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To the Graduate Council:

I am submitting herewith a dissertation written by Gwynn W. Ramsey entitled "A Biosystematic Study of the Genus Cimicifuga (Ranunculaceae)." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Botany.

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A BIOSYSTEMATIC STUDY OF THE GENUS
CIMICIFUGA (RANUNCULACEAE)

A Dissertation
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

by
Gwynn William Ramsey

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I. INTRODUCTION

During the summer of 1962 a population of Cimicifuga with broad, cordate leaflets on the Clinch River, Knox County, Tennessee, was studied. The biotype studied had been assigned by various authors to two taxa: Cimicifuga cordifolia Pursh and Cimicifuga racemosa (L.) Nutt. var. cordifolia (Pursh) Gray, neither of which had been well understood. The plants of this population were distinctive, and were believed to be neither a variety of Cimicifuga racemosa (L.) Nutt. nor Pursh's species. As a result, these plants were studied and compared with the other two eastern species so that the confusion as to their identity might be resolved and their relationships better understood.

During the course of the first summer's study other problems in the genus were recognized. Further investigations of the literature revealed that the genus has never been subjected to a thorough taxonomic study since its establishment in 1767. It was also observed that descriptions and keys of some entities, both North American and Eurasian, were inadequate. Morphological, cytological, anatomical, ecological, phylogenetic, and phytogeographical relationships between eastern and western North American and between North American and Eurasian species had not been studied extensively. Many of the morphological features which are significant taxonomically had not been illustrated. Cimicifuga and the genus Actaea (Ranunculaceae), Aruncus (Rosaceae), and Astilbe (Saxifragaceae), among others, are often confused when only vegetative parts are available. After reviewing some

of these existing problems it was believed that a systematic treatment of the genus would be worthwhile.

Huth (1892) contributed greatly to the understanding of the genus, which at that time was composed of eight species and a number of subspecific taxa. However, probably because of limited North American material, a number of doubtful entities were included. The genus now has thirteen taxa. The works of Makino (1897, 1952, 1963), Koidzumi (1930), Hara (1943), have contributed to a better understanding of species occurring in Japan. The literature of the 19th and 20th centuries has led to a better understanding of anatomy, morphology, physiology, and drug usage of several entities, especially Cimicifuga racemosa. Contributions of this period include: Jones (1843), Bentley (1860), Lloyd and Lloyd (1886), Bastin (1895), Wintermute (1905), Takeda (1910), Munesada (1931), Macht and Cook (1932), and Youngken (1950). Earle (1938), studied the embryology of Cimicifuga racemosa. Only limited cytological and phylogenetic work has been undertaken (see Section III). Important among floristic works which have treated the genus in North America, are those of: Michaux (1803), Pursh (1814), Torrey and Gray (1840), Robinson in Gray (1895), Fernald (1950), Gleason (1952), Small (1933), Abrams (1944), Kearney and Peebles (1951), and Hitchcock, et al. (1964).

In the present study, an intensive biosystematic investigation of the North American Cimicifuga has been undertaken. An attempt has been made to distinguish clearly the existing species and biotypes. Specimens have been borrowed from a number of major herbaria and

studied. In addition, populations of six of the seven recognized North American taxa have been observed and sampled in the field.

Eurasian Cimicifuga have been studied less intensively because of language difficulties, lack of field data, and number and condition of specimens. Specimens of these exotic species have been borrowed from major North American herbaria and also from herbaria abroad. Attempts to obtain specimens from the Chinese mainland by loan have been unsuccessful.

Some collections possibly important nomenclaturally were not available from Japan.

Descriptions and keys have been made, possible relationships, distribution comparisons, and phytogeographical aspects have been discussed and suggestions for future research proposed. Methods for distinguishing between Cimicifuga and several other genera have been outlined. Thus, several biosystematic techniques, including a biometrical analysis in one instance, have been used in this study.

The abbreviations used to designate the herbaria in which cited specimens are deposited correspond to those used by Lanjouw and Stafleu (1964) as follows: (with exception to APSC, HAM, KS, LYN)

A- Arnold Arboretum, Cambridge, Massachusetts, U.S.A.

APSC - Austin Peay State College, Clarksville, Tennessee, U.S.A.

ARIZ - University of Arizona, Tucson, Arizona, U.S.A.

ASC - Arizona State College, Flagstaff, Arizona, U.S.A.

AUA - Auburn University, Auburn, Alabama, U.S.A.

BR - Jardin Botanique de l'Etat, Bruxelles, Belgium

- BM - British Museum of Natural History, London, Great Britain
- C - Botanical Museum and Herbarium, Copenhagen, Denmark
- CAN - National Museum of Canada, Ottawa, Canada
- CINC - University of Cincinnati, Cincinnati, Ohio, U.S.A.
- DAO - Phanerogamic Herbarium, Plant Research Institute, Central
Experimental Farm, Ottawa, Ontario, Canada
- DPU - T. G. Yuncker Herbarium, Depauw University, Greencastle,
Indiana, U.S.A.
- F - Chicago Natural History Museum, Chicago, Illinois, U.S.A.
- GA - University of Georgia, Athens, Georgia, U.S.A.
- GH - Gray Herbarium of Harvard University, Cambridge,
Massachusetts, U.S.A.
- HAM - Royal Botanical Gardens, Hamilton, Ontario, Canada
- ILL - University of Illinois, Urbana, Illinois, U.S.A.
- IND - Indiana University, Bloomington, Indiana, U.S.A.
- K - The Herbarium and Library, Kew, Great Britain
- KAG - Kagoshima University, Kagoshima, Japan
- KS - Korea University, Seoul, Korea
- KY - University of Kentucky, Lexington, Kentucky, U.S.A.
- LA - University of California, Los Angeles, California, U.S.A.
- LE - Herbarium of the Komarov Botanical Institute, Leningrad,
Russia
- LYN - Lynchburg College, Lynchburg, Virginia, U.S.A.
- MICH - University of Michigan, Ann Arbor, Michigan, U.S.A.
- MO - Missouri Botanical Gardens, St. Louis, Missouri, U.S.A.

NCU - University of North Carolina, Chapel Hill, North Carolina,
U.S.A.

NEBC - The New England Botanical Club, Inc., Cambridge,
Massachusetts, U.S.A.

NY - The New York Botanical Garden, New York, New York, U.S.A.

ORE - University of Oregon, Eugene, Oregon, U.S.A.

OSC - Oregon State University, Corvallis, Oregon, U.S.A.

P - Museum National d'Histoire Naturelle, Paris, France

PENN - University of Pennsylvania, Philadelphia, Pennsylvania,
U.S.A.

PH - Academy of Natural Sciences, Philadelphia, Pennsylvania,
U.S.A.

S - Naturhistoriska Riksmuseum, Stockholm, Sweden

SIU - Southern Illinois University, Carbondale, Illinois, U.S.A.

TAI - Taiwan University, Tapei, Taiwan, China

TENN - University of Tennessee, Knoxville, Tennessee, U.S.A.

TRT - University of Toronto, Toronto, Ontario, Canada

UARK - University of Arkansas, Fayetteville, Arkansas, U.S.A.

UBC - The University of British Columbia, Vancouver, British
Columbia, Canada

UPS - University of Uppsala, Uppsala, Sweden

US - U. S. National Herbarium, Washington, D. C., U.S.A.

VPI - Virginia Polytechnic Institute, Blacksburg, Virginia,
U.S.A.

WIS - University of Wisconsin, Madison, Wisconsin, U.S.A.

WTU - University of Washington, Seattle, Washington, U.S.A.

WVA - West Virginia University, Morgantown, West Virginia,

U.S.A.

II. GENERAL CONSIDERATIONS

The family Ranunculaceae contains many well-known plants such as the shrubby Xanthorhiza (Shrub-Yellowroot), Ranunculus (Buttercup), Clematis (Virgin's Bower), Aquilegia (Columbine), and the dainty Anemone (Windflower). But not one among them is more graceful or striking than the members of the genus Cimicifuga. When in flower these plants are very ornamental, having long racemes of creamy-white flowers on stems three to eight feet high and large decomposed leaves (Lamson-Scribner, 1934). They are among one of the tallest herbaceous plants, and if seen at a distance, when in flower, hint of candelabra.

Cimicifuga is known by a long list of common names, some of which are: Black Snakeroot (Ger. Schwarz Schlangenwurzel; Fr. Racine d'Actee A Grappes), Black Cohosh, Bugbane, Bugwort, Macrotrys, Fairy Candles, Rattleroot, Rattlesnake Root, Rattletop, Rattleweed, Richweed, Serpentry, Squawroot, and Star-Lance.

A Brief Taxonomic History of the Genus Cimicifuga

The generic name, Cimicifuga, was coined by Linnaeus (1750) in Plantae Rariores Camschatcenses, which was reprinted in Amoenitates Academicae (1751). This name is derived from the Latin Cimex (bug) and fugare (to drive away), thus, the common name of Bugbane. Even though Linnaeus did not give a species name, he made particular reference to the Kamchatkan Bugbane, which he listed in the first edition of Species Plantarum (1753) as Actaea cimicifuga. He later changed this to Cimicifuga foetida (1767).

Various members of the genus, as we know them today, were earlier classified under other generic names. Christophoriana was the earliest generic name proposed for the group by Plukenet (1705) and Tournefort (1719). Most pre-Linnaean writers used Tournefort's generic name. Linnaeus (1753) classified Cimicifuga racemosa under Actaea, even though he had already proposed the name Cimicifuga.

Rafinesque (1808) proposed the generic name Macrotrys, meaning "long raceme," which was used later by Eaton (1829). When Eclecticism was popular, Eaton's manual was the accepted textbook of Botany, hence, the early eclectic authorities used the name Macrotrys. This name became firmly established in their literature, during the 19th Century, even though the more modern texts favored the name Cimicifuga. Rafinesque (1818) coined the new generic name Megotrys and in 1828 changed the name to Botrophis, which meant "snake raceme."

Turczaninow, in Fischer and Meyer (1835), proposed Actinospora as a new genus which would include certain scaly-seeded members of the group, while Siebold and Zuccarini (1843) suggested the name Pityroperma, both of which were shifted back again to Cimicifuga by Miquel (1865). Bentham and Hooker (1862-1883) and Robinson in Gray (1895) used Macrotrys and Actinospora as subgenera. Huth (1892) separated the non scaly-seeded forms into the section Eucimicifuga.

Huth (1892) is the only person to work on a revision of the genus on a world-wide basis. His work was concentrated primarily on Eurasian taxa, having only a limited amount of North American material at his disposal. A detailed discussion of the histories of particular species may be found in Section VIII.

