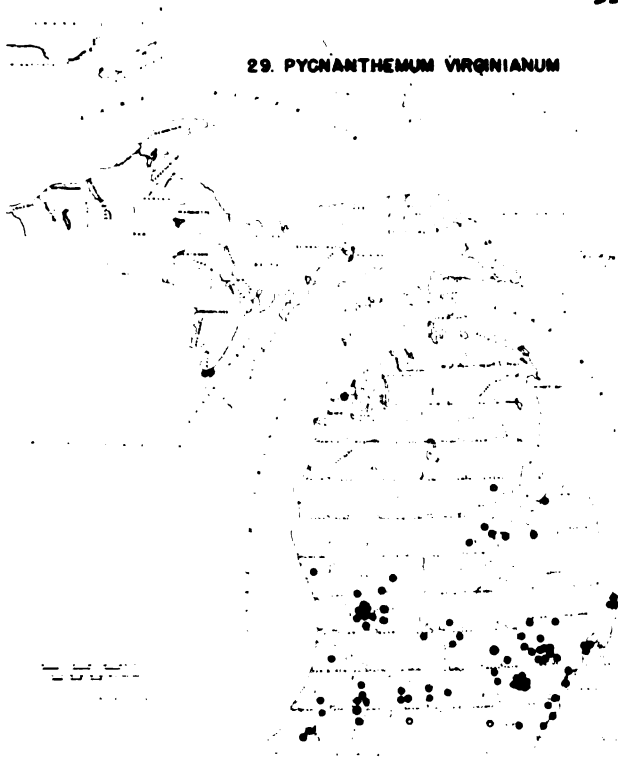
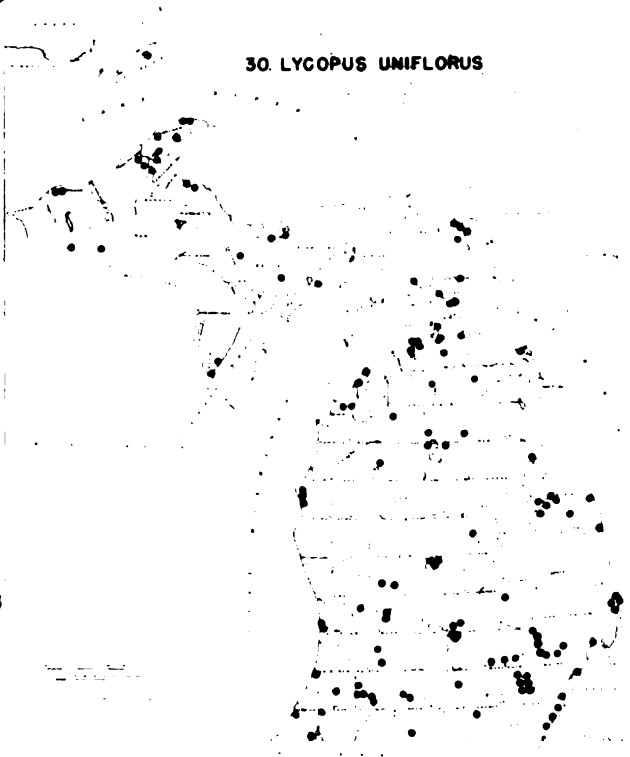
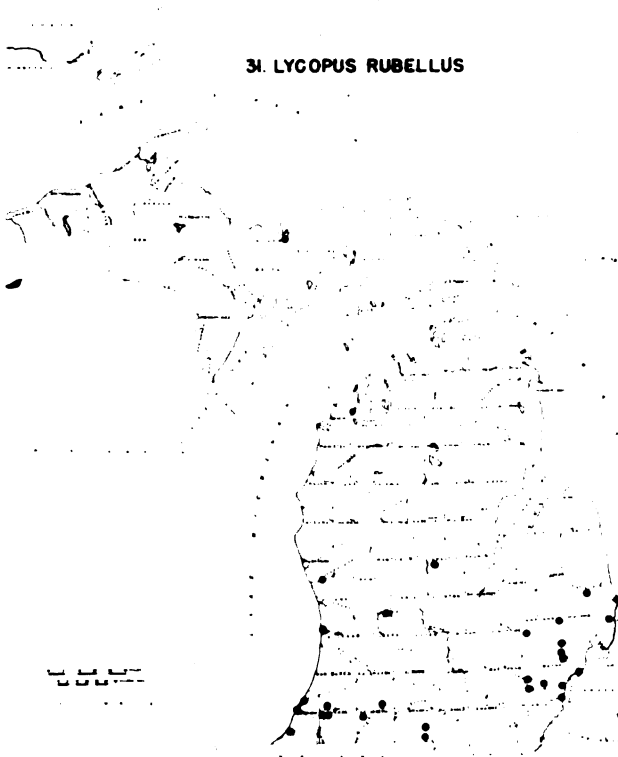
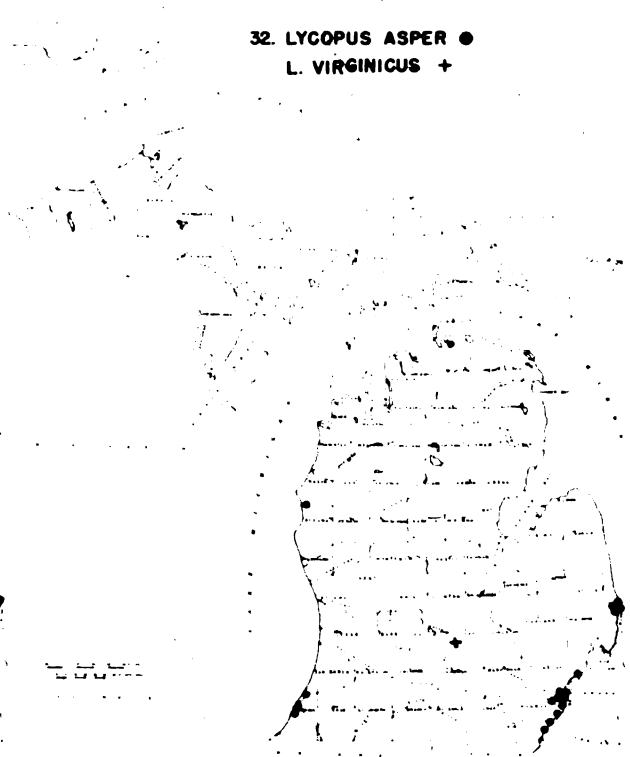
4. L. rubellus Moench. Water Horehound. Map 31.

Scattered throughout the state, but not known from Isle Royale. In swamps, marshes, and on wooded river banks. Flowering from July to September.

5. L. americanus Muhl. Map 33.

Including var. longii Benner and var. scabrifolius Fern.

Widely distributed and the most common species of this genus in Michigan. On sandy or swampy lake shores, river banks, and in roadside

29. *LYCOPodium VIRGINIANUM*30. *LYCOPodium UNIFLORUM*31. *LYCOPodium RUBELLUM*32. *LYCOPodium ASPER* ●
L. VIRGINICUM +

ditches. Flowering from July to August.

28. Mentha L. Mint.

- a. Flowers in crowded terminal spikes or in terminal interrupted spikes. b
- aa. Flowers in axils of leaves in subglobose clusters. d
 - b. Spikes interrupted; leaves petioled. . . 1. M. piperita
 - bb. Spikes densely crowded, slender and leafless; leaves sessile or nearly so. c
- c. Plants soft-pubescent; leaves round-ovate to broadly elliptical.
 - 2. M. rotundifolia
- cc. Plants essentially glabrous; leaves oblong or ovate-lanceolate.
 - 3. M. spicata
 - d. Stem glabrous or with few scattered hairs; calyx glabrous or upper half pubescent. 4. M. gentilis
 - dd. Stem retorse-pubescent on angles; calyx pubescent.
 - 5. M. arvensis subsp. canadensis

1. M. piperita L. Peppermint. Map 34.

The non-cultivated specimens of this species have sterile anthers.

Introduced from Europe and considered by some to be a hybrid between M. aquatica L. and M. spicata L. (cf. Clapham, Tutin, and Warburg, 1952). Scattered throughout the state. Along swampy roadsides and borders of cultivated fields. Flowering from July to September.

2. M. rotundifolia (L.) Huds. Apple-scented Mint. No map.

Introduced from Europe and known in Michigan from only three collections: Kalamazoo Co., Schoolcraft Twp., Portage Creek, damp ground,

Rapp & Hanes 2466, 21 August 1936 (WMU); Kent Co., Alpine Twp., Cole s.n., 8 October 1899 (AQC); Grand Rapids, Cole s.n., 1899 (MSC).

3. M. spicata L. Spearmint. Map 35.

All material examined of this species had only sterile anthers. Introduced from Europe and scattered throughout the Lower Peninsula. On beaches, damp roadsides, and along rivers. Flowering from August to September.

4. M. gentilis L. Map 35.

Introduced from Europe and thought to be a hybrid between M. arvensis and M. spicata (cf. Clapham, Tutin, and Warburg, 1952). Scattered in the Lower Peninsula. In moist or wet areas. Flowering from July to August.

5. M. arvensis L. subsp. canadensis (L.) Hara. Wild Mint. Map 36.

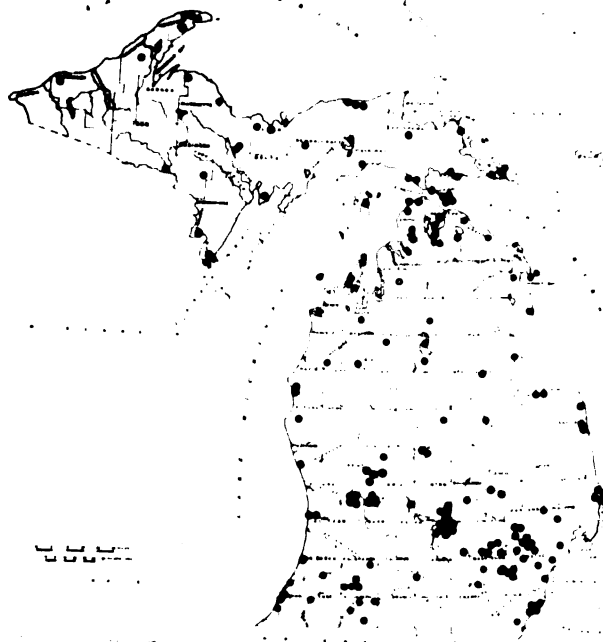
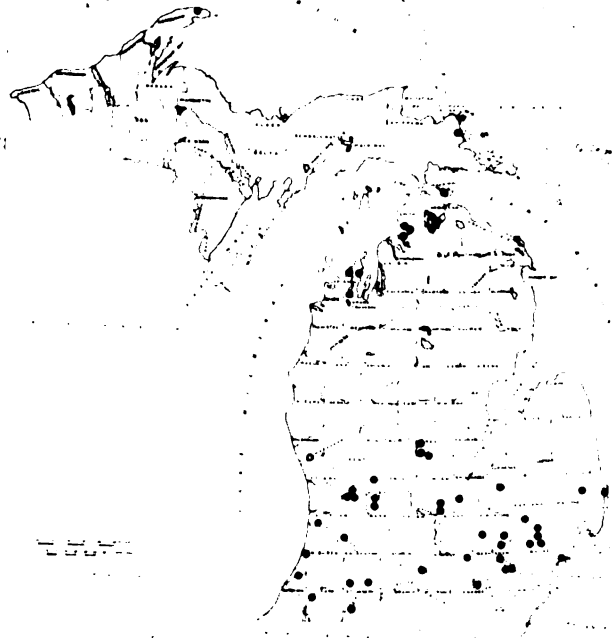
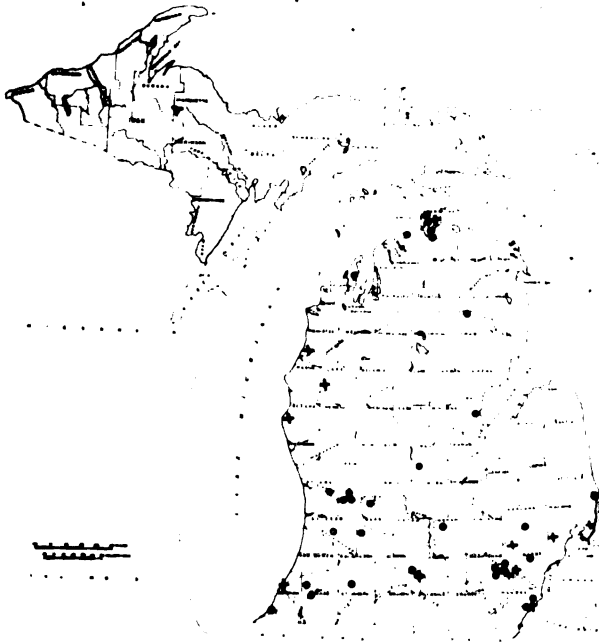
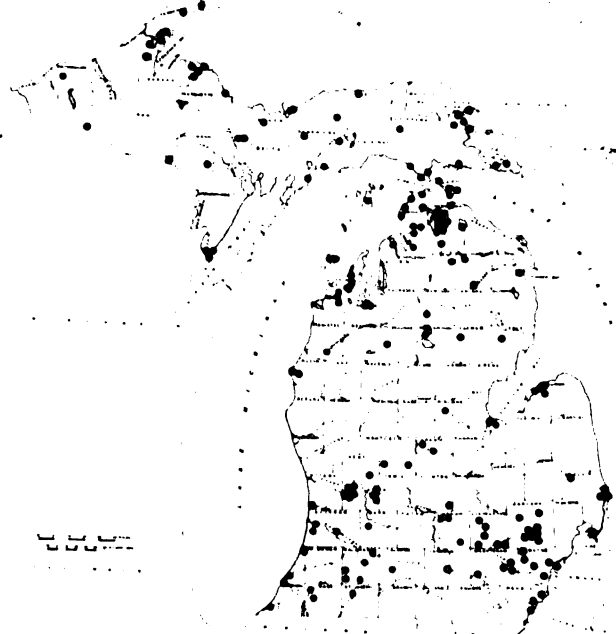
Reference: Hara, 1956.

M. arvensis var. glabrata Fern. and var. villosa (Benth.) S. R. Stewart.

This is a circumboreal species; the range of subsp. canadensis extends from Alaska to Labrador, south to California, Arizona, and Virginia. It differs from the European subsp. arvensis and the Asian subsp. piperascens in chromosome number, leaf and calyx-lobe shape, and has pulegone instead of menthol.

In Michigan specimens there is variation in amount of stem and leaf pubescence.

Common throughout the state. Along lake shores and river banks and in marshes. Flowering from June to August.

33. *LYCOPUS AMERICANUS*34. *MENTHA PIPERITA*35. *MENTHA SPICATA* ●
M. GENTILIS +36. *MENTHA ARVENSIS* SUBSP.
CANADENSIS

29. Collinsonia L. Horse Balm.

1. Collinsonia canadensis L. Stone-root; Rich-weed. Map 25.

Fairly common in the southern part of the Lower Peninsula. In woodlands. Flowering from July to October.

Check List of Species Recorded in Each Michigan County

ALCONA COUNTY

Clinopodium vulgare
Dracocephalum parviflorum
Lycopus americanus
Scutellaria galericulata

Clinopodium vulgare
Leonurus cardiaca
Lycopus americanus
Mentha arvensis subsp.
 canadensis
Trichostema brachiatum

ALGER COUNTY

Blephilia ciliata
Clinopodium vulgare
Galeopsis tetrahit
Lycopus americanus
L. rubellus
L. uniflorus
Mentha arvensis subsp.
 canadensis
Prunella vulgaris
Scutellaria galericulata
S. lateriflora

ANTRIM COUNTY

Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Lycopus americanus
Prunella vulgaris
Scutellaria galericulata

ALLEGAN COUNTY

Agastache nepetoides
Blephilia hirsuta
Clinopodium vulgare
Glechoma hederacea
Lamium maculatum
Mentha arvensis subsp.
 canadensis
M. piperita
M. spicata
Monarda fistulosa
M. punctata var.
 villicaulis
Physostegia virginiana var.
 speciosa
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Scutellaria lateriflora
Stachys hyssopifolia
Teucrium canadense

ARENAC COUNTY

Clinopodium vulgare
Lycopus americanus
Pycnanthemum virginianum
Stachys hispida
Teucrium canadense

BARAGA COUNTY

Clinopodium vulgare
Galeopsis tetrahit
Prunella vulgaris

BARRY COUNTY

Glechoma hederacea
Leonurus cardiaca
Lycopus uniflorus
Mentha arvensis subsp.
 canadensis
M. spicata
Monarda fistulosa
M. punctata var. *villicaulis*
Nepeta cataria
Prunella vulgaris
Scutellaria lateriflora
Stachys hyssopifolia

ALPENA COUNTY

Calamintha glabella var.
 angustifolia

BAY COUNTY

Clinopodium vulgare
Hedeoma pulegioides
Lycopus americanus
Mentha arvensis subsp.
 canadensis
M. spicata
Physostegia virginiana var.
 virginiana
Pycnanthemum virginianum

BENZIE COUNTY

Clinopodium vulgare
Leonurus cardiaca
Lycopus americanus
Mentha arvensis subsp.
 canadensis
Monarda punctata var.
 villicaulis
Nepeta cataria
Scutellaria galericulata

BERRIEN COUNTY 1/

Agastache nepetoides
Ajuga reptans
Blephilia hirsuta
Clinopodium vulgare
Glechoma hederacea
Hedeoma pulegioides
Lycopus americanus
L. asper
L. rubellus
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp.
 canadensis
M. gentilis
M. piperita
M. spicata
Monarda fistulosa
M. punctata var.
 villicaulis
Nepeta cataria
Physostegia virginiana var.
 speciosa

Prunella vulgaris
Pycnanthemum pilosum
P. virginianum
Satureja hortensis
Scutellaria galericulata
S. lateriflora
S. parvula
Stachys hispida
S. hyssopifolia
S. tenuifolia
Teucrium canadense

BRANCH COUNTY

Agastache nepetoides
Collinsonia canadensis
Hedeoma pulegioides
Lycopus rubellus
L. uniflorus
Monarda fistulosa
Pycnanthemum virginianum
Scutellaria galericulata
Stachys tenuifolia

CALHOUN COUNTY

Blephilia ciliata
Clinopodium vulgare
Collinsonia canadensis
Glechoma hederacea
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp.
 canadensis
M. gentilis
M. piperita
M. spicata
Monarda fistulosa
M. punctata var. *villicaulis*
Nepeta cataria
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora
Stachys hyssopifolia
Teucrium canadense

1/ The nine species of the Labiatae noted in Billington's (1925) study of Warren Woods have been seen.

CASS COUNTY

Agastache nepetoides
A. scrophulariaefolia
Blephilia hirsuta
Clinopodium vulgare
Collinsonia canadensis
Hedeoma pulegioides
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Mentha arvensis subsp.
 canadensis
M. piperita
M. spicata
Monarda fistulosa
Nepeta cataria
Physostegia virginiana var.
 virginiana
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria elliptica var.
 hirsuta
S. galericulata
S. lateriflora
Stachys hyssopifolia

CHARLEVOIX COUNTY

Acinos arvensis
Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Leonurus cardiaca
Lycopus americanus
Mentha arvensis subsp.
 canadensis
Prunella vulgaris
Scutellaria galericulata
Teucrium canadense

CHARLEVOIX COUNTY: GARDEN ISLAND

Acinos arvensis
Calamintha glabella var.
 angustifolia

Leonurus cardiaca
Nepeta cataria

CHARLEVOIX COUNTY: BEAVER ISLAND

Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Lamium purpureum
Lycopus americanus
Mentha arvensis subsp.
 canadensis
Monarda fistulosa
Nepeta cataria
Prunella vulgaris
Scutellaria lateriflora

CHEBOYGAN COUNTY 2/

Acinos arvensis
Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Galeopsis tetrahit
Glechoma hederacea
Hedeoma hispida
Hedeoma pulegioides
Lamium maculatum
Leonurus cardiaca
Lycopus americanus
L. asper
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp.
 canadensis
M. gentilis
M. piperita
M. spicata
Monarda fistulosa
Nepeta cataria
Prunella vulgaris
Pycnanthemum flexuosum
Scutellaria galericulata
S. lateriflora
Stachys palustris var. *palustris*
S. palustris var. *homotricha*
Teucrium canadense

2/ In the history of the floristics in Douglas Lake Region, Voss (1956) has given an account of the rejected records.

CHIPPEWA COUNTY

Acinos arvensis
Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Galeopsis tetrahit
Glechoma hederacea
Lycopus americanus
L. uniflorus
Mentha arvensis subsp.
 canadensis
M. piperita
Monarda fistulosa
M. punctata var. *villicaulis*
Nepeta cataria
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
S. parvula
Stachys palustris var. *palustris*
Trichostema brachiatum

CLARE COUNTY

Scutellaria lateriflora
Thymus serpyllum

CLINTON COUNTY

Blephilia ciliata
Clinopodium vulgare
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp.
 canadensis
M. piperita
Monarda fistulosa
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora

CRAWFORD COUNTY

Dracocephalum parviflorum
Lycopus americanus

L. uniflorus
Mentha arvensis subsp.
 canadensis
M. gentilis
Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Scutellaria galericulata
S. lateriflora

DELTA COUNTY

Calamintha glabella var.
 angustifolia
Clinopodium vulgare
Lycopus americanus
L. uniflorus
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys hispida
Teucrium canadense

DICKINSON COUNTY

Dracocephalum parviflorum
Hedeoma hispida
Lycopus americanus
Mentha arvensis subsp.
 canadensis
Monarda fistulosa
Prunella vulgaris
Stachys hispida

EATON COUNTY

Blephilia hirsuta
Clinopodium vulgare
Collinsonia canadensis
Glechoma hederacea
Prunella vulgaris
Pycnanthemum virginianum
Teucrium canadense

EMMET COUNTY 3/

Acinos arvensis

Calamintha glabella var.
angustifolia
Clinopodium vulgare
Galeopsis tetrahit
Glechoma hederacea
Hedeoma hispida
H. pulegioides
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp.
canadensis
M. piperita
M. spicata
Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys palustris var. *palustris*
S. palustris var. *homotricha*
Thymus serpyllum

GENESEE COUNTY

Blephilia hirsuta
Collinsonia canadensis
Galeopsis tetrahit
Lycopus americanus
Mentha piperita
Monarda fistulosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys hispida
S. tenuifolia
Teucrium canadense

GLADWIN COUNTY

Nepeta cataria
Scutellaria galericulata

GOGEBIC COUNTY 4/

Clinopodium vulgare

Dracocephalum parviflorum
Galeopsis tetrahit
Lycopus uniflorus
Mentha arvensis subsp.
canadensis
Prunella vulgaris
Satureja hortensis
Scutellaria galericulata
S. lateriflora
Stachys palustris var. *palustris*

GRAND TRAVERSE COUNTY

Clinopodium vulgare
Leonurus cardiaca
Lycopus americanus
Mentha arvensis subsp.
canadensis
Monarda fistulosa
Nepeta cataria
Physostegia virginiana var.
virginiana
Prunella vulgaris
Teucrium canadense

GRATIOT COUNTY

Agastache scrophulariaefolia
Blephilia hirsuta
Clinopodium vulgare
Glechoma hederacea
Lycopus americanus
L. rubellus
Leonurus cardiaca
Mentha arvensis subsp.
canadensis
M. piperita
M. spicata
Monarda fistulosa
Nepeta cataria
Physostegia virginiana var.
speciosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys hispida
Teucrium canadense

4/ Darlington (1921) reports Glechoma hederacea, Teucrium canadense, and (1923) Lycopus americanus. These specimens are not in the Michigan State University Herbarium but undoubtedly occur in this county.

N COUNTY

Adiantum vulgare
Asplenium officinalis
Cystopteris cardiaca
Cystopteris americanus
Cystopteris anniflorus
Cystopteris vulgare
Cystopteris arvensis subsp.
Cystopteris canadensis
Cystopteris verticillatum
Cystopteris virginianum
Cystopteris galericulata
Cystopteris lateriflora

HILLSDALE COUNTY

Agastache nepetoides
 Collinsonia canadensis
 Glechoma hederacea
 Monarda fistulosa
 Teucrium canadense

HOUGHTON COUNTY

Agastache foeniculum
 Clinopodium vulgare
 Dracocephalum parviflorum
 Galeopsis tetrahit
 Glechoma hederacea
 Leonurus cardiaca
 Lycopodium americanus
 L. uniflorus
 Mentha arvensis var.
 canadensis
 Monarda fistulosa
 Nepeta cataria
 Physostegia virginiana var.
 virginiana
 P. virginiana var. speciosa
 Prunella vulgaris
 Scutellaria galericulata
 S. lateriflora
 Stachys palustris var. palustris
 Thymus serpyllum

INGHAM COUNTY

Agastache scrophulariaefolia
 Blephilia hirsuta
 Collinsonia canadensis
 Dracocephalum parviflorum
 Glechoma hederacea
 Hedeoma pulegioides
 Lamium amplexicaule
 L. maculatum
 L. purpureum
 Leonurus cardiaca
 L. marrubiastrum
 Lycopodium americanus
 L. uniflorus
 L. virginicus
 Marrubium vulgare
 Mentha arvensis subsp.
 canadensis
 M. spicata

Monarda fistulosa
 Nepeta cataria
 Physostegia virginiana var.
 speciosa
 Prunella vulgaris
 Pycnanthemum flexuosum
 P. pilosum
 P. virginianum
 Satureja hortensis
 Scutellaria galericulata
 S. lateriflora
 S. leonardi
 S. parvula
 Stachys hispida
 S. tenuifolia
 Teucrium canadense
 Thymus serpyllum
 Trichostema brachiatum

IONIA COUNTY

Ajuga reptans
 Blephilia ciliata
 B. hirsuta
 Clinopodium vulgare
 Lamium amplexicaule
 Leonurus cardiaca
 Lycopodium americanus
 Monarda fistulosa
 Nepeta cataria
 Prunella vulgaris
 Scutellaria galericulata
 S. parvula

IOSCO COUNTY

Clinopodium vulgare
 Lycopodium americanus
 L. uniflorus
 Mentha arvensis subsp.
 canadensis
 Scutellaria galericulata

IRON COUNTY

Clinopodium vulgare
 Glechoma hederacea
 Lycopodium americanus
 Mentha arvensis subsp.
 canadensis

Prunella vulgaris
Scutellaria galericulata

ISABELLA COUNTY

Nepeta cataria

JACKSON COUNTY

Agastache nepetoides
Blephilia ciliata
Collinsonia canadensis
Glechoma hederacea
Hedeoma hispida
H. pulegioides
Lamium maculatum
Leonurus cardiaca
Lycopus uniflorus
Mentha arvensis subsp.
 canadensis
M. piperita
Monarda fistulosa
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora
Teucrium canadense
Thymus serpyllum

KALAMAZOO COUNTY

Agastache nepetoides
A. scrophulariaefolia
Blephilia ciliata
B. hirsuta
Clinopodium vulgare
Collinsonia canadensis
Dracocephalum parviflorum
Glechoma hederacea
Hedeoma hispida
H. pulegioides
Lamium amplexicaule
L. purpureum
Lycopus americanus
L. rubellus
L. uniflorus

Marrubium vulgare
Mentha arvensis subsp.
 canadensis
M. piperita
M. rotundifolia
M. spicata
Monarda didyma
M. fistulosa
M. punctata var. *villicaulis*
Nepeta cataria
Physostegia virginiana var.
 speciosa
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Salvia azurea var. *grandiflora*
S. reflexa
Scutellaria elliptica var.
 hirsuta
S. galericulata
S. lateriflora
Stachys hispida
S. hyssopifolia
S. palustris var. *palustris*
S. tenuifolia
Teucrium canadense
Thymus serpyllum
Trichostema dichotomum

KALKASKA COUNTY

Hedeoma pulegioides
Lycopus uniflorus
Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Scutellaria galericulata
Teucrium canadense

KENT COUNTY 5/

Agastache nepetoides
A. scrophulariaefolia
Blephilia ciliata
B. hirsuta
Clinopodium vulgare
Collinsonia canadensis

5/ The three species indicated by an asterisk (*) have been collected since the study of E. J. Cole (1901).

Glechoma hederacea
 *Hedeoma hispida
 H. pulegioides
 Hyssopus officinalis
 Leonurus cardiaca
 Lycopus americanus
 L. rubellus
 L. uniflorus
 Marrubium vulgare
 Mentha arvensis subsp.
 canadensis
 M. piperita
 M. rotundifolia
 M. spicata
 Monarda didyma
 M. punctata var. villicaulis
 Nepeta cataria
 Physostegia virginiana var.
 speciosa
 Prunella vulgaris
 Pycnanthemum virginianum
 Salvia azurea var. grandiflora
 *Satureja hortensis
 Scutellaria galericulata
 S. lateriflora
 Stachys hispida
 S. hyssopifolia
 S. palustris var. palustris
 S. tenuifolia
 Teucrium canadensis
 *Thymus serpyllum

KEWEENAW COUNTY

Clinopodium vulgare
 Dracocephalum parviflorum
 Galeopsis tetrahit
 Glechoma hederacea
 Leonurus cardiaca
 Lycopus americanus
 L. uniflorus
 Mentha arvensis subsp.
 canadensis
 M. piperita
 Nepeta cataria
 Physostegia virginiana var.
 virginiana
 Prunella vulgaris
 Scutellaria galericulata
 S. lateriflora
 Stachys palustris var. palustris
 S. palustris var. homotricha

KEWEENAW COUNTY: ISLE ROYALE

Clinopodium vulgare
 Dracocephalum parviflorum
 Galeopsis tetrahit
 Glechoma hederacea
 Lycopus americanus
 L. uniflorus
 Mentha arvensis subsp.
 canadensis
 Prunella vulgaris
 Scutellaria galericulata
 S. lateriflora
 Thymus serpyllum

LAKE COUNTY

Mentha gentilis
 Prunella vulgaris
 Scutellaria galericulata
 Stachys hyssopifolia
 Teucrium canadense
 Thymus serpyllum

LAPEER COUNTY

Monarda fistulosa
 Prunella vulgaris
 Teucrium canadense

LEELANAU COUNTY

Acinos arvensis
 Calamintha glabella var.
 angustifolia
 Clinopodium vulgare
 Hedeoma hispida
 H. pulegioides
 Lamium amplexicaule
 Leonurus cardiaca
 Lycopus americanus
 L. rubellus
 L. uniflorus
 Marrubium vulgare
 Mentha arvensis subsp. canadensis
 M. piperita
 M. spicata
 Monarda fistulosa
 M. punctata var. villicaulis
 Nepeta cataria

Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Scutellaria galericulata
S. lateriflora
Teucrium canadense
Thymus serpyllum

LENAWEE COUNTY

Agastache nepetoides
Blephilia hirsuta
Collinsonia canadensis
Leonurus cardiaca
Lycopus uniflorus
Monarda fistulosa
Nepeta cataria
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora
Stachys hispida
S. palustris var. *palustris*
Teucrium canadense

LIVINGSTON COUNTY

Hedeoma hispida
H. pulegioides
Lamium amplexicaule
L. purpureum
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. piperita
Monarda fistulosa
Nepeta cataria
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora
Stachys tenuifolia

LUCE COUNTY

Clinopodium vulgare
Lycopus americanus
Mentha arvensis subsp. *canadensis*

Prunella vulgaris
Scutellaria galericulata
Stachys palustris var. *palustris*

MACKINAC COUNTY

Acinos arvensis
Calamintha glabella var. *angustifolia*
Galeopsis tetrahit
Glechoma hederacea
Lamium maculatum
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. piperita
Monarda fistulosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys palustris var. *palustris*
Teucrium canadense

MACOMB COUNTY

Galeopsis tetrahit
Hedeoma hispida
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha gentilis
Monarda didyma
M. fistulosa
Nepeta cataria
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Scutellaria galericulata
S. lateriflora
Stachys tenuifolia
Teucrium canadense

MANISTEE COUNTY

Clinopodium vulgare
Lycopus americanus
Mentha arvensis subsp. *canadensis*
M. gentilis
Monarda fistulosa

Prunella vulgaris
Scutellaria galericulata
S. lateriflora

MARQUETTE COUNTY

Ajuga genevensis
Clinopodium vulgare
Galeopsis tetrahit
Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
Monarda fistulosa
Nepeta cataria
Physostegia virginiana var.
 speciosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora

MASON COUNTY

Clinopodium vulgare
Lycopus americanus
L. asper
L. uniflorus
Mentha arvensis subsp. *canadensis*
Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys hyssopifolia

MECOSTA COUNTY

Clinopodium vulgare
Monarda punctata var.
 villicaulis
Stachys hyssopifolia

MENOMINEE COUNTY

Leonurus cardiaca
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
Monarda fistulosa
Physostegia virginiana var. *virginiana*

Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
S. lateriflora
Stachys hispida
Teucrium canadense

MIDLAND COUNTY

Agastache nepetoides
Glechoma hederacea
Hedeoma hispida
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
Physostegia virginiana var.
 speciosa
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Scutellaria galericulata
S. lateriflora
Stachys hispida
Teucrium canadense

MISSAUMEE COUNTY

Clinopodium vulgare
Lycopus americanus
Mentha arvensis subsp. *canadensis*
Prunella vulgaris
Scutellaria galericulata

MONROE COUNTY

Blephilia hirsuta
Glechoma hederacea
Leonurus cardiaca
Lycopus americanus
L. asper
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. gentilis
M. spicata
Monarda fistulosa
Nepeta cataria
Physostegia virginiana var.
 speciosa
Prunella vulgaris
Pycnanthemum flexuosum

P. pilosum
P. virginianum
Salvia reflexa
Scutellaria galericulata
S. lateriflora
Stachys hispida
S. palustris var. *palustris*
S. tenuifolia
Teucrium canadense

MONTCALM COUNTY

Agastache scrophulariaefolia
Blephilia ciliata
Clinopodium vulgare
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
Monarda fistulosa
Pycnanthemum virginianum
Scutellaria galericulata
Stachys palustris var. *palustris*

MONTMORENCY COUNTY

Clinopodium vulgare
Lycopus uniflorus
Mentha arvensis subsp. *canadensis*
Monarda fistulosa
Scutellaria galericulata

MUSKEGON COUNTY

Agastache nepetoides
Lycopus americanus
L. rubellus
Mentha piperita
Monarda punctata var. *villicaulis*
Prunella vulgaris

Pycnanthemum verticillatum
P. virginianum
Scutellaria galericulata
Stachys hyssopifolia
S. palustris var. *palustris*
Thymus serpyllum

NEWAYGO COUNTY

Blephilia ciliata
Hedeoma hispida
Monarda fistulosa
M. punctata var. *villicaulis*
Nepeta cataria
Prunella vulgaris
Scutellaria galericulata
Stachys hyssopifolia
Teucrium canadense

OAKLAND COUNTY 6/

**Acinos arvensis*
Agastache nepetoides
A. scrophulariaefolia
Collinsonia canadensis
Glechoma hederacea
Hedeoma hispida
H. pulegioides
Lamium amplexicaule
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp. *canadensis*
 **Mentha gentilis*
M. piperita
M. spicata
Monarda fistulosa
M. punctata var. *villicaulis*

6/ From M. Bingham's (1945) list the following species were not seen: *Blephilia ciliata*, *B. hirsuta*, *Satureja glabella* (synonym for *Acinos arvensis*?), *Satureja vulgaris* (synonym for *Clinopodium vulgare*), *Hyssopus officinalis*, *Pycnanthemum pilosum*, *Stachys tenuifolia* and *S. parviflora* (?). *Perilla frutescens* (L.) Britt. is also reported. The two specimens with this determination are: Bingham s.n., middle beach, W. Bloomfield Twp., August 1936 (BLH 7284), and Stoutamire 2183, wet woods near Horseshoe Lake, Oxford Twp. (BLH 32101). These two collections are *Collinsonia canadensis*. The additions to Bingham's county flora are indicated by and asterisk (*).