Economic Importance

During the nineteenth century, and to a lesser degree in the twentieth century, Cimicifuga was in demand for medicinal purposes, especially Cimicifuga racemosa of Eastern North America. The part of the plant used was the rhizome from which was extracted a drug known as macrotin or cimicifugin. Jones (1843) states, "chiefly used in treatment of rheumatism, dropsy, lung infection, stimulating secretions of the skin and kidneys, chorea, and uterine disorders." However, Macht and Cook (1932) report:

The results of the present investigation afford no scientific basis for the extravagant claims in regard to the therapeutic value of Cimicifuga which are found in some of the old textbooks on medical practice and treatment.

It is probably due to heavy collecting by root collectors, that it has disappeared from many areas of the Eastern United States.

Some species of this genus have been cultivated in wildflower gardens for centuries in both the Old and New World, especially C. foetida, C. japonica, C. racemosa, and C. simplex.

Anatomy

Several authors have been concerned with the internal structures of the rhizomes and roots of a few species of Cimicifuga, but none have made extensive comparisons of interspecific anatomical differences. Gross anatomical differences between the rhizomes of Cimicifuga species have been observed. Typically, the rhizomes possess a pith surrounded with a circle of prominent, woody rays.

Gross differences in root anatomy of two eastern North American

species have been reported. Lloyd and Lloyd (1884) described and illustrated the tissue arrangement in the mature roots of Cimicifuga americana and Cimicifuga racemosa. Bastin (1895) indicates that in the root of Cimicifuga racemosa:

The primary bundle is usually tetrarch or possesses four xylem rays but is sometimes triarch or pentarch. In a section of a mature root the arrangement of xylem elements presents the form of a maltese cross.

This structure is confirmed by Wintermute (1905) and Youngken (1950). The work of the latter three confirms that of Lloyd and Lloyd. The woody tissues in the root of C. americana appear in the form of lunate bundles arranged in a circle. Both Lloyd and Lloyd (1884) and Wintermute (1905) agree on this arrangement.

Careful examination of fifty transverse sections of young and mature roots of Cimicifuga rubifolia revealed that the primary bundles are triarch nearer the distal end of the root and tetrarch nearer the proximal end. This pattern makes it similar to C. racemosa and different from C. americana. However, triarch xylem appears, in many cases, near the proximal end.

Further study and comparison of anatomical features of the roots are considered necessary before a precise statement can be made concerning the significance of these anatomical arrangements in the recognition of Cimicifuga species. Results of present observations and the occurrence of different xylem patterns in the three eastern North American species are enough to suggest that substantial and consistent anatomical differences may be found in these species. Thus, further studies of this nature are being planned.

Munesada (1931) illustrates the xylem arrangement for the mature root of Cimicifuga foetida as tetrarch and states that the vessels appear in four arcs.

Pollen Morphology

Wodehouse (1936) gives a generic description for the pollen grains of Cimicifuga, and Ikuse (1956) describes and illustrates the grains of several Asian species. The grains are oblate-spheroidal, 23-28 μ in diameter, tricolpate, as in C. dahurica, C. foetida, and C. simplex or 6-poly-rugate as in C. acerina (= C. japonica) and C. japonica (= C. biternata). The exine is generally thick, firm, granular, and papillate. The furrows are medium long. The intine is thick, especially in the regions underlying the furrows.

The North American species possess grains measuring 19.0-28.6 μ in diameter. C. rubifolia has much smaller grains, averaging 21 μ or less, and are distinctly tricolpate. The pollen grains of the remaining species usually range from 25.0 - 27.5 μ .

Embryology

Earle (1938) studied the embryology of certain members of the Ranales and published the only work of this nature available on the embryology of Cimicifuga racemosa which he treats specifically. His study indicates that the anatropous ovules lie in two rows parallel to the long axis of the ovulary. The embryo sac is of the Lilium type, containing eight nuclei, and is rhombic in shape as seen in longitudinal section. The endosperm contains oil but no starch. The

embryo consists at first of a globular mass of undifferentiated cells, and the cotyledons arise at the distal end. A massive suspensor develops at the base of the embryo. In the early stages of development the embryology of certain members of the Ranales seems to conform to a general type, closely resembling the condition found in many Monocotyledons; in the Ranunculaceae it is thoroughly dicotyledonous in its later stages.

A Comparison of Vegetative Characteristics of Several Genera with those of the genus Cimicifuga

As previously noted, three genera often confused with the genus Cimicifuga, especially when only foliage is present, are: Actaea (Ranunculaceae), Aruncus (Rosaceae), and Astilbe (Saxifragaceae). If inflorescences or fruits are available one should have little difficulty in distinguishing these genera with the use of present day keys. During the course of this study, comparative notes concerning the vegetative characteristics of these three genera were made; the differences noted are summarized in Table I.

Aruncus can be distinguished from the other three genera by the pinnate venation of the terminal leaflets, since the others have at least three prominent, palmately arranged veins arising at the base of terminal leaflets. The terminal leaflets of Astilbe are comparatively thin, shiny, with long acuminate-caudate lobes, and scabrous, while in the other genera the leaflets are smooth comparatively thick, less shiny or dull, and have acute-acuminate lobes.

Cimicifuga and Actaea are extremely difficult to distinguish in

TABLE I

A COMPARISON OF VEGETATIVE CHARACTERISTICS OF THREE GENERA
WITH THOSE OF THE GENUS CIMICIFUGA

Characteristic	<u>Cimicifuga</u>	<u>Actaea</u>	<u>Astilbe</u>	<u>Aruncus</u>
Family	Ranunculaceae	Ranunculaceae	Saxifragaceae	Rosaceae
No. of terminal leaflet lobes	0-7 (mostly 3)	3	0-3	0
Venation of terminal leaflet	3-7 prominent veins arising basally	3 prominent veins arising basally	3 prominent veins arising basally	pinnate venation
Terminal leaflet pubescence	glabrous-smooth to densely pubescent	glabrous-smooth to scarcely pubescent	scabrous	glabrous-smooth
Terminal leaflet margin	serrate and incised, teeth oriented more toward apex	strongly dentate-serrate, teeth more at right angles to apex	sharply serrate to doubly serrate	coarsely doubly serrate
Color of petiole nodes	darker color than petiole	darker color than petiole	no color difference	no color difference
Usual method of branching	strongly monopodial	not strongly monopodial	strongly monopodial	strongly monopodial
Usual position of the first cauline leaf	near base	distant from base	near base	near base
Habit	relatively large	relatively small	relatively large	relatively large

the absence of reproductive structures even by the professional taxonomist. It is just as hard to describe the subtle differences by which the experienced eye may differentiate between these two genera on the basis of leaf morphology. The habit of Actaea is generally smaller and more delicate in comparison to that of Cimicifuga. Moreover, the teeth of the terminal leaflets of Actaea are usually more nearly at right angles to the apex, the branching habit is not strongly monopodial, and the first cauline leaves are usually distant from the base, while in Cimicifuga the teeth are generally more serrate and oriented toward the apex of the leaflet, the branching habit is strongly monopodial, and the first cauline leaves are near the base. In Actaea, the bracts at the junction of the aerial stem and the rhizome are larger in relation to the size of the aerial stem than those of Cimicifuga.

Because distinctions in vegetative morphology are only subtle between Cimicifuga and Actaea, it is hoped that anatomical investigations planned for the near future will yield more positive discriminating characteristics than those offered here.

Other genera which are occasionally misidentified as Cimicifuga are: Thalictrum (Ranunculaceae), Trautvetteria (Ranunculaceae), and Caulophyllum (Berberidaceae). Both Thalictrum and Caulophyllum, when only vegetative material is available, can be distinguished from Cimicifuga by their smaller leaflets which are entire with rounded lobes. Trautvetteria has large, simple, palmately or pedately incised, broadly reniform and rounded leaves, while the leaves of Cimicifuga are ternately decomound.

III. CYTOLOGICAL CONSIDERATIONS

All available data on chromosomal numbers in the genus Cimicifuga have been summarized (Table II) from Langlet (1927 and 1932), Gregory (1941), Tischler (1950), Darlington and Wylie (1956), Kurita (1956 and 1959), in addition to unpublished results of the author's own cytological investigations. In all investigations the somatic chromosomal number is reported as $2n=16$. In only two reports have gametic chromosomal numbers been given, these being $n=8$.

Evidently, the diploid chromosomal number of the members of the genus is stable, and according to present knowledge polyploid numbers do not exist. Langlet (1927) indicated that Cimicifuga chromosomes are predominately large, always long and bent and called the Ranunculus type (R-type), as opposed to being small and kidney-shaped as in the Thalicttrum type (T-type). Karyotypic analysis has been carried out on a limited number of species (Kurita 1956 and 1959).

In the present study only mitotic material was employed in the cytological investigations on one eastern and one western North American species of Cimicifuga. Exact chromosomal counts and photographs (Fig. 1) were obtained from the smear preparations of root tips from rhizomes growing in greenhouse culture.

Method

The procedure used in the preparation of chromosomes is as follows: Root tips were placed in 0.2 per cent colchicine for three

TABLE II

CHROMOSOMAL NUMBERS REPORTED FOR TAXA OF THE GENUS CIMICIFUGA

Taxon	Gametic No.	Somatic No.	Author
<u>Cimicifuga</u>			
<u>C. acerina</u> = <u>C. japonica</u>	8		Sugiura 1937
<u>C. acerina</u> var. <u>macrophylla</u> = <u>C. japonica</u>		16	Kurita 1956 & 1959
<u>C. acerina</u> var. <u>peltata</u> = <u>C. japonica</u>		16	Kurita 1956
<u>C. americana</u> = <u>C. americana</u> Muhl. = <u>C. cordifolia</u> Pursh = <u>C. americana</u> Michx.		16	Langlet 1932
<u>C. cimicifuga</u> = <u>C. foetida</u> L.		16	Langlet 1927
<u>C. cordifolia</u> Pursh = <u>C. americana</u> Michx		16	Langlet 1932
<u>C. dahurica</u> = <u>Actinospora dahurica</u> Turez. = <u>C. dahurica</u> Huth = <u>C. dahurica</u> Maxim.		16	Langlet 1932
<u>C. elata</u>		16	Ramsey(unpublished)
<u>C. foetida</u>		16	Lewitsky 1931
<u>C. foetida</u>		16	Langlet 1927 & 1932
<u>C. foetida</u>		16	Nakajima 1933
<u>C. foetida</u> var. <u>intermedia</u> = <u>C. foetida</u>		16	Nakajima 1934
<u>C. japonica</u>		16	Langlet 1932
<u>C. japonica</u>		16	Kurita 1956

TABLE II (continued)

Taxon	Gametic No.	Somatic No.	Author
<u>C. racemosa</u>	8	16	Gregory 1941
<u>C. rubifolia</u>		16	Ramsey (unpublished)
<u>C. simplex</u>		16	Langlet 1932
<u>C. Simplex</u> var. <u>yesoensis</u> = <u>C. simplex</u>		16	Kurita 1959

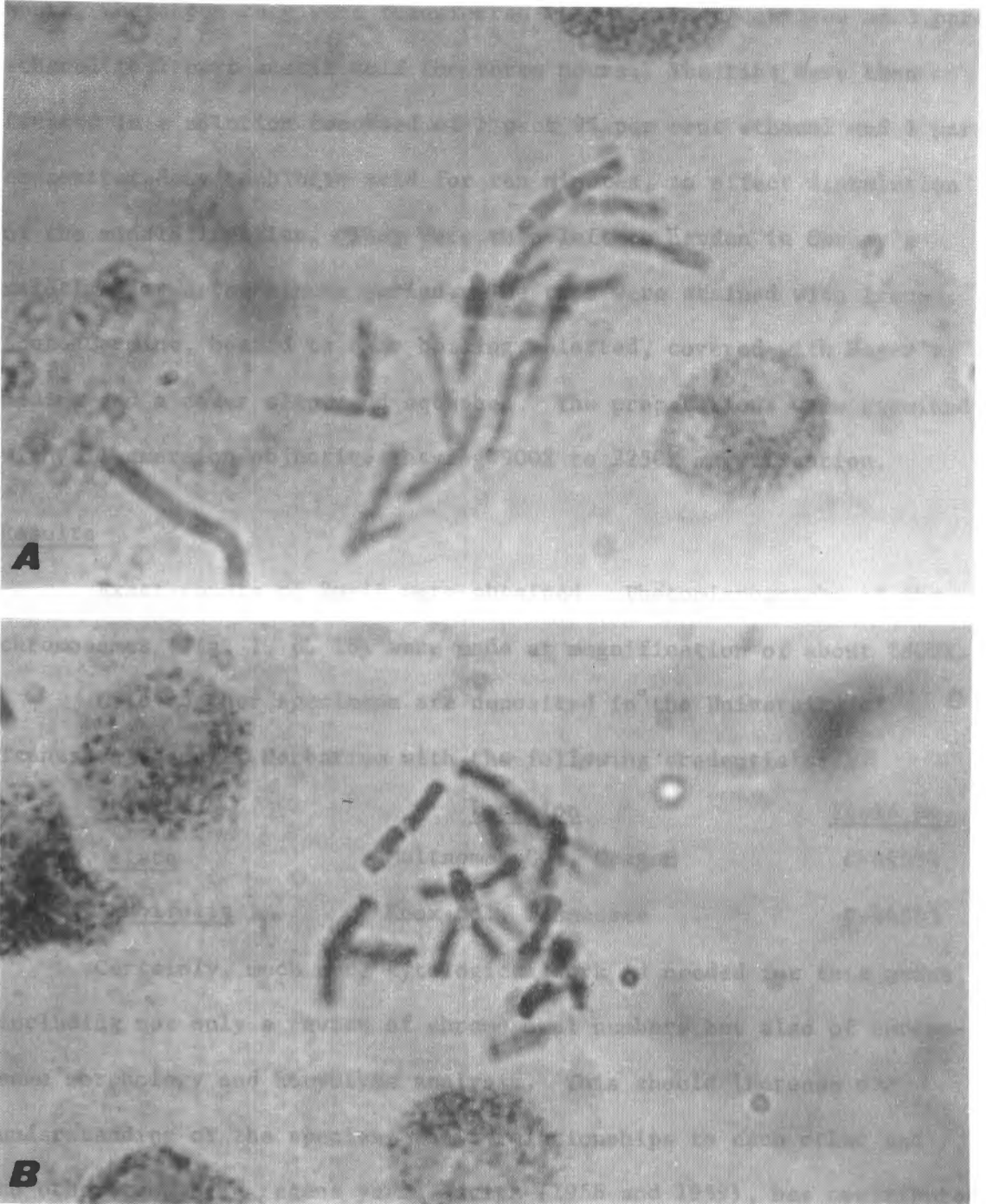


Figure 1. Photographs of Cimicifuga chromosomes. (1800X)

A. C. elata

B. C. rubifolia

hours, whereupon they were transferred to a fixative composed of 3 parts ethanol to 1 part acetic acid for three hours. The tips were then treated in a solution composed of 1 part 95 per cent ethanol and 1 part concentrated hydrochloric acid for ten minutes, to effect dissolution of the middle lamellae. They were then left to harden in Carnoy's solution for a ten minute period. The tips were stained with Iron-Aceto-Carmine, heated to near boiling, blotted, covered with Hoyer's medium and a cover slip, and squashed. The preparations were examined with oil emersion objectives having 900X to 2250X magnification.

Results

Exact counts of $2n=16$ were obtained. Photomicrographs of the chromosomes (Fig. 1, p. 18) were made at magnification of about 1800X.

Cyto-voucher specimens are deposited in the University of Tennessee Vascular Herbarium with the following credentials:

<u>Species</u>	<u>Location</u>	<u>Field No.</u>
<u>C. elata</u>	Multnomah Co., Oregon	C-44554
<u>C. rubifolia</u>	Knox Co., Tennessee	C-44555

Certainly, much more cytological work is needed for this genus, including not only a review of chromosomal numbers but also of chromosome morphology and karyotype analysis. This should increase our understanding of the species, their relationships to each other and to other taxa. In recent years Kurita (1956 and 1959), has contributed much to the understanding of karyotypes through his cytological studies on the Ranunculaceae, including Cimicifuga.

Dr. Hiroshi Hara (personal communication, 1965) of the University

of Tokyo, has advised that one of his students is presently working on the cytotaxonomic relationships of the east Asian Cimicifuga, a work which should be fruitful in contributing to a better understanding of interspecific relationships.

IV. A BIOMETRICAL ANALYSIS OF TERMINAL LEAFLET CHARACTERISTICS FOR THE NORTH AMERICAN CIMICIFUGA

In an effort to further delineate the taxa of North American Cimicifuga the lengths of the stomatal apparatus and the number of stomates per unit area were studied in ten individuals of each taxon. No studies of this nature have been previously published for the genus.

Using the method of Sinclair and Dunn (1961), impressions of the adaxial surface of fresh leaflets were made in Archer's Herbarium Plastic. The plastic layer was peeled from the leaflet surface upon drying and mounted under a cover glass for microscopic study. The length of the stomatal apparatus was measured in microns and the number of stomata per 0.1 mm.^2 (one-tenth of a square millimeter) of leaflet surface was counted, on one plastic peel from each plant. The measurements were made at 1350X magnification and the counts were made at 675X magnification. A total of ten measurements and ten counts were made on each peel, resulting in 100 measurements and 100 counts for each of the six North American species.

The data (i.e., 1200 observations) were subjected to a two-factorial analysis of variance utilizing an IBM 740 Computer. Components of the analysis of variance table were obtained and an F Test performed which indicated a significant difference at the 99 per cent confidence level between several species for stomatal lengths and also in the number of stomata per 0.1 mm.^2

The mean values of 10 measurements of the stomatal apparatus from each of the 10 individuals of all six North American taxa were analyzed for significant differences by the Multiple Range Test proposed by Duncan (1955). The following results were obtained (also see TABLE III):

<u>C. ariz.</u>	<u>C. race.</u>	<u>C. rubi.</u>	<u>C. elata</u>	<u>C. amer.</u>	<u>C. laci.</u>
B	E	F	C	A	D
<u>42.76</u>	<u>43.16</u>	<u>43.21</u>	<u>46.50</u>	<u>47.92</u>	<u>60.59</u>

The mean values of 10 counts of stomates per 0.1 mm.² from each of the 10 individuals of all six North American taxa were analyzed for significant differences by the Duncan's Multiple Range Test. The following results were obtained (also see TABLE IV):

<u>C. laci.</u>	<u>C. amer.</u>	<u>C. elata</u>	<u>C. race.</u>	<u>C. ariz.</u>	<u>C. rubi.</u>
D	A	C	E	B	F
<u>.89</u>	<u>.90</u>	<u>1.17</u>	<u>1.30</u>	<u>1.71</u>	<u>1.72</u>

All means underscored by the same line show no significant differences in lengths of stomatal apparatus or number of stomata per 0.1 mm.² All means not underscored by the same line have significant differences for the two characteristics involved.

The stomatal apparatus of Cimicifuga laciniata is shown to be significantly longer than those of the other North American species. The stomatal lengths of C. americana and C. elata are not significantly different from each other but are from the remaining species. C. arizonica, C. racemosa, and C. rubifolia, have stomates with essentially the same length which is significantly different from

TABLE III.

COMPARISON OF ALL POSSIBLE COMBINATIONS OF MEAN LENGTHS OF THE STOMATAL APPARATUS FOR THE NORTH AMERICAN CIMICIFUGA^a

Taxa Compared	Number of Species in the range	Mean Values	Difference
D-B	6	60.59-42.76	17.83**
D-E	5	60.59-43.16	17.43**
D-F	4	60.59-43.21	17.38**
D-C	3	60.59-46.50	14.09**
D-A	2	60.59-47.92	12.67**
A-B	5	47.92-42.76	5.16**
A-E	4	47.92-43.16	4.76**
A-F	3	47.92-43.21	4.71**
A-C	2	47.92-46.50	1.42*
C-B	4	46.50-42.76	3.74**
C-E	3	46.50-43.16	3.34**
C-F	2	46.50-43.21	3.29**
F-B	3	43.21-42.76	.45
F-E	2	43.21-43.16	.05
E-B	2	43.16-42.76	.40

^aRaw data may be found in Appendix

**Double asterisks indicate a significant difference at ($P > .01$)

*Single asterisks indicate a significant difference at ($P > .05$)

TABLE IV.

COMPARISON OF ALL POSSIBLE COMBINATIONS OF MEAN NUMBERS OF STOMATA PER 0.1 mm^2 FOR THE NORTH AMERICAN CIMICIFUGA^a

Taxa Compared	Number of Species in the range	Mean Values	Differences
F-D	6	1.72- .89	.83**
F-A	5	1.72- .90	.82**
F-C	4	1.72-1.17	.55**
F-E	3	1.72-1.30	.42**
F-B	2	1.72-1.71	.02
B-D	5	1.71- .89	.82**
B-A	4	1.71- .90	.81**
B-C	3	1.71-1.17	.54**
B-E	2	1.71-1.30	.41**
C-D	4	1.30- .89	.41**
E-A	3	1.30- .90	.49**
E-C	2	1.30-1.17	.13
C-D	3	1.17- .89	.28**
C-A	2	1.17- .90	.27**
A-D	2	.90- .89	.01

^aRaw data may be found in Appendix

**Double asterisks indicate a significant difference at ($P > .01$)

that of the other species. Cimicifuga rubifolia can be distinguished from C. americana but not from C. racemosa on the basis of this analysis.

The analysis of the number of stomata shows that C. rubifolia has the greatest number per .1 mm.² but is not significantly different from the stomatal number in C. arizonica. However, these two species are significantly different from the other North American species for this character. C. elata and C. racemosa show no significant differences in number of stomates as is true, also, for C. laciniata and C. americana. On the basis of this analysis C. rubifolia can be distinguished from both C. americana and C. racemosa with which it is often confused. It is interesting to note that an eastern and western North American species have fallen into each of the non-significant categories shown.