Nepeta cataria
 **Physostegia virginiana* var.
 virginiana
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Scutellaria galericulata
S. lateriflora
Teucrium canadense
Trichostema dichotomum

OCEANA COUNTY

Lycopus americanus
Marrubium vulgare
Mentha gentilis
Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Stachys palustris var. *palustris*

OGEMAW COUNTY

Mentha arvensis subsp. *canadensis*
Prunella vulgaris
Scutellaria galericulata

ONTONAGON COUNTY 7/

Blephilia hirsuta
Clinopodium vulgare
Dracocephalum parviflorum
Galeopsis tetrahit
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. *canadensis*
Prunella vulgaris
Scutellaria galericulata

OSCEOLA COUNTY

Monarda punctata var. *villicaulis*
Prunella vulgaris

Scutellaria galericulata
Stachys hyssopifolia

OSCODA COUNTY

Lycopus uniflorus
Mentha spicata
Monarda punctata var. *villicaulis*
Prunella vulgaris
Scutellaria galericulata

OTSEGO COUNTY

Clinopodium vulgare
Lycopus uniflorus
Mentha arvensis subsp. *canadensis*
Nepeta cataria
Teucrium canadense

OTTAWA COUNTY

Blephilia hirsuta
Clinopodium vulgare
Lamium purpureum
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. spicata
Monarda fistulosa
M. punctata var. *villicaulis*
Physostegia virginiana var.
 speciosa
Pycnanthemum verticillatum
Scutellaria galericulata
S. lateriflora
Stachys hispida
S. hyssopifolia
Teucrium canadense

7/ Undoubtedly occurring in this county are the species *Nepeta cataria* and *Scutellaria lateriflora* (Darlington, 1937), but no herbarium specimens have been seen.

PRESQUE ISLE COUNTY

Calamintha glabella var.
angustifolia
Clinopodium vulgare
Galeopsis tetrahit
Hedeoma pulegioides
Lycopus americanus
L. uniflorus
Monarda fistulosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys hispida
Teucrium canadense

ROSCOMMON COUNTY

Dracocephalum parviflorum
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. canadensis
Monarda fistulosa
Nepeta cataria
Prunella vulgaris
Scutellaria galericulata
S. lateriflora

SAGINAW COUNTY

Leonurus cardiaca
Monarda fistulosa
Scutellaria lateriflora
Teucrium canadense
Thymus serpyllum

SANILAC COUNTY

Glechoma hederacea
Lamium amplexicaule
Lycopus americanus
L. uniflorus
Prunella vulgaris

SCHOOLCRAFT COUNTY

Calamintha glabella var.
angustifolia
Clinopodium vulgare
Galeopsis tetrahit

Glechoma hederacea
Lycopus americanus
L. uniflorus
Mentha arvensis subsp. canadensis
Monarda fistulosa
Prunella vulgaris
Scutellaria galericulata
S. lateriflora
Stachys palustris var. palustris

SHIAWASSEE COUNTY

Blephilia hirsuta
Galeopsis tetrahit
Leonurus cardiaca
Lycopus americanus
Mentha piperita
Scutellaria galericulata

ST. CLAIR COUNTY

Agastache nepetoides
A. scrophulariaefolia
Blephilia ciliata
B. hirsuta
Clinopodium vulgare
Collinsonia canadensis
Glechoma hederacea
Hedeoma pulegioides
Hyssopus officinalis
Lamium amplexicaule
L. maculatum
Leonurus cardiaca
Lycopus americanus
L. asper
L. rubellus
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp. canadensis
M. gentilis
M. piperita
M. spicata
Monarda didyma
M. fistulosa
M. media
M. punctata var. villicaulis
Nepeta cataria
Prunella vulgaris
Pycnanthemum virginianum
Satureja hortensis
Scutellaria galericulata
S. lateriflora

Stachys hispida
S. palustris var. *palustris*
Teucrium canadense
Thymus serpyllum

ST. JOSEPH COUNTY

Agastache nepetoides
Clinopodium vulgare
Collinsonia canadensis
Hedeoma pulegioides
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. piperita
M. spicata
Monarda punctata var. *villicaulis*
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
Stachys hispida
S. hyssopifolia
Teucrium canadense

TUSCOLA COUNTY

Physostegia virginiana var.
virginiana
Pycnanthemum virginianum

VAN BUREN COUNTY

Agastache nepetoides
Clinopodium vulgare
Collinsonia canadensis
Hedeoma pulegioides
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Mentha arvensis subsp. *canadensis*
M. spicata

Monarda fistulosa
M. punctata var. *villicaulis*
Prunella vulgaris
Pycnanthemum virginianum
Scutellaria galericulata
Stachys hispida
S. hyssopifolia
Teucrium canadense

WASHTENAW COUNTY 8/

Agastache nepetoides
A. scrophulariaefolia
Blephilia ciliata
B. hirsuta
Collinsonia canadensis
Dracocephalum parviflorum
 **Galeopsis tetrahit*
Glechoma hederacea
Hedeoma hispida
 **Hyssopus officinalis*
Lamium amplexicaule
 **L. purpureum*
Leonurus cardiaca
Lycopus americanus
L. rubellus
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp. *canadensis*
M. gentilis
M. piperita
M. spicata
Monarda didyma
M. fistulosa
M. punctata var. *villicaulis*
Physostegia virginiana var.
virginiana
P. virginiana var. *speciosa*
Prunella vulgaris
Pycnanthemum pilosum
P. virginianum
Scutellaria galericulata
S. lateriflora
Satureja hortensis
Stachys hispida
Teucrium canadense

8/ Species marked with an asterisk (*) indicate species not included in Walpole's (1924) and Hermann's (1936a, 1937) additions to the flora. *Stachys palustris* var. *palustris* is reported by Walpole as being common. No specimens of this species were seen.

Thymus serpyllum
Trichostema brachiatum

WAYNE COUNTY

Agastache nepetoides
A. scrophulariaefolia
Blephilia hirsuta
Collinsonia canadensis
Dracocephalum parviflorum
Hedeoma hispida
H. pulegioides
Glechoma hederacea
Lamium amplexicaule
Leonurus cardiaca
Lycopus americanus
L. asper
L. rubellus
L. uniflorus
Marrubium vulgare
Mentha arvensis subsp. canadensis
M. piperita
M. spicata
Monarda fistulosa
M. punctata var. villicaulis
Nepeta cataria
Physostegia aboriginorum
P. virginiana var. virginiana
Prunella vulgaris
Pycnanthemum flexuosum
P. virginianum
Salvia reflexa
Scutellaria galericulata
S. lateriflora
Stachys hispida
S. tenuifolia
Teucrium canadense

WEXFORD COUNTY

Clinopodium vulgare
Lycopus americanus
L. uniflorus
Scutellaria galericulata

POLLEN GRAIN STUDIES

The pollen grains of the Labiatae are relatively uniform morphologically, but have a rather conspicuous pattern of variation in number of colpi. Differences in number of colpi were first recognized by Fritzsche (1832) and Mohl (1834). Evidence from pollen grain morphology and cytology has been little used for classification, although Erdtman (1945) suggested that such data may support a tentative division of the family into two groups possibly deserving subfamily rank. It will be shown subsequently in this paper that some species and even varieties also can be distinguished on the basis of minor technical characters of pollen grain morphology such as exine sculpturing and shape and size of the grains (cf. discussion, pp. 57-62 and key to species or groups of species based on pollen grain morphology, pp. 63-68).

Material and Methods.

For the majority of species studied, anthers were removed from herbarium material at Michigan State University, the Gray Herbarium, and the University of Michigan. Some examinations were also made of pollen grains obtained from fresh material growing in the Beal-Garfield Botanic Garden of Michigan State University, from field collections, and from cultivated Mentha plants grown by Dr. Ray Nelson of Michigan State University. The latter are plants of M. piperita cv. Mitcham which had no special treatment or were treated in one of the following ways: Irradiated with cobalt-60 at 5,000/r, colchicine treated, or crossed with M. crispa.

The following species occurring naturally in Michigan have not been considered in the pollen grain studies because of insufficient material:

Agastache foeniculum, Ajuga genevensis, Lycopus virginicus, Mentha rotundifolia, Pycnanthemum verticillatum, Salvia reflexa, Scutellaria leonardi, and Trichostema dichotomum.

Voucher specimens of living material investigated have been deposited in the Michigan State University Herbarium. A set of microscope slides of acetylated pollen grains also has been filed in the Michigan State University Herbarium. Specimens from which pollen grain studies have been made are listed in Table II, pp. 74-77. For each specimen there is included in the table the collector and number, herbarium, slide number, condition of plant (either from fresh or from herbarium material), method of preparation (either acetocarmine or acetylation), and reference to illustration in the plates.

Three types of slide preparations were usually made for each specimen: (1) anthers crushed in glycerine jelly for examination of pollen grains in their 'natural' condition, (2) anthers crushed in glycerine jelly-acetocarmine mixture for determination of number of pollen grain nuclei at anthesis, and (3) pollen grains acetylated (and sometimes chlorinated) using Erdtman's (1943, 1952) process for examination of the exine sculpturing, shape class, size measurements and other characteristics. The second method above has been modified from Leitner (1937) and is described in detail as follows. The anthers are first crushed in melted glycerine jelly on a microscope slide. A drop of acetocarmine is mixed with the jelly and the cover glass applied. The slide is then heated gently over an alcohol flame for 5 to 10 minutes. The preparation is then allowed to stand for one to five (or more) hours while the nuclei absorb the stain. Slides thus prepared are semi-permanent. For determination of nuclear content of the pollen grains, the preparation is then

examined under 430 X with very brilliant illumination. This method is not satisfactory for anthers which have been stored previously in acetic acid.

Flowers nearest the base of plants at the beginning of their flowering period were the most satisfactory sources for pollen grains.

Measurements of acetylated pollen grains were made at a magnification of 970 X with a calibrated ocular micrometer in a standard Bausch and Lomb monocular research microscope. Unless otherwise indicated, the measurements given are the average of ten grains.

Photomicrographs were made with a Zeiss research microscope and Leitz pillar-type bellows camera with $3\frac{1}{4}$ " x $4\frac{1}{4}$ " plates. Ansco Type 282 (Isopan) panchromatic film was used. As reproduced in this study, the photomicrographs are at a magnification of 1020 X unless otherwise indicated. A duplicate set of photomicrographs of acetylated pollen grains has been filed in the Paleobotanical Laboratory of Harvard University.

Discussion.

The results of the examinations of pollen grains are summarized in Table I. In the following paragraphs, important features of the pollen grain studies have been indicated. The terminology employed is that of Erdtman (1943, 1952) and Erdtman and Vishnu-Mitter (1958).

Pollen grains of investigated Michigan species are radiosymmetrical (having more than two planes of symmetry) and zonicolpate (the apertures are arranged parallel to the polar axis).^{9/} The apertures are longi-

^{9/} Mentha gentilis, M. piperita cv. Mitcham (both non-irradiated and irradiated), and Monarda didyma have both zonicolpate and pancolpate pollen grains (the latter are grains with 10 or more apertures that are not all arranged parallel to the polar axis).

tudinal and technically referred to as colpi (sing. colpus) and normal grains of all Michigan species are either tricolpate or hexacolpate. The species with tricolpate grains are very constant in respect to this character, although one species, Trichostema brachiatum contains many deformed grains. This may be due to the depauperate specimen from which the anthers were taken. In some species ordinarily having hexacolpate grains, exceptional cases have been observed in which 8, 10, and 12 or more colpi occur in plants from natural populations. The species Lycopus asper, Pycnanthemum virginianum, and Satureja hortensis have hexa- and octacolpate grains. Monarda didyma and Mentha gentilis have 6-, 8-, 10-, and 12- (or more) colpate grains. Both non-irradiated and irradiated plants of Mentha piperita cv. Mitcham have 8, 9, 10, 12, and other polycolpate grains, while colchicine treated plants of this cultivar have only octacolpate or occasional nonacolpate grains. In M. piperita cv. Mitcham and also in M. gentilis the majority of the grains have more than six colpi, but in the other species the hexacolpate grains outnumber those with more than six colpi.

An outline (after Briquet, 1895) of subfamilies, tribes, and subtribes in which the Michigan genera of the Labiatae have been placed is provided below. The number of colpi occurring in the members of each tribe and subtribe is indicated. It should be noted that both tri- and hexacolpate types are found in the subfamily Stachyoideae (Lamioideae).

Subfamily Ajugoideae, tribe Ajugeae: <u>Ajuga</u> , <u>Teucrium</u> , <u>Trichostema</u>	TRICOLPATE
Subfamily Scutellarioideae: <u>Scutellaria</u>	TRICOLPATE
Subfamily Stachyoideae (Lamioideae)	
Tribe Marrubieae: <u>Marrubium</u>	TRICOLPATE
Tribe Nepeteae: <u>Agastache</u> , <u>Dracocephalum</u> , <u>Glechoma</u> , <u>Nepeta</u>	HEXACOLPATE
Tribe Stachyeae (Laminae)	

Subtribe Brunellinae: <u>Prunella</u>	HEXACOLPATE
Subtribe Lamiinae: <u>Galeopsis</u> , <u>Lamium</u> , <u>Leonurus</u> , <u>Physostegia</u> , <u>Stachys</u>	TRICOLPATE
Tribe Salviae: <u>Salvia</u>	HEXACOLPATE
Tribe Monardeae: <u>Monarda</u> , <u>Blephilia</u>	HEXACOLPATE
Tribe Saturieae:	
Subtribe Melissinae (Saturinae): <u>Acinos</u> , <u>Hedeoma</u> , <u>Calamintha</u> , <u>Clinopodium</u> , <u>Satureja</u>	HEXACOLPATE
Subtribe Hyssopinae: <u>Hyssopus</u>	HEXACOLPATE
Subtribe Thymineae: <u>Pycnanthemum</u> , <u>Thymus</u>	HEXACOLPATE
Subtribe Menthainae: <u>Lycopus</u> , <u>Mentha</u>	HEXACOLPATE
Subtribe Perillinae: <u>Collinsonia</u>	HEXACOLPATE

Leitner (1942) reported the occurrence of bi- and trinucleate pollen grains at anthesis in the Labiatae. Erdtman (1945) noted that some of the species Leitner had found to be binucleate were tricolpate and some that she found to be trinucleate were hexacolpate. In the present study this correlation of the binucleate condition in the tricolpate grains also has been found.^{10/} In the species with pollen grains having more than six colpi, the grains are also trinucleate. The hexacolpate grains of Mentha gentilis and M. piperita cv. Mitcham (Pl. I, Fig. 13e) contain no protoplasm but the grains with more than six colpi (Fig. 13a) do sometimes contain protoplasm and have the trinucleate condition.

In Erdtman's tentative division of the Labiatae into two groups based on pollen grains (the first group containing species with binucleate, tricolpate grains and the second group species with trinucleate, hexacolpate grains), the Lamiinae was not considered. In the present study, this subtribe has been found to contain only members with binucleate, tricolpate grains. Consequently it is suggested that this subtribe be included with Erdtman's first tentative group.

^{10/} The vegetative nuclei do not take as deep a stain as do the generative nuclei. In the photomicrographs, therefore, only the generative nucleus can be seen in the tricolpate grains (eg. Pl. I, Fig. 1), and only the two sperm nuclei are visible in the hexacolpate grains (eg. Pl. I, Fig. 7).

In this study three classes of exine sculpturing have been recognized: faintly reticulate, fine reticulate and reticulate.^{11/} The reticulate pattern is made up of muri (ridges) and lumina (spaces). The hexacolpate species have only the reticulate sculpturing pattern. One tricolpate species, Marrubium vulgare differs in its reticulate pattern from the other species in that the muri seemingly are larger than the lumina (Pl. III, Fig. 6a'). The lumina of Physostegia virginiana var. virginiana (Pl. V, Fig. 13a) and var. speciosa are conspicuously larger than those of other reticulate species. They range in diameter from two to four microns in contrast to lumina of other species which are less than two microns in diameter.

The exines of Teucrium canadense (Pl. II, Fig. 1a' and 1c'), Trichostema brachiatum (Pl. II, Fig. 3c), and Physostegia virginiana var. virginiana and var. speciosa are two microns thick or thicker. The other tricolpate species have grains with thinner exines.