The stomates of all six species, discussed here, are of the anomocytic (Ranunculaceous) type.

Measurements of terminal leaflet length, width, and depth of basal sinus have been made on 251 specimens of C. rubifolia, 140 specimens of C. racemosa, and 55 specimens of C. americana. These measurements have been used in an effort to separate further C. rubifolia from the other two eastern North American species.

In 99 per cent of the species identified as C. rubifolia a sinus was present with the depth ranging from 0.2 - 5.5 cm., with most depths being in the 1.5 - 3 cm. range. The mean terminal leaflet length measures 14.4 cm., the mean width 15.6 cm.

In 90 per cent of the specimens identified as C. racemosa there

was no sinus. For those which have a sinus the depth is only 0.2 - 0.5 cm. The terminal leaflet of this species is rarely more than slightly subcordate, if at all. The mean terminal leaflet length measures 10.5 cm., the mean width 8.1 cm.

In 98 per cent of the specimens identified as C. americana there was no sinus. For those which have a sinus the depth is only about 0.5 cm. The terminal leaflet bases of this species are usually sub-cuneate. The mean terminal leaflet length measures 10.4 cm., the width 8.9 cm.

Upon using these characteristics it can be seen that C. rubifolia can usually be separated from the other two species on the basis of basal sinus depth and size of the leaflet which is in direct correlation with its shape. C. americana and C. racemosa cannot be distinguished from each other on the basis of these same characteristics.

Data supporting the inferences and conclusions in this chapter may be found in Tables V to VII in the Appendix.

V. MORPHOLOGICAL CONSIDERATIONS

Comparisons of specimens available, with current descriptions and keys, original descriptions, and field and laboratory observations, indicated that the following characteristics are useful in distinguishing the species: ternateness of the leaves; nature of the petiole sulcus; leaflet number and shape; presence or absence of a basal sinus and number of heavy veins possessed by the terminal leaflet of the central division; number and longevity of sepals; presence or absence of staminodia, their characteristic shapes, and their possession or absence of nectariferous glands; shape, number, and arrangement of bracts relative to the pedicel; shape and number of sessile or stipitate pistils and fruits per flower; pubescence of reproductive and vegetative organs; and seed characteristics. These features were studied intensively for all species. The diagnostic structures which proved most useful in this study have been illustrated (Figs. 2 through 7) and these illustrations serve as reference points for the topical discussions below.

Leaves

The leaves of Cimicifuga japonica and C. biternata are always attached to the base of the aerial stem, whereas, in all the other species, smaller leaves are borne upon the aerial stem toward its apex.

All leaves of this genus are alternately arranged, compound, and may be ternate, biternate, or triternate, and then pinnately

divided. In Cimicifuga japonica the leaves are nearly always ternate, rarely biternate. Cimicifuga biternata and C. rubifolia have biternate leaves but frequently develop the simple ternate form. These three species never develop the triternate leaf form. C. americana usually has triternate leaves. All other species mentioned in this paper have biternate and triternate leaves. Because of these different leaf forms, even within the species, specific names have arisen, such as C. heterophylla (Makino, 1897). These variations in leaf form are considered to be normal within certain species.

The petioles of the basal leaves of all species possess lateral flanges or wings at their base which clasp the stem. The petiole may also bear a sulcus which may be used as a diagnostic characteristic in field recognition of several species. For example, C. americana can be recognized by a deep, broad, sulcus which persists during the enlargement of the petiole, while the shallow, narrow, sulcus of C. racemosa disappears with petiole enlargement. C. rubifolia has a deep, narrow, but hairy sulcus.

The number of leaflets composing a leaf ranges from three to over one hundred. The leaves of C. japonica have three leaflets, rarely more. The leaves of C. rubifolia usually possess three, five, seven, or nine leaflets. Several specimens of this species have been found with leaves containing more than nine leaflets but never more than seventeen. Several of these leaf types may arise from the same rhizome. This type of variation in leaflet number also occurs in C. japonica and C. biternata.

The leaves of C. arizonica and C. elata may occasionally contain only nine leaflets, but the leaf of the former usually possesses between twenty and forty and the latter nine to twenty-seven. The leaves of Cimicifuga laciniata have twenty to thirty-five leaflets. C. racemosa has leaflets numbering from twenty to seventy while those of C. americana may number over one hundred. All other species not specifically mentioned have leaflets numbering into the higher ranges just mentioned.

Terminal Leaflets

The line drawings (Figs. 2 and 3) represent the adaxial surfaces of the terminal leaflets of the central division of leaves, with exception of Fig. 3 A, C, which represent abaxial surfaces. The drawings are of individual specimens considered typical. Primary and secondary venation patterns have been reproduced. The terminal leaflets are diagnostic not only because of general size and shape but also because of morphological features such as number of heavy veins arising basally, and pattern of pubescence.

Terminal leaflets of C. rubifolia and C. elata (Fig. 2 A, F) are very similar to those of C. japonica and C. biternata (Fig. 3 A, C) in being rather deeply cordate with seven to nine heavy veins arising palmately at the base. All other species have leaflets which are rarely cordate but may occasionally be subcordate and have only three heavy veins arising basally with exception to C. heracleifolia (Fig. 3 D) which has five.

The lobes of C. japonica, C. dahurica and C. heracleifolia

FIGURE 2. Drawings of terminal leaflets of North American Cimicifuga.

(natural size)

(A) Cimicifuga rubifolia

(B) Cimicifuga racemosa

(C) Cimicifuga americana

(D) Cimicifuga arizonica

(E) Cimicifuga laciniata

(F) Cimicifuga elata

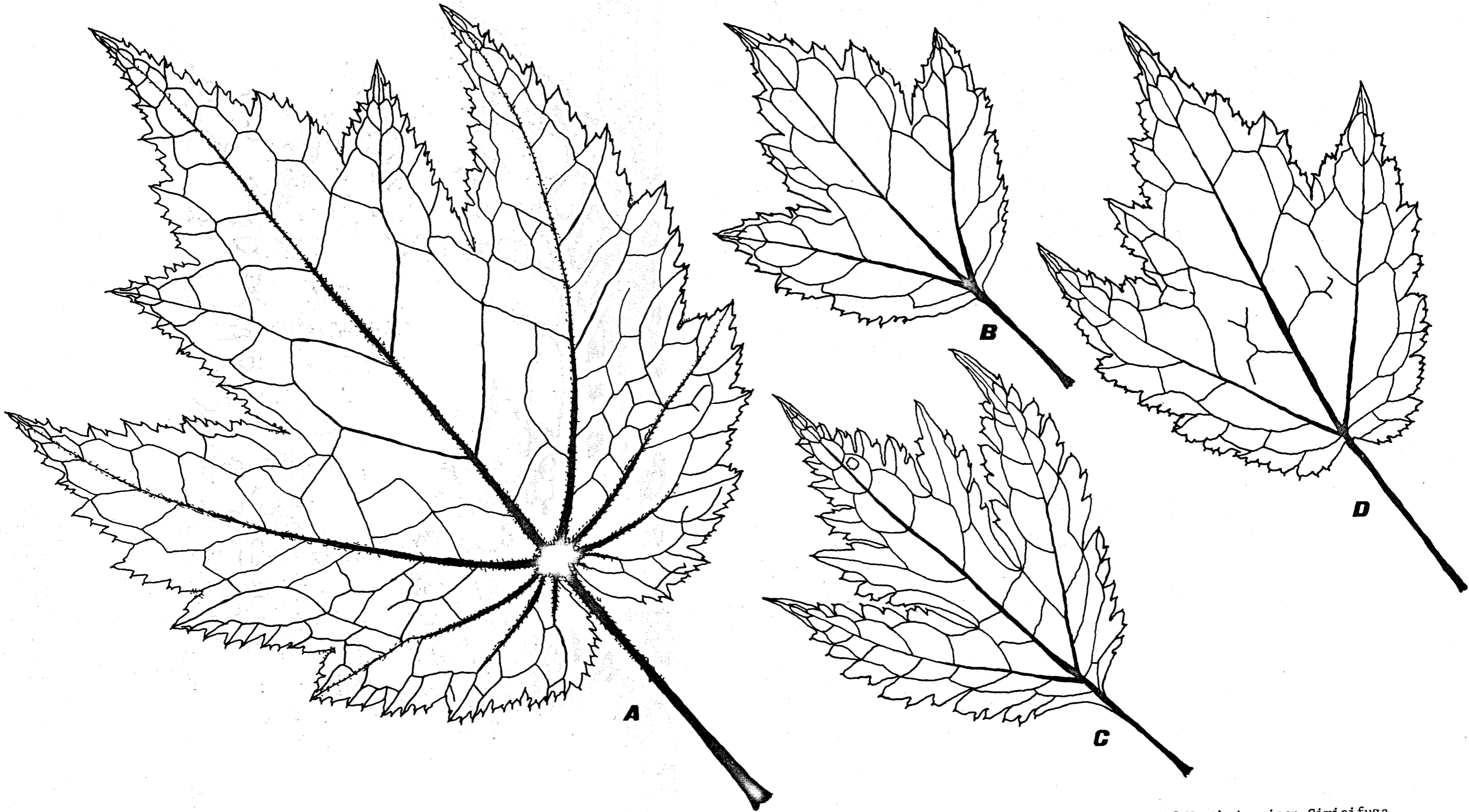
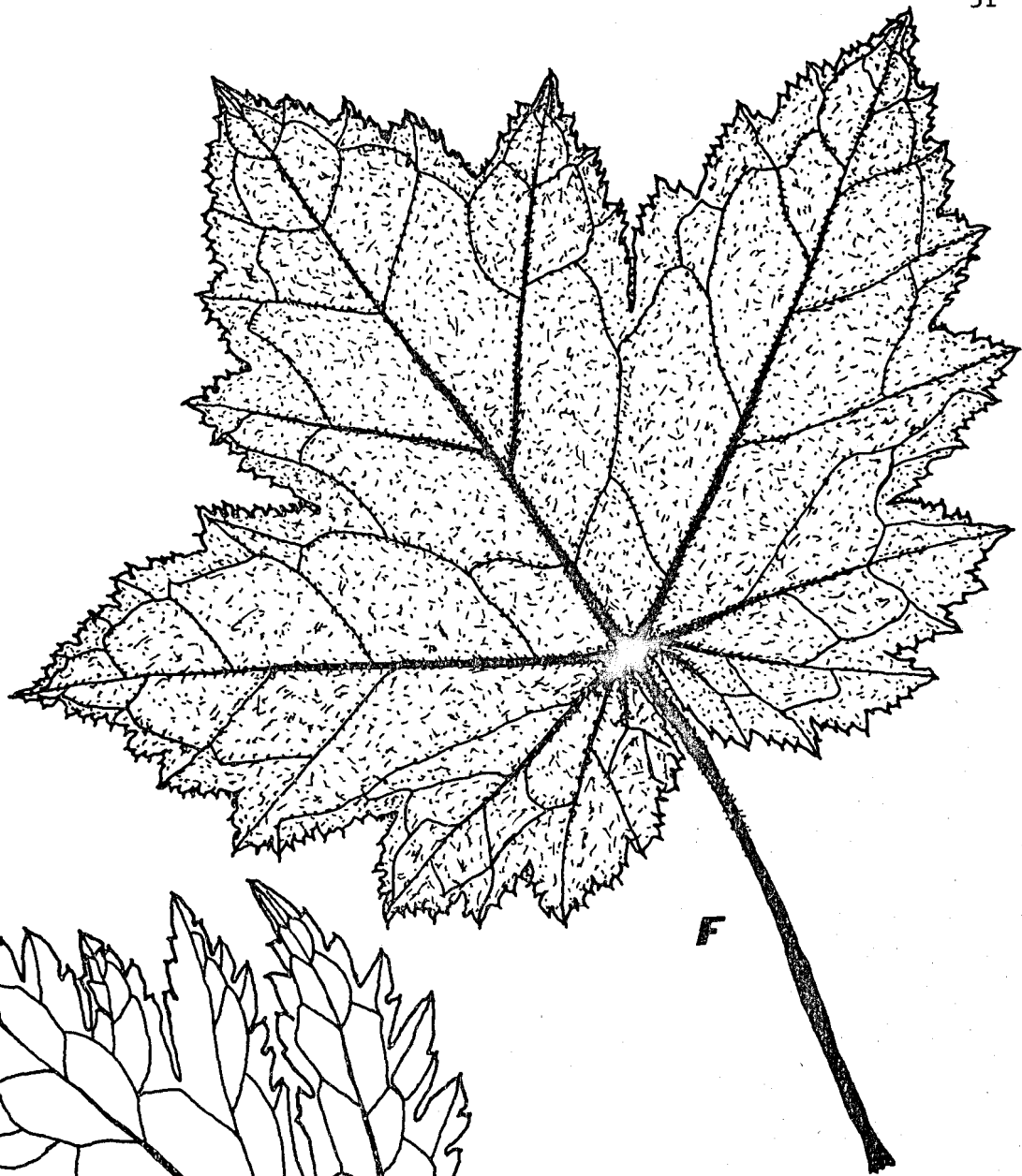
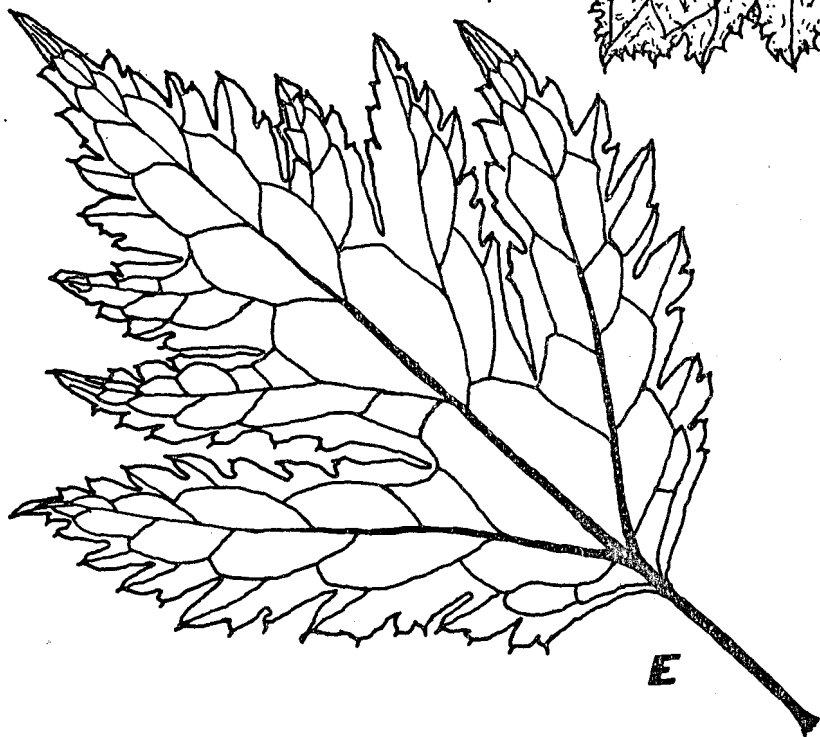