In each species the margins of the colpi have been found to have a ragged appearance. At the region of the colpus the margins of the exine end either abruptly or with gradual thinning as seen in Pl. II, Fig. 6a or Pl. IV, Fig. 11b'. The only exception is Collinsonia canadensis (Pl. XV, Fig. 47a') in which the exine thins abruptly at 2 microns from the edge of the colpus and thus appears half-umbonate.

The shape classes of the pollen grains of Michigan species of the Labiatae are subprolate, prolate spheroidal, and oblate spheroidal (the

^{11/} A cultivated species, Lamium album is psilate (smooth) by ordinary light microscopy (Pl. VI, Fig. 17). However, by the carbon replica technique used with electron microscopy, Bradley (1957) found a pollen grain of this species with the exine finely punctate and the colpus warty.

shape class subprolate is determined as a ratio of length of polar axis divided by the equatorial diameter and ranges between 1.33 and 1.14; the prolate spheroidal shape ranges numerically between 1.14 and 1.00; and oblate spheroidal has a numerical range from 1.00 to 0.88). Shape class variation is slight in these species. The shape class oblate spheroidal is found only in Salvia azurea var. grandiflora. This shape is similar to that of the cultivated species, S. coccinea (Pl. VII, Fig. 23) which is oblate (numerical ratio of 0.75 to 0.50).

The polar diameters of normal pollen grains range between 18 and 56 microns (based on measurements of 10 grains). The polar diameters of most species, however, range between 30 and 40 microns. Generally the tricolpate grains are smaller than those that are hexacolpate. Leonurus cardiaca has the smallest tricolpate grains (polar diameter 18 μ) and Physostegia virginiana var. speciosa has the largest (52 μ). In the hexacolpate species, the smallest grains occur in Lycopus uniflorus (polar diameter 27 μ) and the largest in Monarda didyma (56 μ). Thymus serpyllum, an escape from cultivation, has two distinct means in the range of polar diameters (Pl. XI, Figs. 35a and 35c) in the same plant. The photomicrographs of octacolpate grains of Lycopus asper, Pycnanthemum virginianum, and Satureja hortensis (Pls. X, XI, and XII) show that these grains are larger than the hexacolpate grains from the same plants. But when an average polar diameter of 10 octacolpate grains is taken (see Table I), this is found to be about the same as the average polar diameter of 10 hexacolpate grains. This similarity in size of hexa- and octacolpate grains is contrary to the reports in the literature (such as Maurizio, 1956). In Monarda didyma, however, the grains having more than six colpi are larger. Mentha gentilis (probably of hybrid origin, see

p. 37) has a great variation in number of colpi and size (from 10 μ to 60 μ) similar to M. piperita cv. Mitcham (Pl. XIII, Fig. 42), although the latter generally has larger polar diameters.

In the key to species based on pollen grain characteristics certain groupings consider only polar and equatorial diameters. These differences are more or less arbitrary however, and may be influenced in part by the acetylation preparation. Yet when the measurements of acetylated grains of four species in this study (Lamium amplexicaule, L. purpureum, Lycopus uniflorus, and Monarda fistulosa) are compared with measurements of glycerine jelly mounts stained with gentian-violet or fuchsin in Ikuse's work (1956), there is considerable agreement in size measurements in the two studies. The acetylated preparations show a greater range in size variation which may be due to the collapsed or expanded condition of some of the grains measured.

Further study is needed especially in species in which irregularity occurs in the number of colpi and size of pollen grains. These species also should be investigated chromosomally, experimentally, and taxonomically throughout their entire geographic range.

Key to Species or Groups Based on Pollen Grain Characteristics

Some of the Michigan species that occur in natural populations or are cultivated can be keyed out to species while others can only be placed into groups as follows: Group I includes two tricolpate, faintly reticulate species with polar diameters between 24 μ and 26 μ ; Group II includes 4 tricolpate, fine reticulate species with polar diameters between 24 μ and 36 μ ; Group III includes 15 hexacolpate species with polar diameters between 27 μ and 36 μ ; Group IV includes 7 hexacolpate species with polar diameters between 39 μ and 46 μ ; and Group V includes species with both hexacolpate and octacolpate grains.

The sizes of pollen grains are the average measurements of 10 grains prepared by the acetylation method. It should be noted that distinctions of species and groupings based on size alone are more or less arbitrary.

For additional characteristics of the 49 species in the key, see Table I. and the illustrations.

- A. Pollen grains tricolpate, sculpturing reticulate, fine or faintly reticulate, or psilate. B
- AA. Pollen grains hexacolpate, sculpturing reticulate. Q
- B. Exine reticulate. C
- BB. Exine fine or faintly reticulate, or psilate. G
- C. Polar diameter less than 30 μ D
- CC. Polar diameter greater than 30 μ E
- D. Equatorial diameter 27 μ x 22 μ , polar diameter 26 μ , shape class subprolate, muri seemingly larger than lumina, exine 2 μ in thickness (Pl. III, Fig. 6). . . . Marrubium vulgare

- DD. Equatorial diameter $26.7\mu \times 23.5\mu$, polar diameter 24.5μ ,
prolate spheroidal, muri not larger than lumina, exine less
than 2μ in thickness (Pl. VI, Fig. 19). . Stachys hispida
- E. Polar diameter greater than 50μ , prolate spheroidal (equatorial
diameter $56.3\mu \times 50\mu$, polar diameter 51.5μ). Physostegia
virginiana var. speciosa
- EE. Polar diameter less than 50μ , subprolate. F
- F. Equatorial diameter $45.7\mu \times 37\mu$, polar diameter 42.8μ (Pl. V,
Fig. 13). Physostegia virginiana var. virginiana
- FF. Equatorial diameter $42.9\mu \times 32.5\mu$, polar diameter 24μ (Pl. V,
Fig. 16). Galeopsis tetrahit
- G. Exine psilate (equatorial diameter $27\mu \times 25\mu$, polar diameter 26μ ,
prolate spheroidal; Pl. VI, Fig. 17). Lamium album
- GG. Exine fine or faintly reticulate. H
- H. Exine faintly reticulate. I
- HH. Exine fine reticulate. J
- I. Shape class prolate spheroidal, polar diameter 24μ to 26μ , Group
I: equatorial diameter $26\mu \times 23.5\mu$, polar diameter 24μ
Scutellaria elliptica var. hirsuta; equatorial diameter $26.5\mu \times$
 24.4μ , polar diameter 25.7μ Lamium maculatum
- II. Shape class subprolate, polar diameter 26.7μ (equatorial diameter
 $30.7\mu \times 24\mu$; Pl. III, Fig. 5). Scutellaria lateriflora
- J. Polar diameter greater than 36μ (equatorial diameter $42.8\mu \times$
 31μ , subprolate, Pl. II, Fig. 8). . . Trichostema brachiatum
- JJ. Polar diameter less than 36μ K
- K. Polar diameter less than 20μ (equatorial diameter $19.4\mu \times 16.5\mu$,
polar diameter 18μ , subprolate; Pl. V, Fig. 4). Leonurus cardiaca

KK. Polar diameter greater than 20 μ L

L. Exine 2 μ or more in thickness (equatorial diameter 38.5 μ x 28.9 μ , polar diameter 33 μ , subprolate; Pl. II, Fig. 1. . .

Teucrium canadense

Ll. Exine less than 2 μ in thickness. M

M. Polar diameter greater than 30 μ (equatorial diameter 30.8 μ x 28.9 μ , polar diameter 31.5 μ , prolate spheroidal). . . Lamium amplexicaule

MM. Polar diameter less than 30 μ N

N. Polar diameter less than 23 μ O

NN. Polar diameter greater than 23 μ P

O. Polar diameter 21.5 μ , equatorial diameter 23 μ x 21 μ , prolate spheroidal. Stachys tenuifolia

OO. Polar diameter 22.4 μ , equatorial diameter 26 μ x 21.7 μ , subprolate, (Pl. V. Fig. 15). Leonurus marrubiastrum

P. Polar diameter 29 μ (equatorial diameter 35.7 μ x 26.6 μ , subprolate, (Pl. VI, Fig. 18). Lamium purpureum

PP. Polar diameter between 24 μ and 27 μ , Group II: equatorial diameter 26.5 μ x 23 μ , polar diameter 24 μ , subprolate, Pl. II, Fig. 4. Scutellaria galericulata; 28 μ x 22.4 μ , 24 μ , subprolate, Pl. VII, Fig. 21. Stachys palustris var. homotricha; 27.5 μ x 22 μ , 26.5 μ , subprolate, Pl. VI, Fig. 20. Stachys hyssopifolia; 27.5 μ x 27 μ , 27 μ , prolate spheroidal. Stachys palustris var. palustris; 30 μ x 24 μ , 27 μ , subprolate, Pl. II, Fig. 2. Ajuga reptans

Q. Shape class subprolate to prolate spheroidal. S

QQ. Shape class oblate to oblate spheroidal. R

R. Shape class oblate, equatorial diameter 39.6 μ x 54.4 μ , polar

- diameter $66.3\mu \times 51\mu$ (Pl. VII, Fig. 23). . Salvia coccinea
- RR. Shape class oblate spheroidal, equatorial diameter $25\mu \times 26.9\mu$,
polar diameter $28\mu \times 24\mu$. . . Salvia azurea var. grandiflora
- S. Exine at colpus margin abruptly thinning at 2μ from the edge and
appearing half-umbonate in polar median section (equatorial diameter
 $42\mu \times 35.5\mu$, polar diameter 41.5μ , subprolate, Pl. XV, Fig. 47. . .
- Collinsonia canadensis
- SS. Exine at colpus margin not thinning abruptly at 2μ from the edge,
the same thickness throughout or gradually thinning as seen in
mid-optical section T
- T. Pollen grains hexacolpate only. U
- TT. Pollen grains hexa-, octa-, nona-, or polycolpate. W
- U. Pollen grains with two distinct sizes in the same plant (equatorial
diameter $33.6\mu \times 27.4\mu$, polar diameter 31μ , subprolate; $25.3\mu \times$
 22μ , 24.6μ , subprolate, Pl. XI, Fig. 35. Thymus serpyllum
- UU. Pollen grains more or less uniform in the same plant. V
- V. Polar diameters between 27μ and 36μ , Group III: polar diame-
ter 27μ , equatorial diameter $28.8\mu \times 25.6\mu$, prolate spheroidal,
Pl. XII, Fig. 41. Lycopus uniflorus; 27.3μ , $28.4\mu \times$
 25.7μ , prolate spheroidal, Pl. XI, Fig. 34. Hyssopus
officinalis; 29μ , $29.7\mu \times 28\mu$, prolate spheroidal.
Lycopus rubellus; 30.3μ , $31.1\mu \times 27.5\mu$, prolate spheroidal, Pl.
XII, Figs 38 and 40. Lycopus americanus; 30.3μ ,
 $34.9\mu \times 31.7\mu$, prolate spheroidal, Pl. III, Fig. 7.
Agastache nepetoides; 32.6μ , $35.8\mu \times 28.7\mu$, subprolate, Pl. IX,
Fig. 28. Blephilia hirsuta; 33.7μ , $33.7\mu \times 33.4\mu$,
prolate spheroidal. Pycnanthemum flexuosum; 33.2μ .

- 35.2 μ x 26.6 μ , subprolate, Pl. IV, Fig. 10. Nepeta cataria; 33.5 μ , 37.5 μ x 34 μ , prolate spheroidal, Pl. IX, Fig. 30. Acinos arvensis; 33.7 μ , 36.5 μ x 33.7 μ , prolate spheroidal, Pl. X, Fig. 33. Clinopodium vulgare; 33.5 μ , 40.7 μ x 35.9 μ , prolate spheroidal, Pl. X, Fig. 31. Calamintha glabella var. angustifolia; 35 μ , 37.2 μ x 29.7 μ , subprolate. Hedeoma pulegioides; 35.9 μ , 38 μ x 31.8 μ , subprolate, Pl. XIII, Fig. 42. Mentha arvensis subsp. canadensis; 35.9 μ , 38.6 μ x 30.4 μ , subprolate, Pl. IV, Fig. 12. Prunella vulgaris; 30.3 μ , 34.9 μ x 31.7 μ , prolate spheroidal, Pl. III, Fig. 8. Agastache scrophulariaefolia
- VV. Polar diameter between 39 μ and 45.6 μ , Group IV: polar diameter 39 μ , equatorial diameter 40.5 μ x 35.6 μ , subprolate, Pl. IX, Fig. 27. Blephilia ciliata; 39.4 μ , 40.7 μ x 33.1 μ , subprolate, Pl. IV, Fig. 11. Dracocephalum parviflorum; 40.3 μ , 39.7 μ x 35.6 μ , prolate spheroidal, Pl. XI, Fig. 29. Hedeoma hispida; 42.2 μ , 44.5 μ x 42 μ , prolate spheroidal. Monarda media; 44.5 μ , 46.4 μ x 38 μ , subprolate, Pl. VIII, Fig. 25. Monarda fistulosa; 45.3 μ , 46.1 μ x 37.6 μ , subprolate, Pl. IV, Fig. 9. Glechoma hederacea; 45.7 μ , 47.4 μ x 34.3 μ , prolate spheroidal, Pl. VIII, Fig. 26.
- Monarda punctata var. villicaulis
- W. Pollen grains hexa- and octacolpate, Group V: hexacolpate, 33.3 μ , 34.5 μ x 30.1 μ , subprolate, octacolpate grains (average of 3) 32.4 μ , Pl. X, Fig. 32. Satureja hortensis; hexacolpate, 33.6 μ , 39.5 μ x 35.2 μ , prolate spheroidal, octacolpate grains (avg. of two) 38.5 μ , Pl. XI, Figs 36 and 37. Pycnanthemum virginianum;

- hexacolpate, 35.5 μ , 37.9 μ x 31.9 μ , subprolate, octacolpate grains
 35.5 μ , Pl. XII, Fig. 39. Lycopus asper
- WW. Pollen grains hexa-, octa-, and polycolpate. X
- X. Polar diameter of hexacolpate grains 27.9 μ , subprolate, polar
 diameter of octacolpate grains 24 μ -35 μ , decacolpate grains
 37 μ -40 μ , also with very small grains between 12 μ and 16 μ . .
- Mentha gentilis
- XX. Polar diameter of hexacolpate grains 55.9 μ , of octacolpate
 grains (avg. of 4) 59.4 μ , of decacolpate (one grain) 56.7 μ ,
 dodecacolpate (avg. of two) 61.5 μ , no small grains, Pl. VII,
 Fig. 24. Monarda didyma

Table I. Pollen Grain Characteristics

Species	No. of Nuclei at Anthesis	No. of Colpi	Sculpturing	Shape Class	Equatorial Diameter (in microns)	Polar Diameter (in microns)
<i>Trichostema brachiatum</i>	2	3	fine reticulate	subprolate	42.80 (36-48) x 31.19 (24-33)	36.05 (32-40)
<i>Ajuga reptans</i>	2	3	fine reticulate	subprolate	30.22 (25-36) x 24.06 (20-26)	27.22 (24-31)
<i>Teucrium canadense</i>	2	3	fine reticulate	subprolate	38.50 (34-41) x 28.92 (25-32)	33.17 (30-36)
<i>Scutellaria elliptica</i> var. <i>hirsuta</i>	2	3	faintly reticulate	prolate spheroidal	26.00 (24-27) x 23.57 (21-26)	24.06 (21-25)
<i>S. lateriflora</i>	2	3	faintly reticulate	subprolate	30.78 (25-36) x 24.06 (19-26)	26.74 (24-32)
<i>S. galericulata</i>	2	3	fine reticulate	subprolate	26.52 (25-29) x 23.09 (17-24)	24.22 (21-26)
<i>S. parvula</i>	2	3			(few and very small grains, ca. 10u)	
<i>Marrubium vulgare</i>	2	3	reticulate	subprolate	27.62 (25-32) x 22.11 (20-25)	25.31 (22-28)
<i>Agastache nepetoides</i>	3	6	reticulate	prolate spheroidal	34.91 (32-39) x 31.67 (30-32)	30.32 (28-40)
<i>A. scrophulariaefolia</i>	3	6	reticulate	prolate spheroidal	37.91 (34-41) x 28.04 (28-32)	36.37 (32-41)
<i>Nepeta cataria</i>	3	6	reticulate	subprolate	35.27 (28-38) x 26.62 (23-37)	33.23 (24-38)
<i>Glechoma hederacea</i>	3	6	reticulate	subprolate	46.12 (41-50) x 37.61 (32-47)	45.30 (41-49)
<i>Dracocephalum parviflorum</i>	3	6	reticulate	subprolate	40.66 (37-45) x 33.12 (30-38)	39.45 (35-45)
<i>Prunella vulgaris</i>	3	6	reticulate	subprolate	38.58 (37-42) x 30.38 (28-33)	35.89 (32-41)

Table I. Pollen Grain Characteristics (continued)