Figure 2. Drawings of terminal leaflets of North American Cimicifuga.



F



E

FIGURE 3. Drawings of terminal leaflets of Eurasian Cimicifuga.

(natural size)

- (A) Cimicifuga japonica
- (B) Cimicifuga dahurica
- (C) Cimicifuga biternata
- (D) Cimicifuga heracleifolia
- (E) Cimicifuga foetida
- (F) Cimicifuga simplex

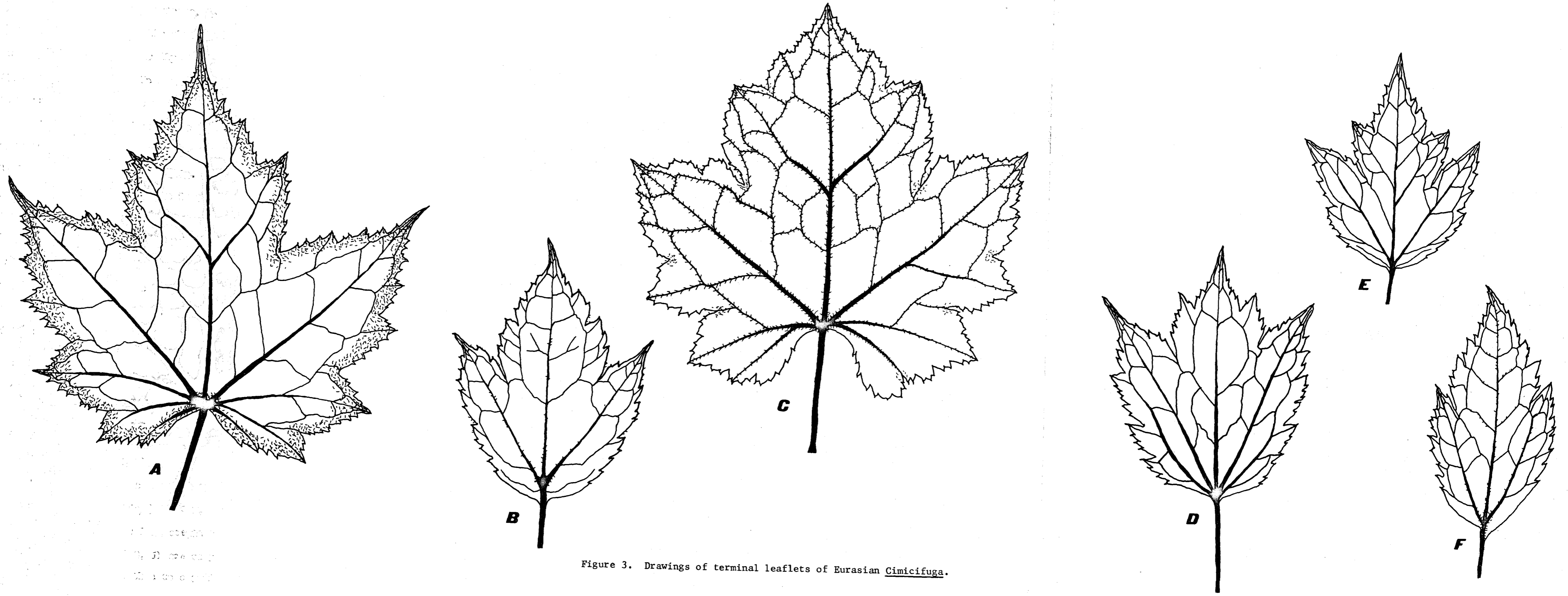


Figure 3. Drawings of terminal leaflets of Eurasian Cimicifuga.

(Fig. 3 A, B, D) and C. americana, C. arizonica, C. laciniata (Fig. 2 C, D, E) are usually short to long acuminate. The lobe tips of other species are generally acute. The terminal leaflets of most species are tri-lobed. In some specimens (not shown) the leaflet tips are occasionally truncate as if from some growth defect.

The leaflet surface may be glabrous or possess various grades and patterns of pubescence. The pubescence on the abaxial surface of C. japonica and C. biternata (Fig. 3 A, C) present strikingly different patterns. In the former there is a narrow zone of short stiff hairs along the margin with the remaining surface area being completely devoid of hairs, while in the latter, strigose hairs are found on all principal veins rather than being concentrated near the margin. By using only this comparison of pubescence, these two Japanese Snakeroots can be distinguished, without resorting to other striking and consistent differences.

Fruits

The fruits (Fig. 4) of the genus Cimicifuga are follicles which vary in shape from ovoid in C. racemosa (Fig. 4 E) to oblong in C. rubifolia (Fig. 4 F) or obovate as in C. americana, C. foetida, and C. simplex (Fig. 4 A, I, K).

The follicles may be sessile to a pedicel as in C. racemosa, C. elata, and C. rubifolia (Fig. 4 E, C, F). All other species have fruits which are short or long stipitate. The fruits of C. japonica and C. biternata (Fig. 4 G, J) are very nearly sessile to the stem of the inflorescence rather than to a pedicel. These two species can be

FIGURE 4. Drawings of Cimicifuga fruits.