Species	No. of Nuclei at Anthesis	No. of Colpi	Sculpturing	Shape Class	Equatorial Diameter (in microns)	Polar Diameter (in microns)
					Length x Width	
<i>Physostegia aboriginorum</i>	2	3	reticulate			
<i>P. virginiana</i> var. <i>virginiana</i>	2	3	reticulate	subprolate	45.79 (39-50) x 37.09 (29-42)	42.80 (38-49)
<i>P. virginiana</i> var. <i>speciosa</i>	2	3	reticulate	prolate spheroidal subprolate	56.25 (54-62) x 50.10 (39-59)	51.52 (46-58)
<i>Leonurus cardiaca</i>	2	3	fine reticulate	subprolate	19.44 (17-23) x 16.52 (15-19)	18.14 (17-20)
<i>L. marrubiastrum</i>	2	3	fine reticulate	subprolate	26.00 (24-28) x 21.71 (20-24)	22.36 (20-24)
<i>Galeopsis tetrahit</i>	2	3	reticulate	subprolate	42.93 (36-45) x 32.56 (24-39)	34.10 (32-37)
<i>Lamium album</i>	2	3	psilate	prolate spheroidal	27.03 x 25.16	26.61
<i>L. maculatum</i>	2	3	faintly reticulate	prolate spheroidal	26.49 (25-28) x 24.95 (23-28)	25.68 (24-30)
<i>L. amplexicaule</i>	2	3	fine reticulate	prolate spheroidal	30.81 (26-32) x 28.92 (26-34)	31.56 (29-34)
<i>L. purpureum</i>	2	3	fine reticulate	subprolate	35.75 (32-37) x 26.6. (23-31)	29.24 (26-36)
<i>Stachys palustris</i> var. <i>palustris</i>	2	3	fine reticulate	prolate spheroidal	27.86 (26-29) x 27.62 (25-29)	27.86 (25-32)
<i>S. palustris</i> var. <i>homotricha</i>	2	3	fine reticulate	subprolate	28.03 (25-32) x 22.44 (19-26)	24.14 (22-25)
<i>S. hispida</i>	2	3	reticulate	prolate spheroidal	26.81 (24-28) x 23.81 (21-26)	24.70 (23-26)

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Table I. Pollen Grain Characteristics (continued)

Species	No. of Nuclei at Anthesis	No. of Colpi	Sculpturing	Shape Class	Equatorial Diameter (in microns)		Polar Diameter (in microns)
					Length x Width		
S. tenuifolia	2	3	fine	prolate	23.33 (22-26) x 21.30 (19-23)	21.46 (20-23)	
S. hyssopifolia	2	3	reticulate	spheroidal			
			fine	subprolate	27.86 (24-32) x 21.93 (20-24)	26.62 (24-34)	
Salvia azurea var. grandiflora	3	6	reticulate	oblate	25.03 (22-27) x 26.97 (22-29)	28.19 x 24.39	
			reticulate	spheroidal			
S. coccinea	6	6	reticulate	oblate	39.56 x 54.37	66.30 x 51.00	
S. sylvestris	6	6	reticulate	subprolate	29.56 x 25.24	29.24 x 27.70	
Monarda punctata var. villicaulis	3	6	reticulate	prolate	47.39 (45-55) x 34.26 (20-42)	45.68 (42-49)	
M. fistulosa	3	6	reticulate	spheroidal			
M. didyma	3	6	reticulate	subprolate	46.44 (41-52) x 38.06 (35-44)	44.47 (43-48)	
			reticulate	subprolate	54.59 (41-52) x 43.79 (30-53)	55.95 (45-62)	
			reticulate		56.70		
			reticulate		56.70		
M. media	3	12	reticulate	prolate	44.51 (42-46) x 42.12 (40-49)	42.20 (37-46)	
Blephilia ciliata	3	6	reticulate	spheroidal			
			reticulate	subprolate	40.52 (37-46) x 35.58 (32-40)	38.88 (32-40)	
B. hirsuta	3	6	reticulate	subprolate	35.77 (25-39) x 28.67 (25-31)	32.64 (30-36)	
Hedeoma pulegioides	3	6	reticulate	subprolate	37.18 (36-40) x 29.71 (24-34)	35.07 (32-37)	
H. hispida	3	6	reticulate	prolate	39.77 (35-47) x 35.56 (34-41)	40.34 (36-46)	
				spheroidal			

Table I. Pollen Grain Characteristics (continued)

Species	No. of Nuclei at Anthesis	No. of Colpi	Sculpturing	Shape Class	Equatorial Diameter (in microns)	Polar Diameter (in microns)
<i>Satureja hortensis</i>	3	6	reticulate	subprolate	34.51 (32-36) x 30.13 (28-32)	33.29 (31-36)
		8	reticulate			32.40
<i>Acinos arvensis</i>	3	6	reticulate	prolate	37.48 (33-41) x 34.10 (32-36)	33.47 (32-35)
				spheroidal		
<i>Calamintha glabella</i> var. <i>angustifolia</i>	3	6	reticulate	prolate	40.74 (37-44) x 35.93 (32-40)	34.75 (32-41)
<i>Clinopodium vulgare</i>	3	6	reticulate	spheroidal		
				prolate	36.53 (32-39) x 33.69 (30-36)	33.70 (30-36)
				spheroidal		
<i>Hyssopus officinalis</i>	3	6	reticulate	prolate	28.36 (27-31) x 25.74 (22-28)	27.25 (25-30)
				spheroidal		
<i>Thymus serpyllum</i>	3	6	reticulate	subprolate	33.65 (32-36) x 27.38 (22-32)	31.10 (24-36)
	3	6	reticulate	subprolate	25.34 (19-29) x 21.95 (19-24)	24.62 (20-24)
<i>Pycnanthemum flexuosum</i>	3	6	reticulate	prolate	33.70 (27-36) x 33.37 (29-38)	33.70 (29-36)
				spheroidal		
<i>P. pilosum</i>	3	6	reticulate			
<i>P. virginianum</i> (slide No. 48)	3	6	reticulate	subprolate	37.85 (32-49) x 32.81 (30-37)	33.61 (30-37)
<i>P. virginianum</i> (slide No. 31)	3	6	reticulate	prolate	39.53 (35-41) x 35.60 (33-36)	37.58 (36-41)
				spheroidal		
<i>Lycopus uniflorus</i>	3	8	reticulate	prolate	(few grains) 28.83 (26-31) x 25.60 (20-29)	26.45, 40.50 26.97 (26-32)
				spheroidal		
<i>L. asper</i>	3	6	reticulate	subprolate	37.99 (35-41) x 31.97 (29-37)	35.64 (34-38)
	3	8	reticulate			35.48 (32-41)
<i>L. rubellus</i>	3	6	reticulate	prolate	29.73 (28-32) x 28.03 (27-29)	29.16 (28-30)
				spheroidal		

Table I. Pollen Grain Characteristics (continued)

Species	No. of Nuclei at Anthesis	No. of Colpi	Sculpturing	Shape Class	Equatorial Diameter (in microns)	Polar Diameter (in microns)
<i>L. americanus</i>	3	6	reticulate	prolate spheroidal	31.19 (28-36) x 27.50 (24-30)	30-38 (29-37)
<i>Mentha piperita</i> cv. Mitcham	3	6	reticulate			19.44-32.40
	3	8	reticulate			28.35-48.60
	3	10	reticulate			40.50-48.60
		12	reticulate			43.74-52.65
<i>M. piperita</i> cv. Mitcham (irradiated)	3	6	reticulate			21.06-24.30
	3	8	reticulate			28.35-56.70
	3	10	reticulate			
		12 or more				
<i>M. piperita</i> cv. Mitcham (colchicine)	3	8	reticulate	subprolate	48.6 x 36.45 (one grain)	36.26-69.85
		9				46.98 (three grains)
<i>M. piperita</i> cv. Mitcham x <i>M. crispa</i>	6	6	reticulate	prolate	28.39 x 24.91	30.03
<i>M. gentilis</i>	6	6	reticulate	spheroidal		
	8	8	reticulate	subprolate	44.55 x 26.45 (few grains) ^{12/}	27.94 (24-31) 24-30
	10	10	reticulate			37-40
<i>M. arvensis</i> subsp. canadensis	3	6	reticulate	subprolate	38.07 (34-51) x 31.75 (29-35)	35.88 (34-41)
<i>Collinsonia canadensis</i>	3	6	reticulate	subprolate	42.38 (36-48) x 35.73 (32-41)	41.74 (36-45)

^{12/} This plant specimen also has pollen grains between 10 and 16 microns which are hexacolpate.

Table II. Documentation of Pollen Grain Studies

Species	Collector & No.	Herbarium	Slide No.	Condition of Plant: Fresh (F) or Herbarium (H)	Preparation: Acetocarmine (A) Acetylation (B)	Plate No. & Fig. No.
<i>Acinos arvensis</i>	Farwell 6375	GH	75	H	A	Pl. IX, Fig. 30
	Marshall 390	MSC	49	H	B	Pl. III, Fig. 7
<i>Agastache nepetoides</i>	Parmelee 2917	MSC	21	H	AB	Pl. I, Fig. 2
<i>A. scrophulariaefolia</i>	Dodge (in August 1897)	GH	65	H	A	Pl. III, Fig. 8
	Parmelee 3280	MSC	36	H	B	Pl. II, Fig. 2
<i>Ajuga reptans</i>	Haslick (in May 1953)	MSC	9	H	A	Pl. IX, Fig. 27
	(in Beal-Garfield Botanic Garden)		4	F	AB	Pl. I, Fig. 8; Pl. IX, Fig. 28
<i>Blephilia ciliata</i>	Hermann 6810	MSC	37	H	AB	
<i>B. hirsuta</i>	Parmelee 1564	MSC	27	H	A	
<i>Calamintha glabella</i> var. <i>angustifolia</i>	Gates 13822	GH	74	H	B	Pl. X, Fig. 31
	Drew M320	MSC	51	H	AB	Pl. I, Fig. 9; Pl. X, Fig. 33
<i>Clinopodium vulgare</i>	Waterman 282	MSC	10	F	A	Pl. XV, Fig. 47
<i>Collinsonia canadensis</i>	Bailey (in August 1880)	GH	81	H	B	Pl. IV, Fig. 11
	Parmelee 438	MSC	28	H	A	Pl. V, Fig. 16
<i>Dracocephalum parviflorum</i>	Hermann 6836	GH	63	H	AB	Pl. IV, Fig. 9
	(anon. in June 1888)	MSC	24	H	AB	Pl. IX, Fig. 29
<i>Galeopsis tetrahit</i>	Ehlers 195	GH	67	H	AB	Pl. XI, Fig. 34
	Parmelee 2022	MSC	25	H		
<i>Glechoma hederacea</i>	Marshall 47	MSC	5a	H		
<i>Hedeoma hispida</i>	Chandler (in July 1916)	MSC	38	H		
<i>H. pulegioides</i>	Pepoon 298	MSC	30	H		
<i>Hyssopus officinalis</i>	Bradford (in July 1896)	MSC	29	H		

Table II. Documentation of Pollen Grain Studies (continued)

Species	Collector & No.	Herbarium	Slide No	Condition of Plant: Fresh (F) or Herbarium (H)	Preparation: Acetocarmine (A) Acetylation (B)	Plate No. & Fig. No.
<i>Lamium album</i>	(in Beal-Garfield Botanic Garden)		7	F	B	Pl. VI, Fig. 17
<i>L. simplexicaule</i>	Waterman 268	MSC	1	H	A	
			89	H	B	
<i>L. maculatum</i>	Ranson (in May 1894)	MSC	94	H	AB	Pl. I, Fig. 5
<i>L. purpureum</i>	Ehlers (in May 1920)	MSC	68	H	A	Pl. VI, Fig. 18
	Waterman 247	MSC	11	F	B	Pl. V, Fig. 14
<i>Leonurus cardiaca</i>	Byer 5725	MSC	3	F	AB	Pl. V, Fig. 15
<i>L. marrubiastrum</i>	Parmelee 3293	MSC	39	H	AB	Pl. I, Fig. 10
<i>Lycopus americanus</i>	Gleason & Gleason 176	GH	78	H	A	Pl. XII, Fig. 38
	McDonald 5137	MSC	32	H	B	Pl. XII, Fig. 40
	Hyypio 141	MSC	41	H	B	Pl. I, Fig. 11
<i>L. asper</i>	Dodge 37	GH	82	H	A	Pl. XII, Fig. 39
	McDonald 5386	MSC	40	H	AB	
<i>L. rubellus</i>	Dodge (in August 1893)	MSC	103	H	A	
	Dodge (in August 1898)	GH	100	H	B	
<i>L. uniflorus</i>	Hermann 6385	GH	77	H	A	
	McDonald 5561	MSC	42	H	B	Pl. XII, Fig. 41
<i>Marrubium vulgare</i>	Pepoon 74	MSC	20	H	AB	Pl. III, Fig. 6
<i>Mentha arvensis</i> subsp. canadensis	Lansing 3243	GH	79	H	A	Pl. I, Fig. 12
	DiAngelo B78	MSC	44	H	B	Pl. XIII, Fig. 42
<i>M. gentilis</i>	Marshall 153	MSC	45	H	AB	
<i>M. piperita</i> cv. Mitcham	Waterman 285	MSC	57	F	AB	Pl. XIII, Fig. 43
(colchicine treated)	Waterman 286	MSC	15	F	AB	Pl. XIII, Fig. 44
(irradiated)	Waterman 287	MSC	58	F	AB	Pl. I, Fig. 13; Pl. XIV, Fig. 45

Table II. Documentation of Pollen Grain Studies (continued)

Species	Collector & No.	Herbarium	Slide No.	Condition of Plant: Fresh (F) or Herbarium (H)	Preparation: Acetocarmine (A) Acetylation (B)	Plate No. & Fig. No.
<i>M. piperita</i> cv. Mitcham	(in MSU Greenhouse)		17	F	B	Pl. XV, Fig. 46
<i>M. crispa</i>						
<i>Monarda didyma</i>	Dodge (in August 1892)	MSC	46	H	AB	Pl. VIII, Fig. 24
<i>M. fistulosa</i>	Fernald & Pease 3506	GH	59	H	A	Pl. I, Fig. 7
	Wilson 1	MSC	26	H	B	Pl. VIII, Fig. 25
<i>M. media</i>	Dodge (in July 1896)	MSC	90	H	AB	
<i>M. punctata</i> var.	Gleason	GH	73	H	A	
<i>villicaulis</i>	Parmelee & Gilly 1078	MSC	47	H	B	Pl. VIII, Fig. 26
<i>Nepeta cataria</i>	Barlow (in July 1901)	MSC	64	H	A	Pl. I, Fig. 3
	Marshall 98	MSC	22	H	B	Pl. IV, Fig. 3
<i>Physostegia aboriginum</i>	Farwell 5093½	GH	84	H	A	
<i>P. virginiana</i> var.	Ryypio 164	MSC	23	H	AB	Pl. V, Fig. 13
<i>P. virginiana</i>	Farwell 4566	GH	66	H	A	
<i>speciosa</i>	Waterman 447	MSC	102	F	B	
<i>Prunella vulgaris</i>	Hakala (in July 1951)	MSC	2b	H	A	Pl. I, Fig. 4
	Waterman 281	MSC	2a	F	B	Pl. IV, Fig. 12
<i>Pycnanthemum flexuosum</i>	Walpole (in August 1920)	MSC	106	H	A	
	Voss 1058	MICH	98	H	B	
<i>P. pilosum</i>	Farwell 6023	GH	76	H	A	
<i>P. virginianum</i>	Bazuin 22	MSC	48	H	AB	Pl. XI, Fig. 36
	Parmelee 1795	MSC	31	H	AB	Pl. XI, Fig. 37
<i>Salvia azurea</i> var.	Cole (in September 1893)	MSC	91	H	AB	
<i>grandiflora</i>						
<i>S. coccinea</i>	Waterman 448	MSC	12	F	B	Pl. VII, Fig. 23

Table II. Documentation of Pollen Grain Studies (continued)

Species	Collector & No.	Herbarium	Slide No	Condition of Plant: Fresh (F) Herbarium (H)	Preparation: Acetocarmine (A) Acetylation (B)	Plate No. & Fig. No.
<i>S. sylvestris</i>	(in Beal-Garfield Botanic Garden)		9	F	B	Pl. VII, Fig. 22
<i>Satureja hortensis</i>	Bessey & Darlington 3093	MSC	50	H	AB	Pl. X, Fig. 32
<i>Scutellaria elliptica</i> var. <i>hirsuta</i>	Parmelee 1535	MSC	104	H	A	
	Rapp 255	MICH	96	H	B	
<i>S. galericulata</i>	McDonald 5136	MSC	19	H	AB	Pl. II, Fig. 4
<i>S. lateriflora</i>	Gleason & Gleason 273	GH	61	H	A	Pl. I, Fig. 1
	Poltorak 29	MSC	52	H	B	Pl. II, Fig. 5
<i>S. parvula</i>	Smith (in 1877)	GH	62	H	A	
	McVaugh 9162	MICH	97	H	B	
<i>Stachys hispida</i>	Lansing 3262	GH	71	H	A	
	Davis (in July 1892)	MSC	33	H	B	Pl. VI, Fig. 19
<i>S. hyssopifolia</i>	Chaney 102	GH	70	H	A	
	Parmelee 958	MSC	53	H	B	Pl. VI, Fig. 20
<i>S. palustris</i> var. <i>palustris</i>	Gleason 209	GH	69	H	A	Pl. I, Fig. 6
<i>S. palustris</i> var. <i>homotricha</i>	Waterman 409	MSC	101	F	B	
	Marshall 486	MSC	54	H	AB	Pl. VII, Fig. 21
<i>S. tenuifolia</i>	Cooley (in July 1887)	MSC	105	H	A	
<i>Teucrium canadense</i>	Billington (in July 1919)	MICH	95	H	B	
	Parmelee 653	MSC	18	H	A	
	Marshall 730	MSC	55	H	B	Pl. II, Fig. 3
<i>Thymus serpyllum</i>	(anon., Isle Royale, 1946)	MSC	56	H	AB	Pl. XI, Fig. 35
<i>Trichostema brachiatum</i>	Wheeler (in July 1895)	MSC	35	H	AB	Pl. II, Fig. 3

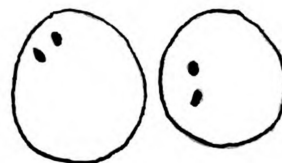
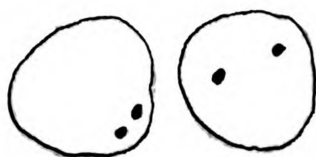
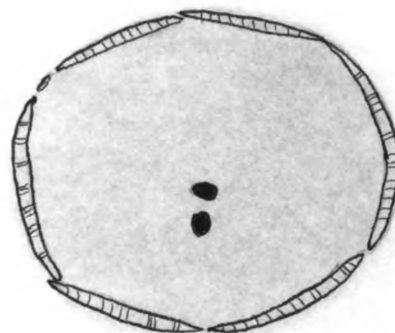
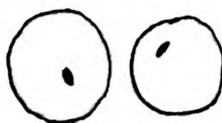
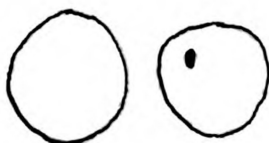
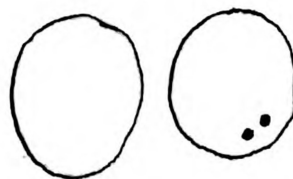
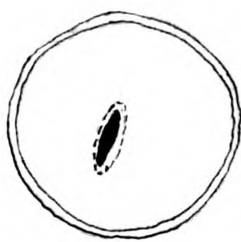
PLATES I-XV

For specimen documentation of pollen grain illustrations, see Table II. All photomicrographs unless otherwise indicated are at a magnification of 1020 X. Each letter (i.e. a, b, etc.) indicates an individual pollen grain for which there may be two or more photomicrographs made at different focal levels (except in illustration 45e).

Plate I

Nuclei in mature pollen grains photographed in glycerine jelly-acetocarmine mixture.

1. Scutellaria lateriflora. Generative nucleus, 8 μ in length; tricolpate pollen grain, 29 μ . Faint outline of generative cell membrane is visible (indicated by dashed line on overlay).
2. Agastache scrophulariaefolia. Two sperm nuclei; hexacolpate; 460 X.
3. Nepeta cataria. Two sperm nuclei; hexacolpate; 460 X
4. Prunella vulgaris. Two sperm nuclei visible in 4b; hexacolpate; 460 X.
5. Lamium purpureum. Generative nucleus visible in 5b; tricolpate; 460 X.
6. Stachys palustris var. palustris. Generative nucleus, tricolpate; 460 X.
7. Monarda fistulosa. Two sperm nuclei, 3 μ in length; hexacolpate, 48 μ x 41 μ .
8. Blephilia hirsuta. Two sperm nuclei; hexacolpate; 460 X.
9. Clinopodium vulgare. Two sperm nuclei; hexacolpate; 460 X.
10. Lycopus americanus. Two sperm nuclei; hexacolpate; 460 X.
11. L. asper. Two sperm nuclei; hexacolpate; 460 X.
12. Mentha arvensis subsp. canadensis. Two sperm nuclei; hexacolpate; 460 X.
13. Mentha piperita cv. Mitcham (irradiated). Two sperm nuclei visible in 13a which is poly- and pancolpate; b-- 12-colpate; c and d-- octacolpate; e-- hexacolpate, without protoplasm; all 460 X.
14. Collinsonia canadensis. Two sperm nuclei; hexacolpate; 460 X.

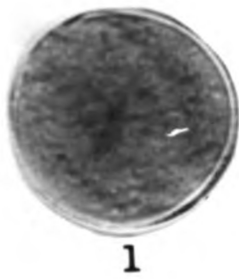


1944

1944

1944

1944



1



2



3



4a



4b



5a



5b



6a



6b



7



8a



8b



9



10



11a



11b



12



13a



13b



13c



13d 13e



14

PLATE I

Plates II-XV

Acetylated pollen grains (some also chlorinated, i.e. bleached).

Plate II

1. Teucrium canadense. Tricolpate; a-- oblique equatorial surface, exine reticulate; a'-- mid-optical section of same, 35 μ x 32 μ ; b-- oblique optical section of polar view, 34 μ x 34 μ ; b'-- surface view of same, showing ragged colpi margins; c-- polar surface; c'-- mid-optical section of same showing thick exine.
2. Ajuga reptans. Tricolpate; a-- optical section of polar view, 28 μ ; b-- mid-optical section of equatorial view just below surface, 28 μ x 24 μ ; c-- surface view of equatorial plane showing ragged colpus margin.
3. Trichostema brachiatum. Tricolpate; all equatorial views; a-- 44 μ x 34 μ ; b-- 42 μ x 32 μ ; c-- 45 μ x 32 μ . Second-largest-grained species of the tricolpate species.
4. Scutellaria galericulata. Tricolpate; a-- oblique polar view, fine reticulate; a'-- mid-optical section of same, 25 μ ; b and b'-- equatorial views slightly below the surface, 25 μ x 21 μ ; c and c'-- equatorial mid-optical sections, 25 μ ; d-- oblique polar view slightly below the surface; d'-- mid-optical section of same, 22 μ x 21 μ .

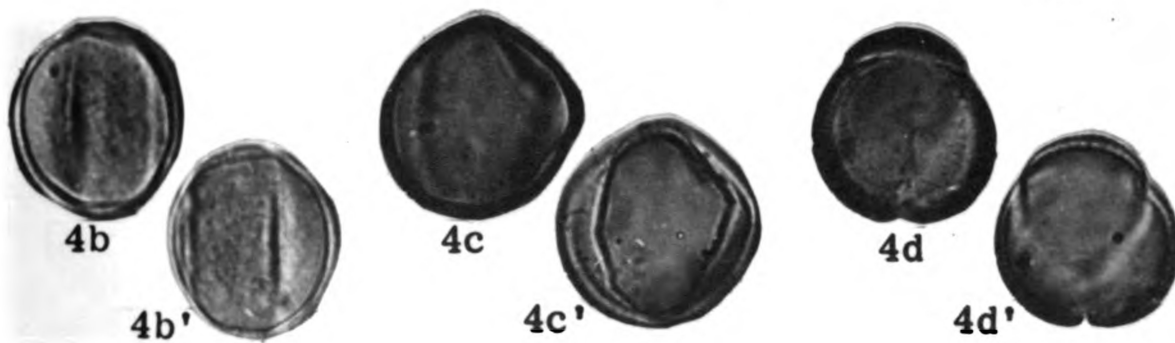
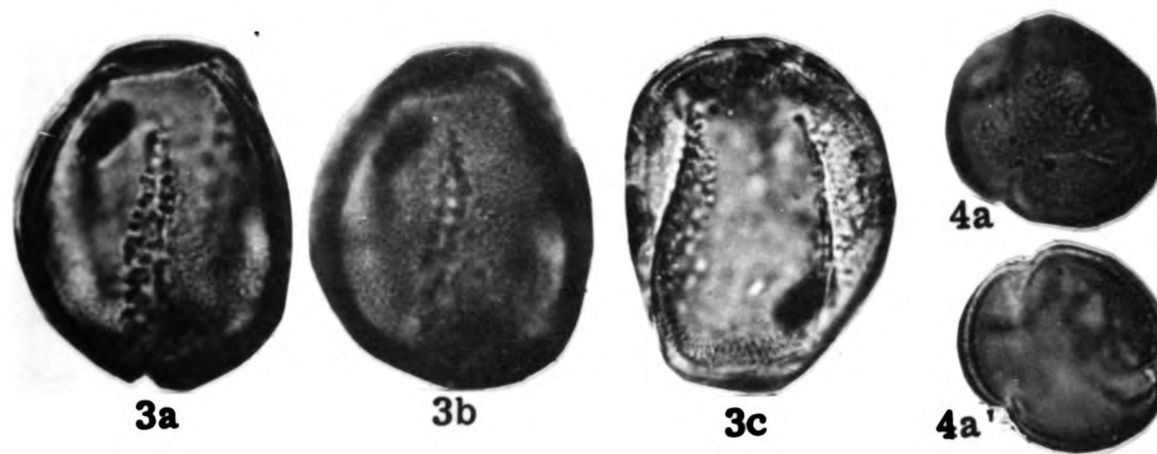
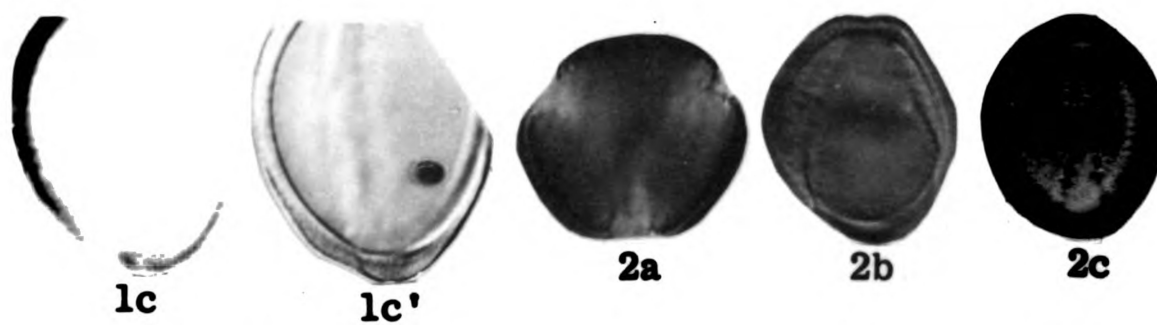
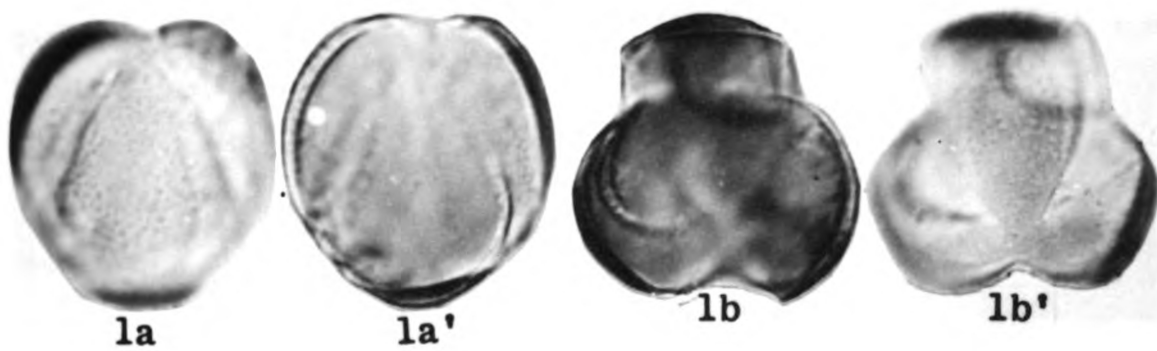


PLATE II

Plate III

5. Scutellaria lateriflora. Tricolpate; faintly reticulate; a-- equatorial view, $29\mu \times 24\mu$; b-- equatorial view $31\mu \times 24\mu$.
6. Marrubium vulgare. Tricolpate, reticulate, muri seemingly larger than lumina, walls thick; a-- mid-optical section of polar view, 26μ ; a'-- polar surface; b-- equatorial mid-optical section, $29\mu \times 25\mu$; b'-- equatorial surface.
7. Agastache nepetoides. Hexacolpate, width of exine about 2μ , width of lumina $1-2\mu$, reticulate; a-- polar surface; a'-- polar mid-optical section, $35\mu \times 34\mu$; b-- equatorial view slightly below surface; c-- equatorial surface of collapsed grain; c'-- lower focus of same, $36\mu \times 21\mu$; d-- ruptured pollen grain, 31μ .
8. Agastache scrophulariaefolia. Hexacolpate, reticulate (grains chlorinated), thickness of exine ca. 2μ , width of lumina $2-3\mu$; a-- polar surface; a'-- mid-optical section of same, 36μ ; b-- equatorial view; c-- equatorial view showing 3 narrow colpi, an exceptionally large grain for this species, $42\mu \times 31\mu$.



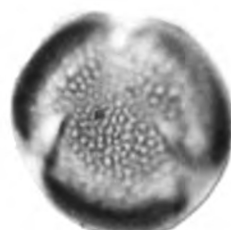
5a



5b



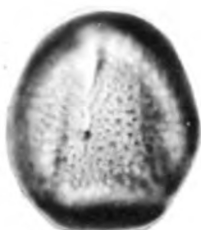
6a



6a'



6b



6b'



7a



7a'



7b



7c



7c'



7d



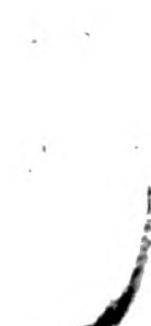
8a



8a'



8b



8c

PLATE III

Plate IV

9. Glechoma hederacea. Hexacolpate, reticulate; a-- polar view, mid-optical section, 52μ ; a'-- polar surface of same; b-- equatorial surface, colpi margins showing granular nature of the exine, $52\mu \times 40\mu$. a-- is an exceptionally flattened grain.
10. Nepeta cataria. Hexacolpate, reticulate; a and a'-- oblique polar sub-surface views, $25\mu \times 23\mu$; b-- subsurface polar view; b'-- mid-optical section of same, $26\mu \times 24\mu$; c-- polar view, grain greatly expanded, 34μ .
11. Dracocephalum parviflorum. Hexacolpate, reticulate, lumina seemingly punctate; a-- equatorial view $40\mu \times 32\mu$; b-- subsurface polar view; b'-- mid-optical section of same, greatly expanded, 46μ ; c-- oblique polar view.
12. Prunella vulgaris. Hexacolpate, reticulate; a-- polar view; a'-- mid-optical section of same, $38\mu \times 36\mu$; b-- equatorial surface showing ragged colpus margin; b'-- mid-optical section of same, $39\mu \times 33\mu$.

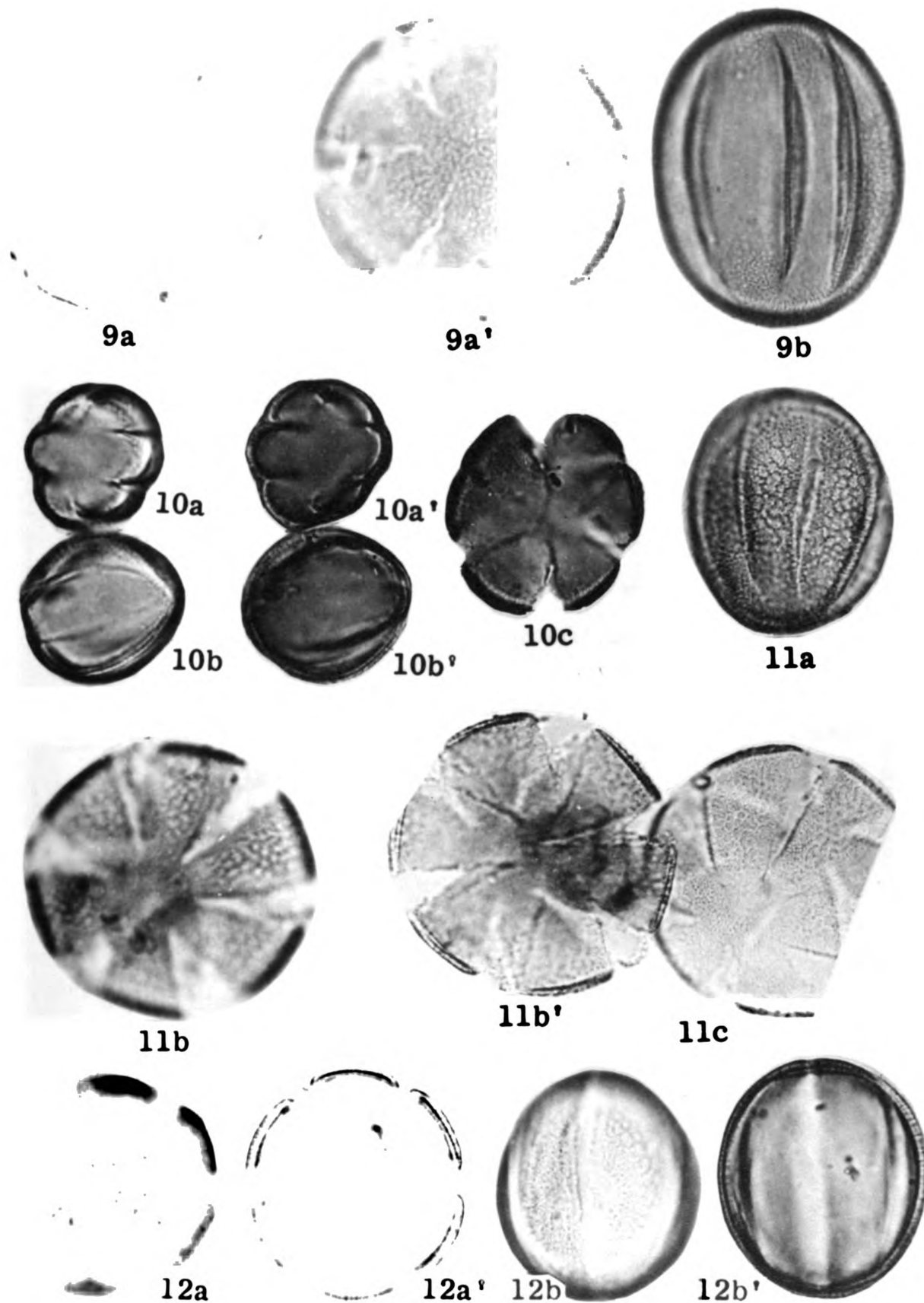


PLATE IV

Plate V

13. Physostegia virginiana var. virginiana. Tricolpate, reticulate pattern very large, 2 to 4 microns; a-- polar surface, colpi nearly meeting, broken, perhaps caused by acetylation; a'-- mid-optical section of same; b, c, and d-- 460 X. Largest-grained species of the tricolpate species.
14. Leomurus cardiaca. Tricolpate, fine reticulate; a-- equatorial surface; a'-- optical section of same, 21 μ x 18 μ ; b and b'-- mid-optical section and surface of oblique polar view, 19 μ ; c and c'-- mid-optical section and surface of oblique equatorial view.
15. Leomurus marrubiastrum. Tricolpate, fine reticulate; a-- surface polar view; a'-- subsurface optical section of same, 26 μ x 24 μ ; b-- polar surface; b'-- mid-optical section of same, 21 μ .
16. Galeopsis tetrahit. Tricolpate, reticulate; a-- oblique polar surface; a'-- mid-optical section of same, 35 μ x 43 μ ; b-- equatorial surface, 37 μ x 31 μ .