- (A) Cimicifuga americana (1.5X)
- (B) Cimicifuga arizonica (2X)
- (C) Cimicifuga elata (2X)
- (D) Cimicifuga laciniata (2X)
- (E) Cimicifuga racemosa (3X)
- (F) Cimicifuga rubifolia (2X)
- (G) Cimicifuga japonica (3X)
- (H) Cimicifuga dahurica (3X)
- (I) Cimicifuga foetida (2X)
- (J) Cimicifuga biternata (3X)
- (K) Cimicifuga simplex (2X)

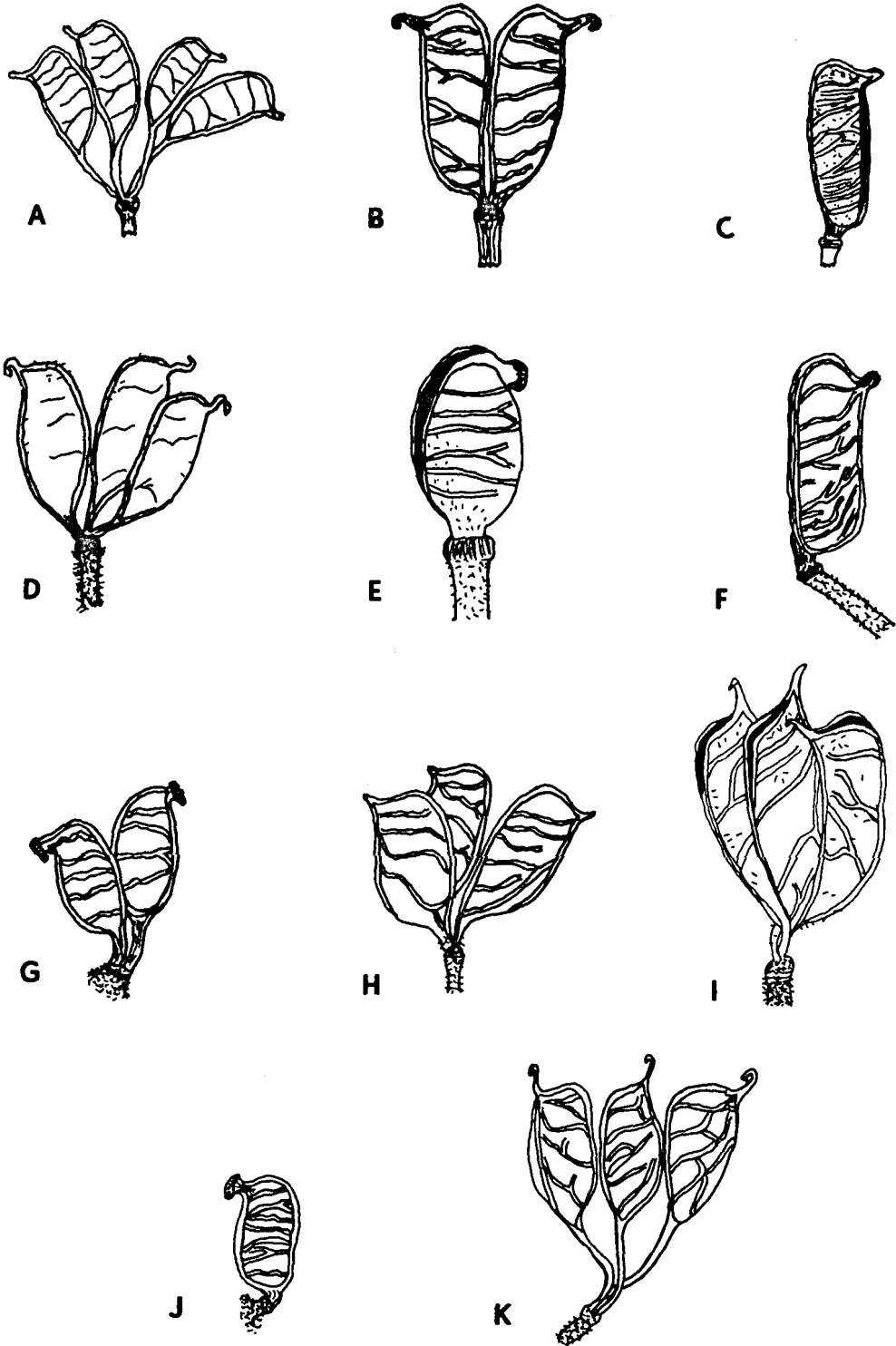


Figure 4. Drawings of Cimicifuga fruits.

distinguished from all other species on this basis alone. The stipes of C. foetida (Fig. 4 I) are generally twisted about one another, while those of C. japonica, C. biternata, and C. simplex (Fig. 4 G, J, K) are not twisted but strongly angled upward.

The follicles have a beak (i. e., hardened, persistent style) which may be straight as in Cimicifuga americana and C. dahurica (Fig. 4 A, H), or uncinata as in C. arizonica, C. laciniata, and C. simplex (Fig. 4 B, D, K). Two general types of beaks exist, those which are slender elongate with a minute tip as in C. americana, C. laciniata, and C. simplex (Fig. 4 A, D, K), or those which are short and stout with a broad tip as in C. racemosa, C. rubifolia, C. japonica, and C. biternata (Fig. 4 E, F, G, J). The beak may be angled downward as in C. racemosa (Fig. 4 E), or at almost 90° as in C. japonica (Fig. 4 G), or angled apically as in C. americana, C. foetida and C. simplex (Fig. 4 A, I, K).

In some species venation of the fruit is quite prominent as in C. arizonica, and C. foetida while almost undetectable in C. laciniata (Fig. 4 B, I, D). In most species the veins are oriented diagonally as in C. foetida (Fig. 4 I) while in others the veins are oriented along a plane perpendicular to the long axis of the follicle as in C. americana and C. racemosa (Fig. 4 A, E).

The texture of the follicle walls varies from chartaceous in C. americana and C. laciniata (Fig. 4 A, D) to coriaceous in C. racemosa and C. biternata (Fig. 4, E, J). The follicle surface may be glabrous as in C. dahurica (Fig. 4 H) to glandularly pubescent in C. elata (Fig. 4 C). Most fruits are glabrescent.

The number of follicles per flower varies between one and eight. The number most common for each species is illustrated. Fruits of C. heracleifolia have not been examined.

Four to fifteen seeds are contained in the follicle and are arranged in one row as in Cimicifuga americana or two rows as in C. racemosa. The two-rowed arrangement is most common. C. rubifolia most commonly has four seeds in two rows of two seeds each in the middle of the follicle with a single seed at each end.

Seeds

The seeds (Fig. 5) of Cimicifuga may be separated into scaly and non-scaly types. C. racemosa (Fig. 5 E) has glabrous, lunate seeds, while C. japonica and C. biternata (Fig. 5 G, K) have a similar shape but frequently bear very short scales. Seeds of C. elata (Fig. 5 C) are transversely rugose or verrucose.

In eight of the twelve species the seeds bear long, flattened, striated, lacerate scales. The seeds of C. foetida and C. simplex (Fig. 5 I, J) are similar, the scale length equalling or exceeding the width of the seed body. Seeds of C. dahurica (Fig. 5 H) are similar to those of C. foetida and C. simplex (Fig. 5 I, J), though much smaller. The seed scales of C. laciniata (Fig. 5 D) are very narrow and greatly exceed the width of the seed body. The seeds of both C. americana and C. laciniata (Fig. 5 A, D) appear flattened because the scales around the median peripheral portion of the seed body are proportionately longer than the others. All seed scales of C. arizonica and C. rubifolia (Fig. 5 B, F) are approximately the same

FIGURE 5. Drawings of Cimicifuga seeds (10X).

- (A) Cimicifuga americana
- (B) Cimicifuga arizonica
- (C) Cimicifuga elata
- (D) Cimicifuga laciniata
- (E) Cimicifuga racemosa
- (F) Cimicifuga rubifolia
- (G) Cimicifuga japonica
- (H) Cimicifuga dahurica
- (I) Cimicifuga foetida
- (J) Cimicifuga simplex
- (K) Cimicifuga biternata

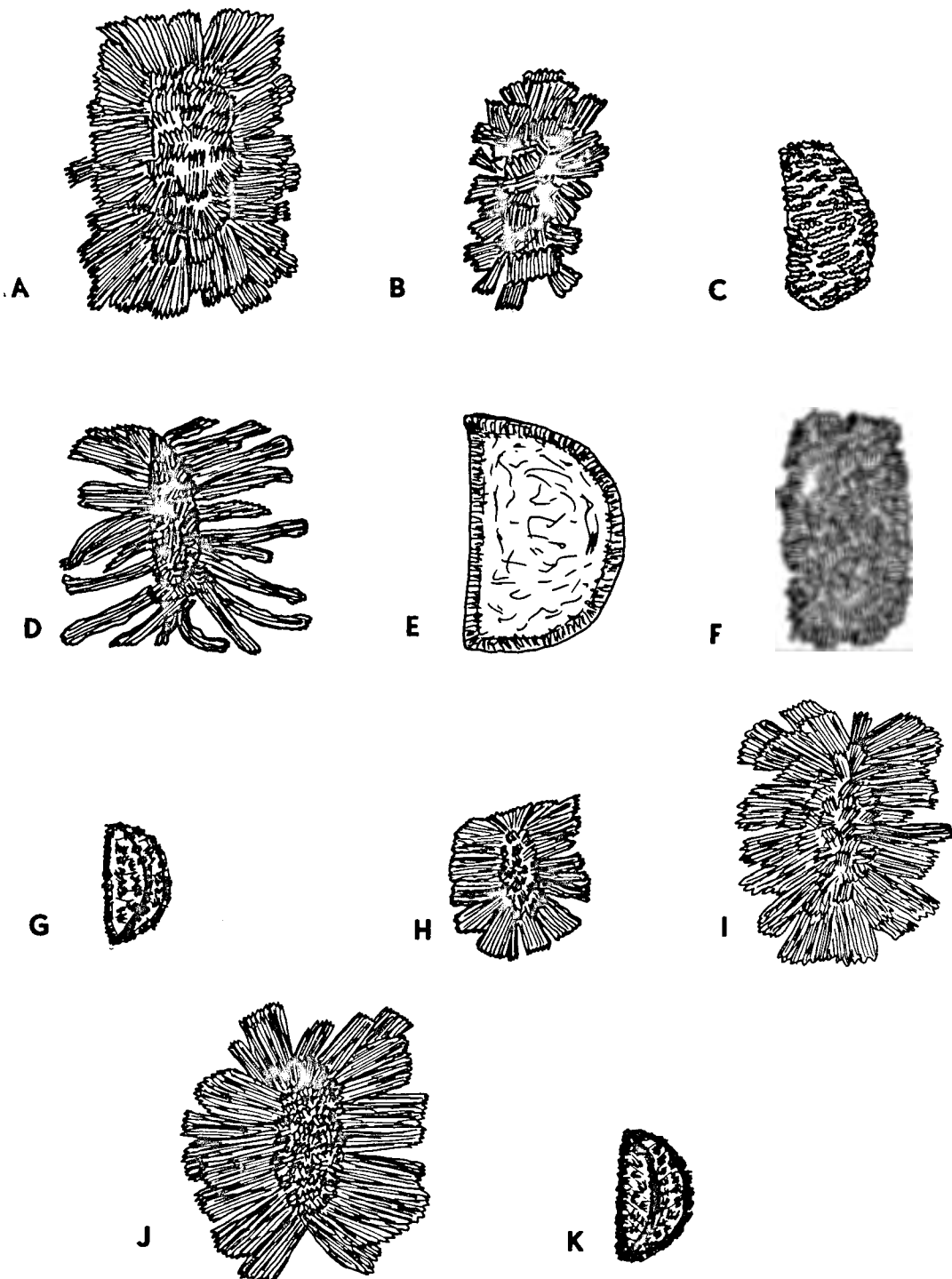


Figure 5. Drawings of Cimicifuga seeds.

length, regardless of their position of attachment to the seed body, giving the seed a cylindrical appearance. However, the scales are more loosely arranged and often unequal in length in Cimicifuga arizonica. (Fig. 5 B).

Color of the seeds at maturity varies from whitish in C. americana and C. laciniata to reddish-brown in Cimicifuga rubifolia and purplish-brown or almost black in C. elata. Seeds of all species contain an oily endosperm.

Pistils

Much variation in shape and size of pistils (Fig. 6) exists between the species of Cimicifuga, however, the pistil characters are rather consistent within each species. The pistils of C. arizonica, C. elata, C. racemosa, and C. rubifolia (Fig. 6 B, C, E, F) are definitely sessile, while all other species have pistils which are, at least, short stipitate. The stipe generally elongates with age. The pistils of all species are attached to elongate pedicels, with exception to those of C. japonica and C. biternata (Fig. 6 G, L).

Cimicifuga elata, C. racemosa, C. rubifolia, C. japonica, and C. biternata (Fig. 6 C, E, F, G, L) generally have a single pistil but may occasionally be found with two or three in some of their flowers. C. elata (Fig. 6 C) normally has two pistils in some of the flowers on the lower half of the inflorescence, while in the upper half there is only one pistil per flower. In C. arizonica (Fig. 6 B) two pistils per flower is the typical number, although one and three are frequently found. All other species possess three to eight pistils.

FIGURE 6. Drawings of Cimicifuga pistils, pedicels, and bracts.

- (A) Cimicifuga americana (6X)
- (B) Cimicifuga arizonica (6X)
- (C) Cimicifuga elata (7X)
- (D) Cimicifuga laciniata (6X)
- (E) Cimicifuga racemosa (6X)
- (F) Cimicifuga rubifolia (8X)
- (G) Cimicifuga japonica (6X)
- (H) Cimicifuga dahurica (6X)
- (I) Cimicifuga foetida (6X)
- (J) Cimicifuga heracleifolia (8X)
- (K) Cimicifuga simplex (5X)
- (L) Cimicifuga biternata (6X)

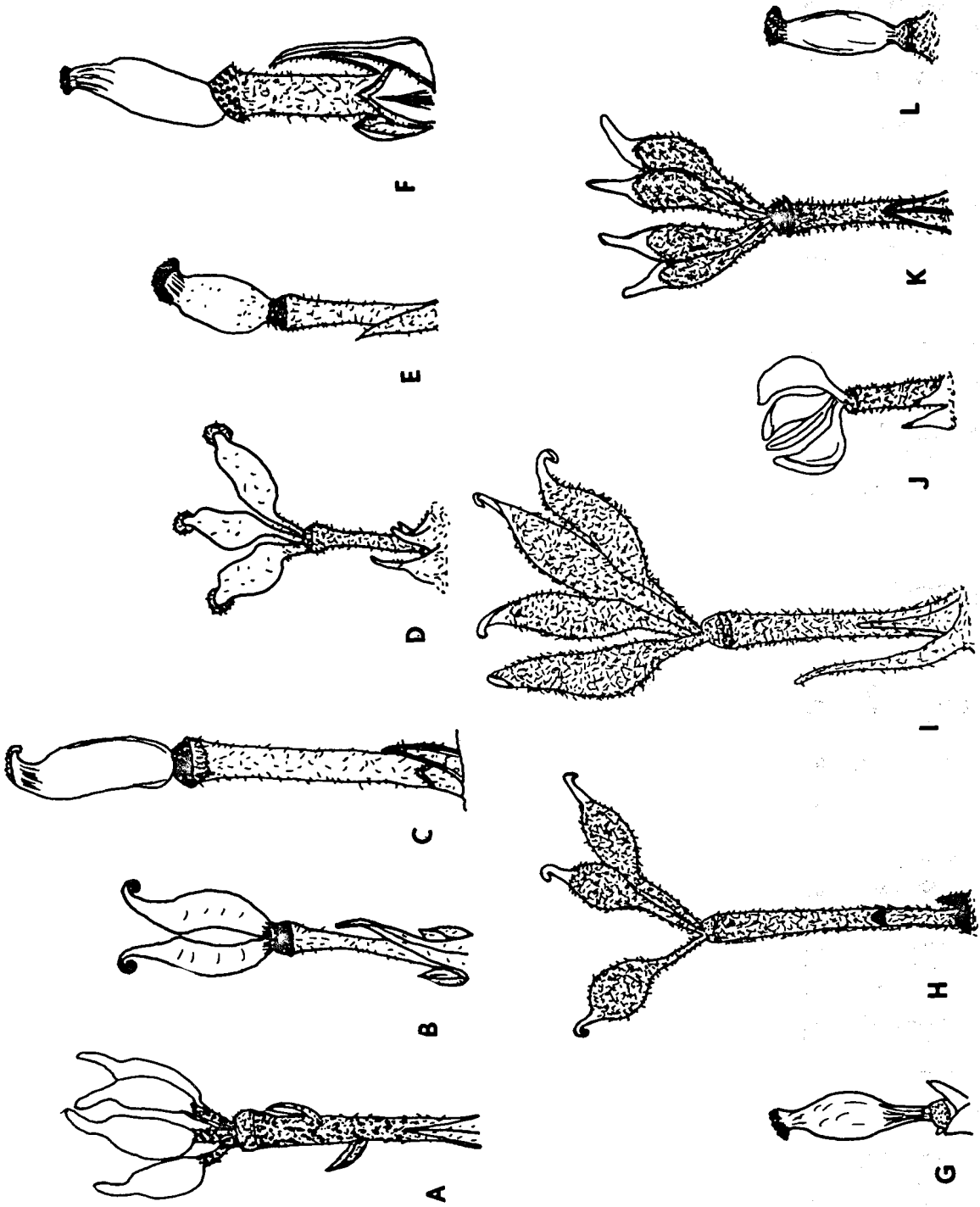


Figure 6. Drawings of Cimicifuga pistils, pedicels, and bracts.

The characteristic number of units constituting the gynoecium for each species is illustrated.

The ovaries of most Cimicifuga species are glabrous. C. laciniata, C. foetida, and C. simplex (Fig. 6 D, I, K, p. 43) normally have a rather heavy indument. The ovaries of Cimicifuga dahurica, while typically glabrous, (Fig. 6 J) may sometimes be finely hairy, while in C. foetida all grades from glabrous to tomentose ovaries occur. It is interesting to note that only the stipe is pubescent in C. americana (Fig. 6 A). The style may be short and stout with a broad-flattened stigma as in C. racemosa, to elongate with a minute stigma as in C. simplex (Fig. 6 E, K).

Cimicifuga dahurica is functionally unisexual. The plants that contain pistils generally possess several aborted stamens. In those plants containing fertile stamens we find no enlarged pistils.

Pedicels

There exists a great variation in the lengths and indument of pedicels (Fig. 6) in and between species of Cimicifuga. Greater variations in pedicel length occur in C. foetida and C. simplex (Fig. 6 I, K). These species possess pedicels whose length may be between 2 mm. and 18 mm. The typical pedicel lengths in the various species, in relation to each other, to their bracts, and pistil lengths, are illustrated (Fig. 6). In most cases the length of the pedicel is not exceeded by the length of the pistil. The pedicel may elongate during maturation of the pistil.

The pubescence of the pedicel ranges from almost granular in

C. americana to sparse-strigose in C. rubifolia or to a thick tomentum in C. simplex (Fig. 6 A, F, K, p. 43).

The pedicels of C. japonica and C. biternata (Fig. 6 G, L) are extremely short making the pistils of these two species appear sessile on the axis of the inflorescence. This characteristic makes these two species especially distinct from the others.

Bracts

The bracts (Fig. 6) subtending the pedicels in Cimicifuga have not been strongly emphasized as diagnostic structures by taxonomists. In this study their shapes, numbers, and position in relation to the pedicel are found to be diagnostically valuable.

The eastern North American species can be distinguished by number and position of bracts alone. C. americana (Fig. 6A) has one elongate-triangular bract subtending the pedicel and several others upon the pedicel itself. Only one bract subtends each pedicel of C. racemosa, (Fig. 6 E) while in C. rubifolia (Fig. 6 F) the pedicel is subtended by three bracts, one long-subulate and two smaller lateral ones with acute tips. Two western North American species, C. arizonica and C. elata (Fig. 6 B, C) also have three bracts subtending the pedicel, one long and two smaller lateral ones. The bracts of these two are less concave than those of C. rubifolia of the east. The bracts of C. elata are triangular, acute, while those of C. arizonica are similar except that the larger, central one is more subulate. C. laciniata (Fig. 6 D) possesses one rather broadly triangular, acute bract.

In C. foetida (Fig. 6 I, p. 43) usually two pubescent, slender, subulate bracts subtend the pedicel. One of these is longer than the other and is nearly one half the length of the pedicel. Occasionally the longer bract exceeds the length of the pedicel especially in specimens from high altitudes in the Himalayan Range. C. simplex (Fig. 6 K) has two very small, unequal, triangular bracts with rounded apices, subtending the pedicel, and often one will be borne upon the pedicel. C. japonica, C. dahurica, C. heracleifolia, and C. biternata (Fig. 6 G, H, J, L) have three bracts subtending the pedicel. The bracts of the latter three are glabrous. Those of C. biternata are caducous.

Staminodia

Cimicifuga staminodia (Fig. 7) are called "petals" by some authors. They are attached next to the outer ring of stamens and are found to be diagnostic. Typical shapes and sizes for the various species are illustrated. The shapes are stable within the species, which can be distinguished by the staminode even in the bud.

Two North American species, C. elata and C. rubifolia do not possess staminodes.

The staminodia of most species are notched or bifid at the apex. The depth of the notch may equal one half the staminode length as in C. dahurica (Fig. 7 F) or be very shallow as in C. japonica (Fig. 7 E). The staminodes of C. biternata (Fig. 7 I) are typically rounded or truncate, but frequently are retuse.

C. heracleifolia (Fig. 7 H) has staminode lobes which are entire (i.e. not notched) and white. The lobes of C. foetida (Fig. 7 G) are

FIGURE 7. Drawings of Cimicifuga staminodia.

(A) Cimicifuga americana (3X)

(B) Cimicifuga arizonica (3X)

(C) Cimicifuga laciniata (3X)

(D) Cimicifuga racemosa (3X)

(E) Cimicifuga japonica (7X)

(F) Cimicifuga dahurica (7X)

(G) Cimicifuga foetida (7X)

(H) Cimicifuga heracleifolia (7X)

(I) Cimicifuga biternata (7X)

(J) Cimicifuga simplex (7X)



A



B



C



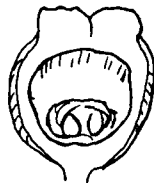
D



E



F



G



H



I



J

Figure 7. Drawings of Cimicifuga staminodia.

about as long as broad and often overlap one another. Specimens of C. foetida from high elevations in the Himalayas have staminodia which are rather deeply notched but still with broad antheroid tips.

Staminode shapes vary from ovate in C. foetida (Fig. 7 G, p. 48) to oblong as in C. racemosa (Fig. 7 D) or spatulate as in C. heracleifolia and C. biternata (Fig. 7 H, I).

In C. arizonica, C. racemosa, C. dahurica, and C. heracleifolia (Fig. 7 B, D, F, H) nectariferous glands are absent on the staminodes. Staminodes of all other species possess nectariferous glands which can be detected even in dried specimens.