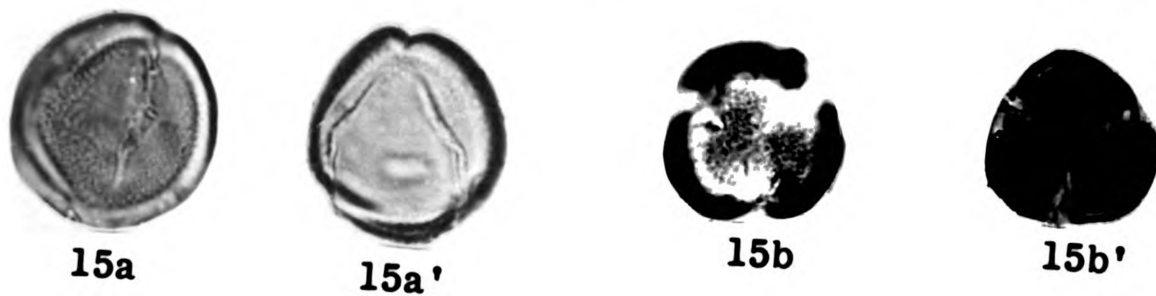
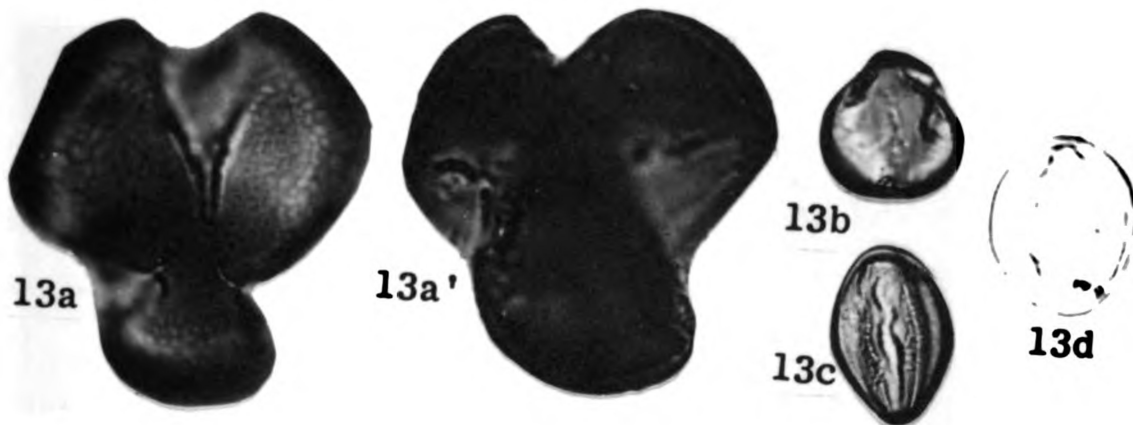


PLATE V

Plate VI

17. Lemium album. Tricolpate, psilate; a-- polar view, 25 μ x 23 μ ;
b, c, d, and e-- equatorial views, each showing one colpus.
18. Lemium purpureum. Tricolpate, fine reticulate, thin exine;
a-- equatorial subsurface; a'-- mid-optical section of same,
35 μ ; b-- equatorial subsurface, 35 μ x 27 μ .
19. Stachys hispida. Tricolpate, reticulate; a-- equatorial sub-
surface view, 33 μ x 22 μ ; b-- polar surface; b'-- mid-optical
section of same, 29 μ ; c and c'-- surface and mid-optical views;
d and d'-- mid-optical and surface equatorial views.
20. Stachys hyssopifolia. Tricolpate, fine reticulate; a-- equatorial
surface; a'-- mid-optical section of same, 25 μ ; b-- equatorial
subsurface, c-- equatorial subsurface, 30 μ x 22 μ .



17a



17b



17c



17d



17e



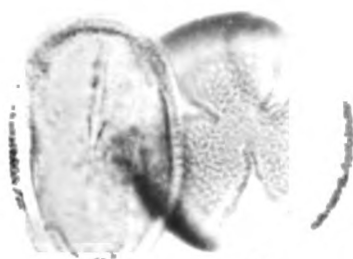
18a



18a'

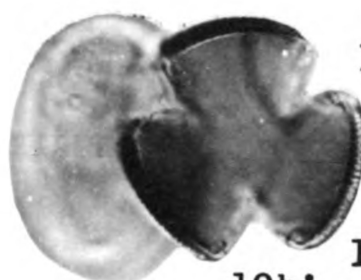


18b



19a

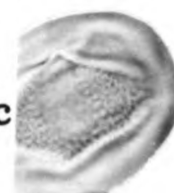
19b



19a'

19b'

19c



19c'

19d



19d'



20a



20a'



20b



20c



PLATE VI

Plate VII

21. Stachys palustris var. homotricha. Tricolpate, fine reticulate; a-- oblique polar surface; a'-- mid-optical section of same, 26 μ ; b-- equatorial surface; b'-- mid-optical section of same, 26 μ x 23 μ ; c-- equatorial surface; c'-- mid-optical section of same.
22. Salvia sylvestris. Hexacolpate, reticulate; a-- subsurface section of polar view, ca. 44 μ ; b-- subsurface section of equatorial view; 460 X.
23. Salvia coccinea. Hexacolpate, reticulate, oblate (i.e. the equatorial axis is greater than the polar diameter); a-- subsurface section of polar view; b-- equatorial surface showing 3 colpi, grain ca. 40 μ x 54 μ ; c-- subsurface section of equatorial view; 460 X.
24. Monarda didyma. Hexacolpate (occasional octacolpate grains are found in the same specimen), reticulate, largest-grained species; a-- oblique polar surface; a'-- mid-optical section of same, 53 μ x 59 μ ; c-- subsurface section of octacolpate grain, 59 μ x 63 μ .

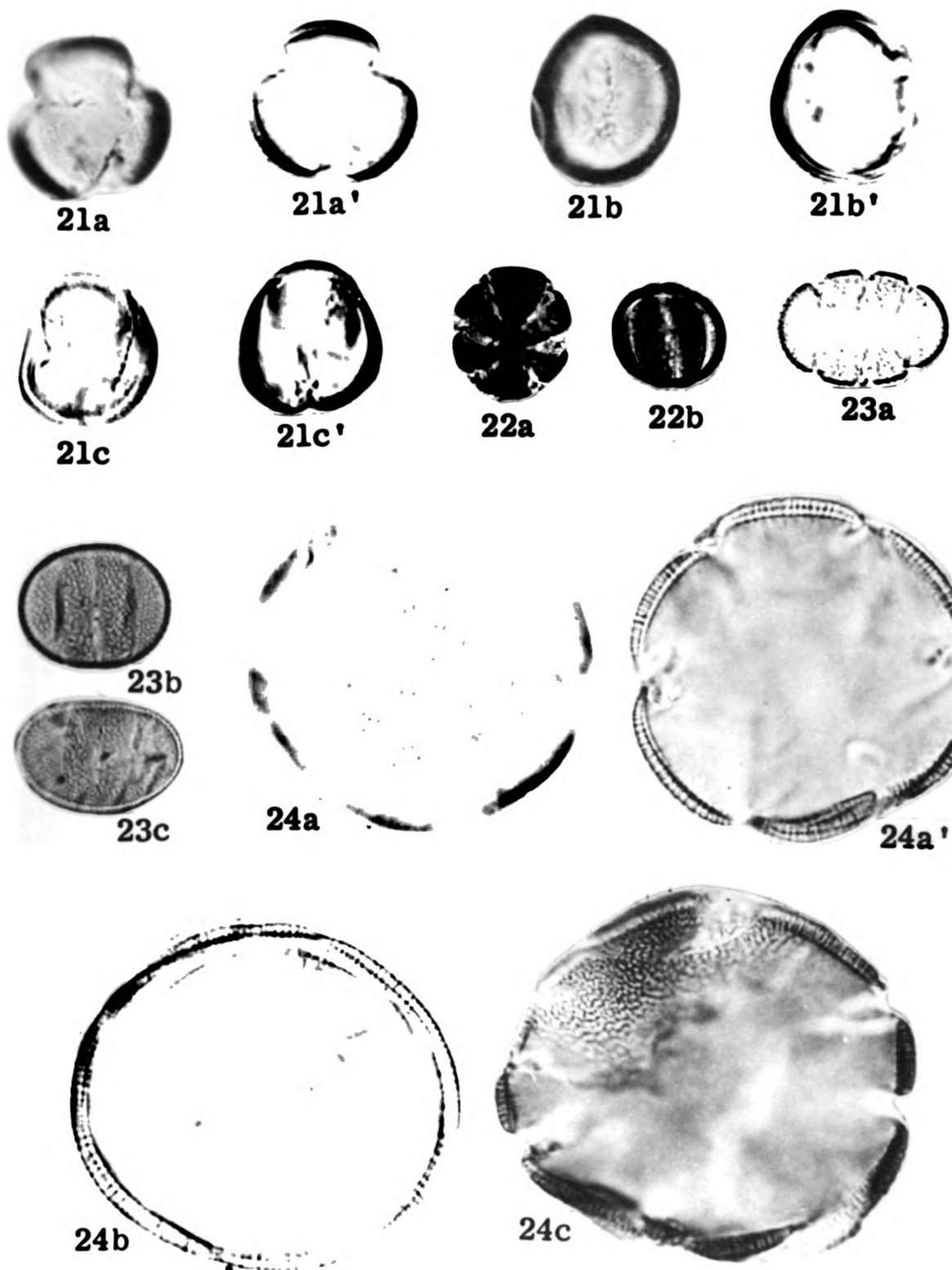


PLATE VII

Plate VIII

25. Monarda fistulosa. Hexacolpate, reticulate; a-- oblique polar view; a'-- mid-optical section of same, 49 μ ; b-- equatorial surface; b' and b''-- mid-optical section and subsurface of same.
26. Monarda punctata var. villicaulis. Hexacolpate, reticulate; a-- polar view, faint bumpy texture in region of the colpi; a'-- mid-optical section of same, pollen grain at a slightly oblique angle, 46 μ ; b-- equatorial mid-optical section, 47 μ x 37 μ .



25a



25a'



25b



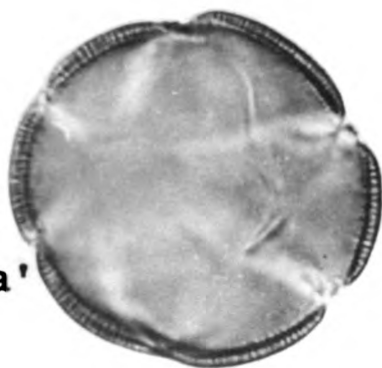
25b'



25b''



26a



26a'

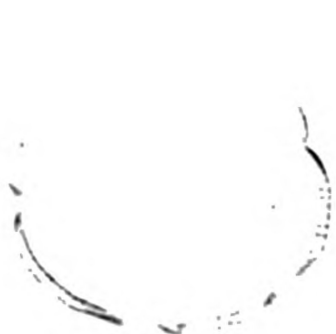


26b

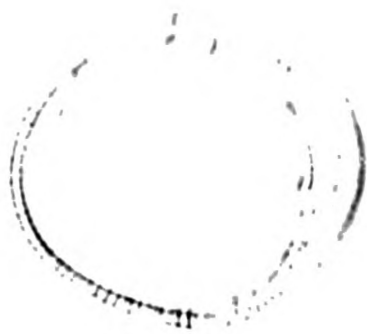
PLATE VIII

Plate IX

27. Blephilia ciliata. Hexacolpate, reticulate; a-- subsurface optical section in polar view, 42 μ ; b-- mid-optical section of equatorial view, 40 μ x 45 μ ; c and d-- same pollen grains as a-- and b--, 460 X.
28. Blephilia hirsuta. Hexacolpate, reticulate; a-- surface of polar view, a'-- mid-optical section of same, 36 μ ; b-- subsurface section of equatorial view, 39 μ x 30 μ .
29. Hedeoma hispida. Hexacolpate, reticulate; a-- surface of polar view; a'-- mid-optical section of same, 43 μ .
30. Acinos arvensis. Hexacolpate, reticulate; a-- surface of oblique polar view; a'-- mid-optical section of same, 39 μ ; b-- subsurface section in equatorial view, 34 μ x 32 μ .



27a



27b



27c



27d



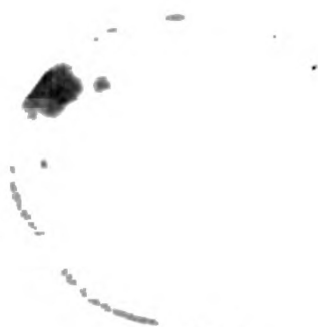
28a



28a'



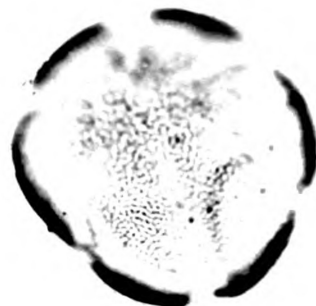
28b



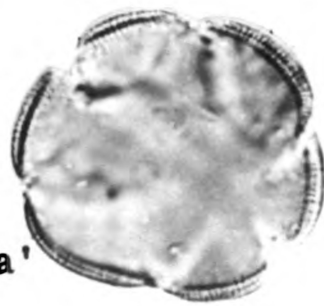
29a



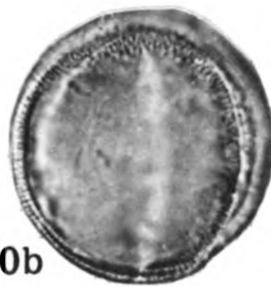
29a'



30a



30a'

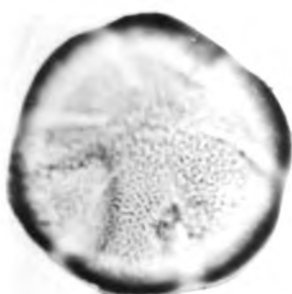


30b

PLATE IX

Plate X

31. Calamintha glabella var. angustifolia. Hexacolpate, reticulate; a-- surface in polar view; b-- subsurface section in polar view; 40 μ x 38 μ ; c-- mid-optical section of equatorial view, 34 μ x 38 μ .
32. Satureja hortensis. Hexacolpate (occasional octacolpate grains from the same specimen), reticulate; a-- oblique polar view; a'-- mid-optical section of same, 32 μ x 31 μ ; b-- equatorial view; b'-- mid-optical section of same, 35 μ x 31 μ ; c-- octacolpate grain, polar view; c'-- mid-optical section of same, 39 μ x 38 μ .
33. Clinopodium vulgare. Hexacolpate, reticulate; a-- oblique polar view; a'-- mid-optical section of same, 36 μ ; b-- polar view; b'-- mid-optical section of same, 33 μ x 34 μ .



31a



31b



31c



32a



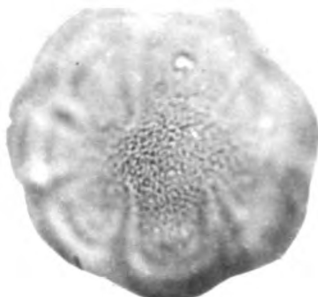
32a'



32b



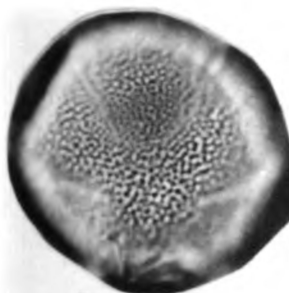
32b'



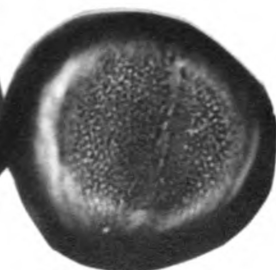
32c



32c'



33a



33b



33a'



33b'

Plate XI

34. Hyssopus officinalis. Hexacolpate, reticulate; subsurface section in equatorial view; pollen grain ruptured.
35. Thymus serpyllum. Hexacolpate, reticulate; surface section of oblique polar view; a'-- mid-optical section of same, $34\mu \times 30\mu$; b-- equatorial mid-optical section, $39\mu \times 24\mu$; b'-- surface view of same slightly collapsed grain; c-- subsurface polar view; d-- subsurface equatorial view, $26\mu \times 23\mu$.
36. Pycnanthemum virginianum (slide no. 48). Hexacolpate, reticulate; a-- surface of oblique polar view; a'-- mid-optical section of same, 34μ ; b-- surface of equatorial view, faint bumpy texture in the region of the colpi; b'-- mid-optical section of same, $40\mu \times 32\mu$.
37. Pycnanthemum virginianum (slide no. 31). Hexacolpate (occasional octacolpate grains from the same plant), reticulate; a-- surface of polar view; a'-- mid-optical section of same, 44μ ; b-- octacolpate grain, subsurface polar view, 42μ .

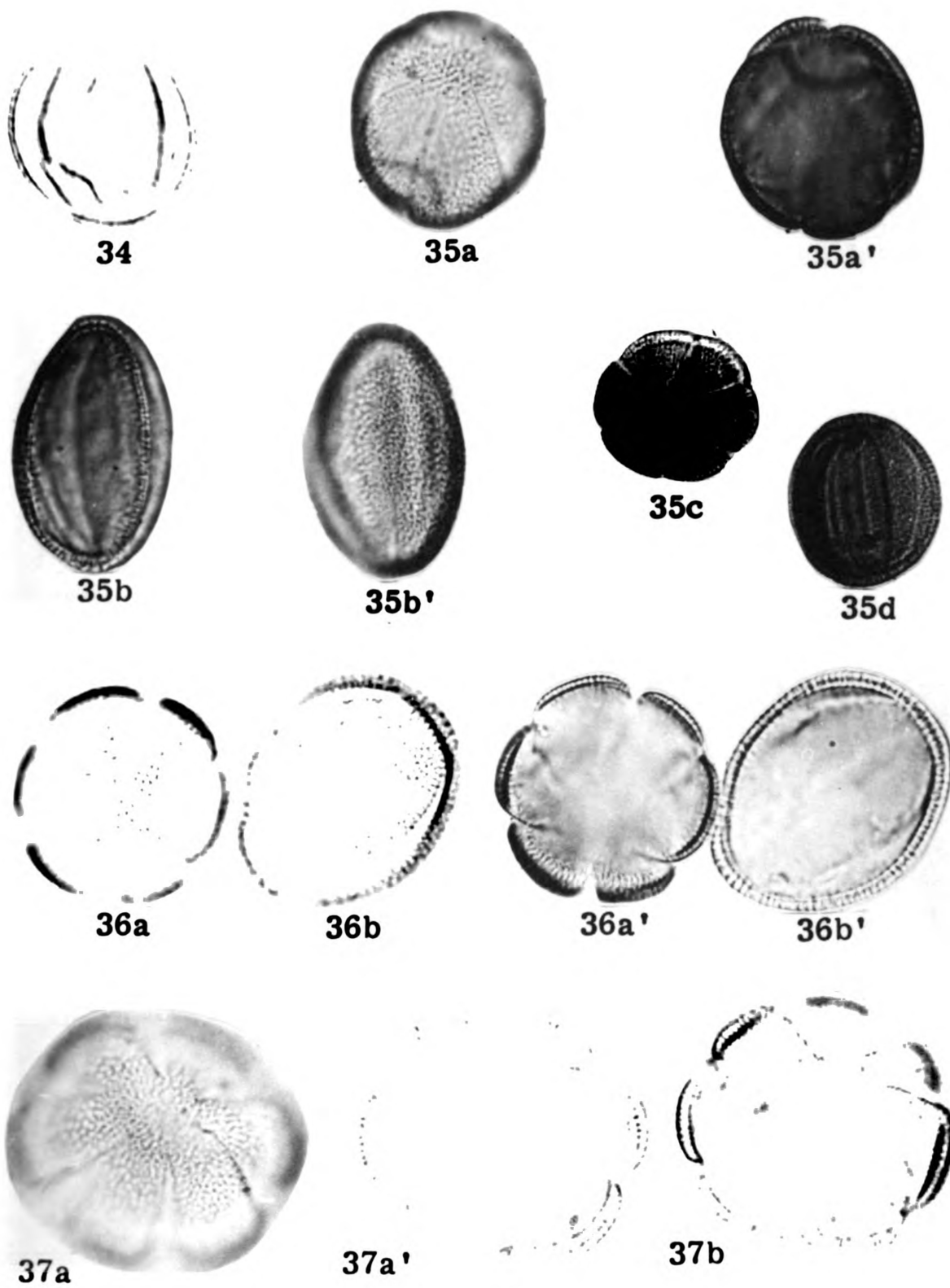
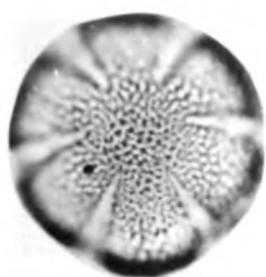


PLATE XI

Plate XII

38. Lycopus americanus (slide no. 32). Hexacolpate, reticulate; a-- surface of polar view; a'-- mid-optical section of same, 34 μ ; b-- mid-optical section in equatorial view, 29 μ x 29 μ .
39. Lycopus asper. Hexacolpate (occasional octacolpate grains from the same plant), reticulate; a-- subsurface in polar view; a'-- mid-optical section of same, 38 μ ; b-- mid-optical section in polar view, 38 μ x 34 μ ; b'-- subsurface of same; c-- octacolpate grain, mid-optical section in oblique polar view. 460 X.
40. Lycopus americanus (slide no. 41). Hexacolpate, reticulate; a-- polar surface; a'-- mid-optical section of same (double exposure), 32 μ ; b-- equatorial surface, 34 μ x 24 μ ; c and d-- equatorial and polar mid-optical sections, 460 X.
41. Lycopus uniflorus. Hexacolpate, reticulate; a-- mid-optical section in oblique polar view, 29 μ ; a'-- subsurface of same; b and b'-- two different optical sections, 27 μ x 27 μ .



38a



38a'



38b



39a



39a'



39b



39b'



39c



40a



40a'



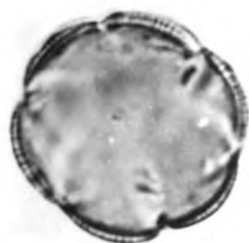
40b



40c



40d



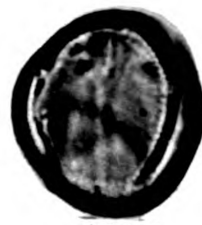
41a



41a'



41b



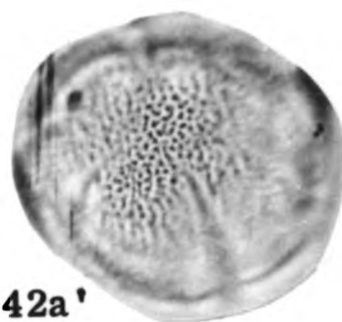
41b'

Plate XIII

42. Mentha arvensis subsp. canadensis. Hexacolpate, reticulate;
a-- mid-optical section of polar view, 37 μ ; surface of oblique
polar view; b and c-- equatorial view, 460 X.
43. Mentha piperita cv. Mitcham. Hexacolpate, reticulate grain
(indicated by arrow), ca. 20 μ ; remaining grains are pancolpate,
many are ruptured and collapsed; 460 X.
44. Mentha piperita cv. Mitcham (colchicine treated). Octacolpate,
reticulate; a-- surface of oblique polar view; b-- mid-optical
section of polar view, 53 μ x 51 μ .



42a



42a'



42b



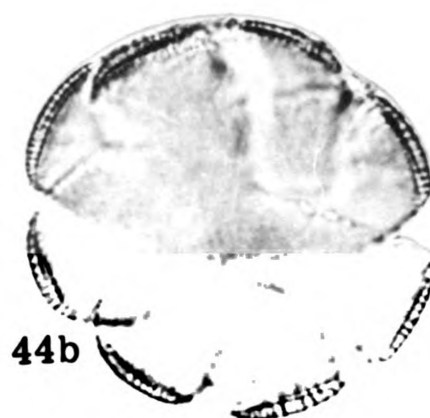
42c



43



44a

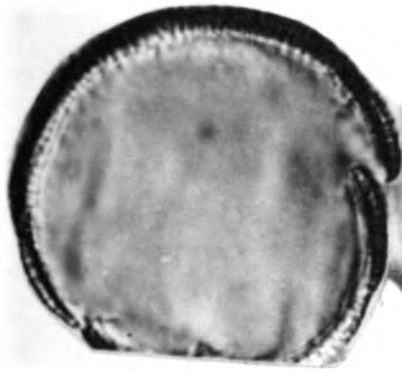


44b

PLATE XIII

Plate XIV

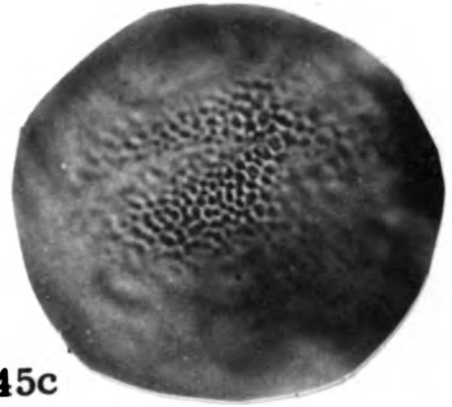
45. Mentha piperita cv. Mitcham (irradiated). Hexa-, octa-, dodeca-, and polycolpate grains, reticulate; a-- optical section, ca. 48 μ ; b-- subsurface view, ca. 35 μ ; c-- surface view; c'-- mid-optical section of dodecacolpate grain, ca. 55 μ ; c''-- subsurface view of same; d-- polar surface of hexacolpate grain; d'-- mid-optical section of same, ca. 33 μ ; e-- microscope field showing variations in number of colpi, arrangement of colpi, and collapsed or deformed grains (note octacolpate grain left of center); 460 X.



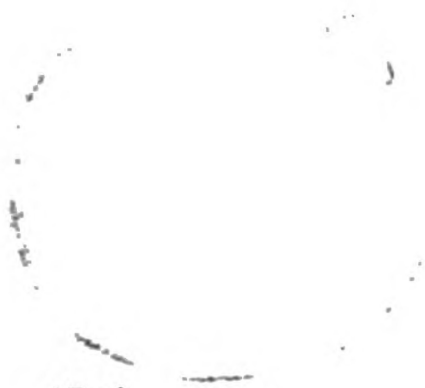
45a



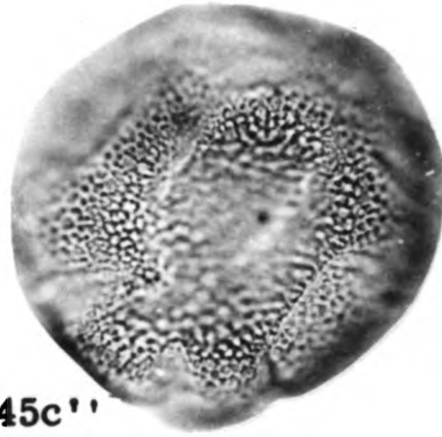
45b



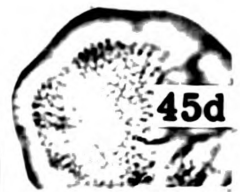
45c



45c'



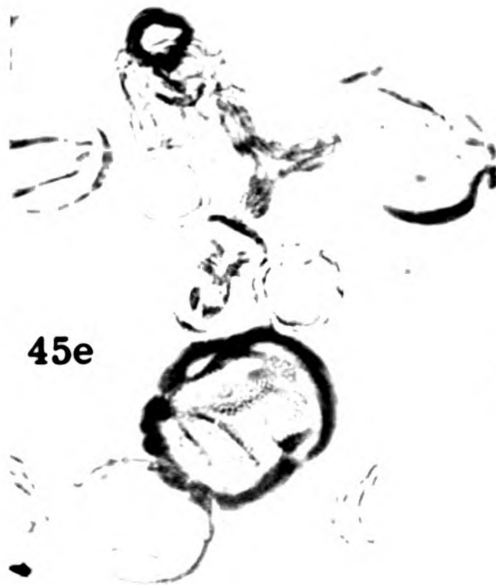
45c''



45d



45d'



45e



PLATE XIV

Plate XV

46. Mentha piperita cv. Mitcham X M. crispa. Hexacolpate, reticulate; ca. $28\mu \times 25\mu$ (equatorial diameter); 460 X.
47. Collinsonia canadensis. Hexacolpate, reticulate, exine shows abrupt thinning near the colpi; a-- oblique polar view; a'-- mid-optical section of same, 42μ ; b and b'-- portion of chlorinated grains; c-- equatorial surface; c'-- mid-optical section of same, $43\mu \times 35\mu$; d, e, and f-- 460 X.

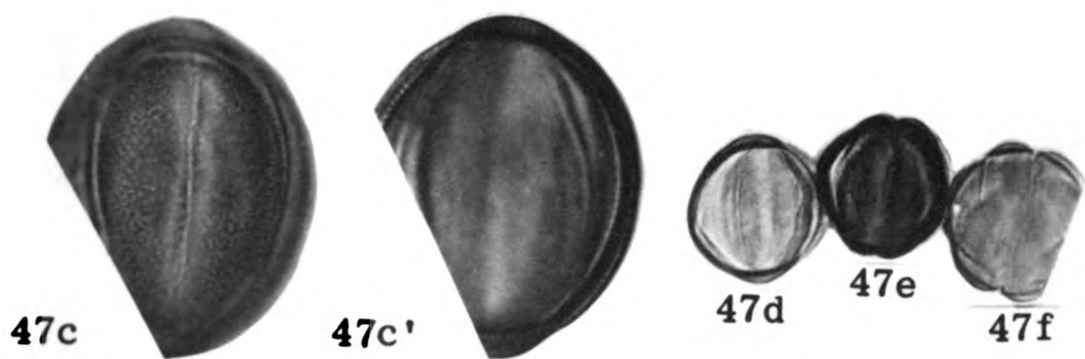
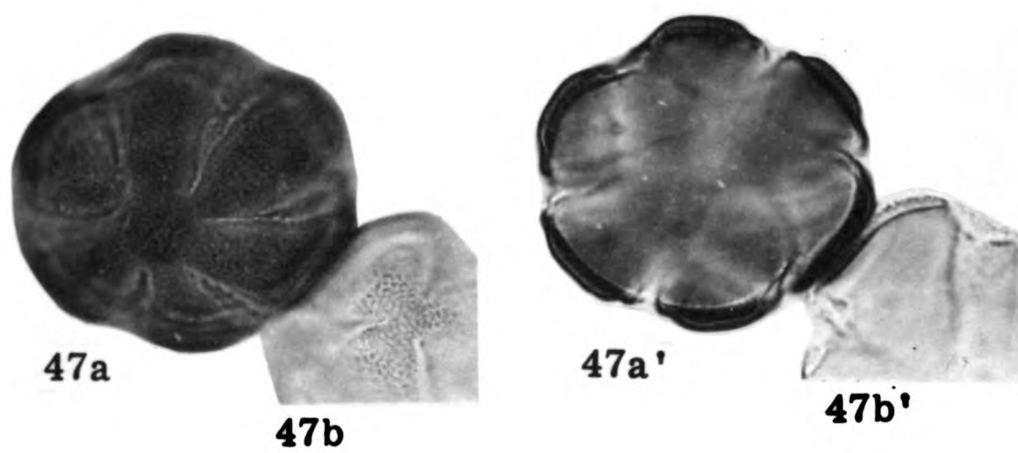
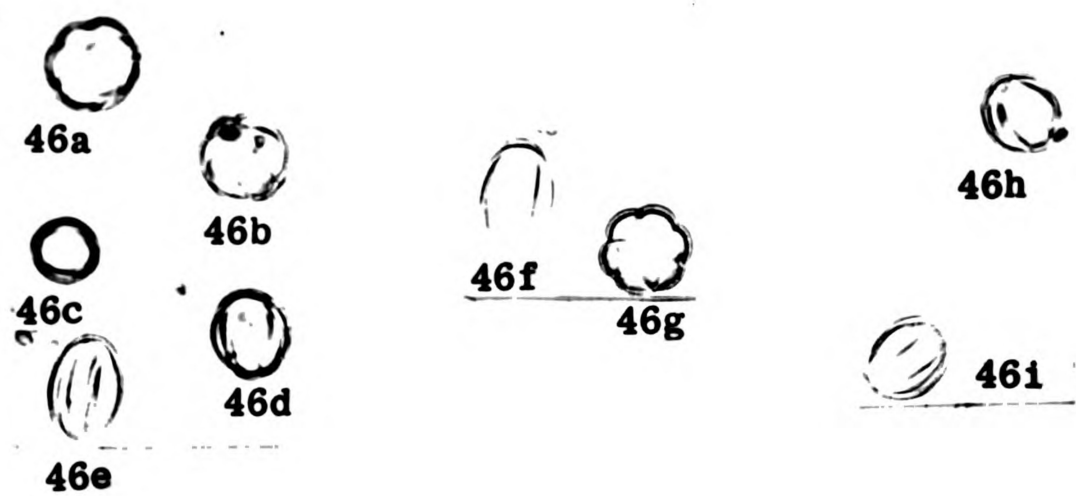


PLATE XV

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