The tips of the staminode lobes may be strongly antheroid as in C. dahurica and C. foetida (Fig. 7 F, G) or small, rounded, and less antheroid as in C. americana, C. laciniata, and C. simplex (Fig. 7 A, C, J).

Numbers of staminodia per flower in the North American species are: C. americana, 2; C. arizonica, rarely 1-2; C. laciniata, 1-5 (usually 3-4); C. racemosa, 3-8 (usually 4). In the Eurasian species staminode numbers are: C. biternata, 2-3; C. dahurica, 2-3; C. foetida 3-5 (mostly 4); C. heracleifolia, 2-3 (mostly 2); C. japonica, 2-3; C. simplex, 1-3 (mostly 2).

Staminodia most commonly are cream-colored with white lobes. The staminodia of C. arizonica and C. racemosa (Fig. 7 B, D) are long stipitate (clawed), whereas, in the other species they are short stipitate or nearly sessile.

VI. GENERIC DESCRIPTION

Cimicifuga L., Pl. Rar. Camsch. 21 (1750); Amoe. Acad. 2:354 (1951);
Syst. ed. 12, 659 (1767).

Plants tall, long-lived, herbaceous perennials with hard, knotted rhizomes of the northern hemisphere which are nearly glabrous to pubescent above. Stems erect, 1.5 to 25 dm. tall. Leaves alternate, ternate, biternate, or triternately decomposed. Leaflets 3 to numerous, ovate-oblong to broadly cordate, simply 3-lobed to incisely-lobed. Petioles with basal wings clasping the stem. Inflorescence a raceme (rarely a spike) within which the flowers open acropetally, simple or paniculate; flowers pedicellate (appearing sessile in C. biternata and C. japonica); pedicels subtended by 1 or 3 bracts (bracts are commonly found upon the pedicels of C. americana and C. simplex). Flowers actinomorphic, perfect (rarely so in C. dahurica), apetalous. Sepals 2-6 (usually 4-5), petaloid, caducous. Staminodia present in some species (absent in others), deciduous or persistent, 1-8, apically dilated, whole, notched, or bifid, antheroid, with a nectariferous area present in some species. Stamens numerous, equal or unequal, exserted; filaments filiform to flattened, elongate, white; anthers round, elliptic or obovoid, yellowish. Pistils 1-8, unilocular, sessile or stipitate; style short or elongate, terete or flattened laterally; stigma broad or minute, straight or uncinat; ovules 4-15 per pistil, anatropous; placentation marginal. Fruit a follicle, ovoid to oblong or obovate, tipped with a short persistent

style, sessile or stipitate. Seed 4-15 per follicle, arranged in single or double rows, smooth, verrucose or densely scaly, angled, cylindrical, or compressed laterally, lenticular; endosperm oily. Flowering summer and fall. Fruiting summer and fall. Somatic chromosomal number, $2n=16$.

Type species: Cimicifuga foetida L.

VII. KEY TO THE TAXA

I. Seeds without scales; stigmas broad.

A. Pistil sessile; upper half of aerial stem foliate,
inflorescence racemose.

B. Fruit ovoid; seeds lunate, smooth, brown; 1 bract
subtending the pedicel; 3 prominent veins arising
at base of terminal leaflet; staminodes 1-8, oblong.

C. Leaflets not deeply incised.(eastern North
America).....1. Cimicifuga racemosa

CC. Small leaflets deeply incised.(eastern North
America).....1A. Cimicifuga racemosa forma dissecta

BB. Fruit oblong; seeds cylindrically lenticular,
verrucose, purplish-brown; 3 bracts subtending
the pedicel; 5-7 prominent veins arising at the
base of the terminal leaflet; staminodes absent.

(western North America).....2. Cimicifuga elata

AA. Pistil stipitate; upper half of aerial stem
efoliate; inflorescence spicate.

B. Pistils long-stipitate, styles long; abaxial surface
of terminal leaflet possessing a narrow zone of
strigose hairs near the margin, remaining surface
area glabrous; terminal leaflets mostly 12.0 - 14.0
cm. long, 11-13 cm. wide, deeply cordate; leaf

ternate; staminode apex broadly retuse.

(Asia).....3. Cimicifuga japonica

BB. Pistils short-stipitate, style short; abaxial surface of terminal leaflet possessing strigose hairs along the veins, none marginal, terminal leaflets mostly 8.0 - 9.0 cm. long, 9.0 - 10.0 cm. wide, broadly cordate; leaf biternate (sometimes ternate); staminode apex truncate or emarginate.

(Asia).....4. Cimicifuga biternata

II. Seeds scaly; stigmas minute (rather broad in C. rubifolia).

A. Flowers with 1-2 sessile pistils, seeds cylindrical.

B. Staminodes absent; filaments seldom over 4.0 mm. long; pistil 1 (rarely more), glabrous; style short, straight; 5-9 prominent veins arising at base of deeply cordate terminal leaflet. (eastern North America).....5. Cimicifuga rubifolia

BB. Staminodes present; filaments commonly about 7.0 mm. long; pistils 2, sparsely to densely glandular; style long, uncinatate; 3 prominent veins arising at base of subcordate terminal leaflet. (western North America).....6. Cimicifuga arizonica

AA. Flowers with 3-8 (rarely less) stipitate pistils; seeds flattened.

B. One bract subtending the pedicel; terminal leaflets incisely cleft, laciniately toothed, subcuneate.

C. Pistils glabrous; additional bracteoles upon the pedicel; stipes granularly pubescent; seed about 3.5 mm. long, invested with broad lacerate scales; inflorescence closely flowered; stamens numbering in the 60's; staminodes about 3.5 - 3.0 mm. long.

(eastern North America).....7. Cimicifuga americana

CC. Pistils densely pubescent; no additional bracteoles upon the pedicel; stipes densely pubescent; seed about 2.5 - 3 mm. long, loosely invested with linear lacerate scales; inflorescence loosely flowered; stamens numbering in the 20's; staminodes about 4.0 mm.

long. (western North America)....8. Cimicifuga laciniata

BB. Two-three bracts subtending the pedicel; terminal leaflets not incisely cleft or laciniately toothed.

C. Staminodes whole, spatulate, nectariferous area absent; 4-5 prominent veins arising at base of a glabrous terminal leaflet; pistils glabrous. (Asia).....9. Cimicifuga heracleifolia

CC. Staminodes emarginate, bifid or deeply notched, nectariferous area present (except in C. dahurica); 3 prominent veins arising at base of terminal leaflets with varying degrees of pubescence; pistils lightly pubescent to tomentose.

- D. Stamines deeply bifid, lobe tips dilated and rounded, nectariferous area absent; plants functionally unisexual; seeds 2 - 2.5 mm. long. (Asia).....10. Cimicifuga dahurica
- DD. Stamines emarginate or deeply notched, lobe tips neither dilated nor rounded, nectariferous area present; plants functionally bisexual; seeds 3.5 - 4 mm. long.
- E. Pistils long stipitate; bracts 2, 0.5 mm. long, never exceeding the pedicel, wedge-shaped; inflorescence a simple raceme (rarely branched); filaments spatulate; staminal lobes longer than broad, not strongly antheroid. (Asia).....11. Cimicifuga simplex
- EE. Pistils short stipitate; bracts 2-3, 1.5 + mm. long, frequently exceeding the pedicel, lance-subulate; inflorescence paniculate (rarely simple); filaments filiform; staminal lobes as long as broad, strongly antheroid. (Asia).....12. Cimicifuga foetida

VIII. SYSTEMATIC TREATMENT

1. CIMICIFUGA RACEMOSA (L.) NUTT.

(Black Snakeroot)

SYNONYMY

Cimicifuga racemosa (L.) Nutt. Gen. N. Am. Pl. 2:15 (1818); Lloyd and Lloyd, Pharma. Rundsc. 4:30 (1886); Huth, Bot. Jahrb. Engler 16:315 (1892); Robinson in Gray, Syn. Fl. N. Am. 1:54 (1895); Gattinger, Fl. Tenn. 80 (1901); Robinson and Fernald, Gray's Man. ed. 7, 407 (1908); Britton and Brown, Illus. Fl. 2:91, 1864 (1923); Small, Man. S.E. Fl. 513 (1933); House, Wild Fl. N. Am. 104 (1935); Deam, Fl. Ind. 457 (1940); Braun, Anno. Cat. Sperm. Ky. 56 (1943); Bailey, Man. Cult. Pl. (Rev. ed.) 407 (1949); Fernald, Gray's Man. ed. 8, 671 (1950); Gleason, Illus. Fl. 2:157; Strausbaugh and Core, Fl. W. Va. 2:398 (1953); Bloomquist and Oosting, Guide Spr. Fl. Pd. N. C. 77 (1954); Massey, Va. Fl. 97 (1961); Soper, Trans. Roy. Can. Inst. 34 (1); 43 (1962); Gleason and Cronquist, Man. Vasc. Pl. 306 (1963); Hoffman, Check List Gt. Smoky Mtns. Castanea 29:17 (1964).

Christophorian facie herba spicata Plukenet, Alma. Bot. 54 (1705).

Christophoriana racemosa Tourn. Institut. Rei. Herb. Edid. Jussuien (1917).

Christophoriana americana Dill. Hort. Elth. 1:67 (1739).

Actaea racemis longissimiss Gronov. Fl. Va. 59 (1739).

Actaea racemosa L. Sp. Pl. ed. 1, 504 (1753); Michx. Fl. I. P. 308

(1803). DC. Prodr. Syst. Nat. Bd. 1:64 (1824); Hooker, Fl. Bor. Am. 1:27 (1829); Beck, Bot. N. Mid. States, 13 (1833); Willd. Sp. Pl. 2:1139 (1879).

Actaea monogyna Walt. Fl. Car. 151 (1788).

Macrotrys actaeoides Raf. Desv. Jour. Bot. 2:170 (1809).

Cimicifuga serpentaria Pursh, Fl. Am. Sept. 2:372 (1814).

Cimicifuga racemosa Ell. Sk. Bot. S. C. & Ga. 2:16 (1824);

Torrey and Gray, Fl. N. Am. 1:36 (1838); Torrey, Fl. N. Y. 1:22 (1843); Gray, Man. ed. 1, 16 (1848); Chapman, Fl. Sou. U.S. ed. 1, 11 (1865); Wood, Class Bk. Bot. 147 (1866); Gray, Man. ed. 5, 48 (1868).

Botrophis serpentaria Raf. Med. Fl. 1:85 (1828).

Macrotys serpentaria Eaton, Man. Bot. ed. 4, (1829).

Botrophis actaeoides Fischer and Meyer, Ind. Sem. Hort. Bot. Petrop. 1:21 (1835).

Thalictrodes racemosum O. Ktze. Rev. Gen. Pl. 1:4 (1891).

A tall, long-lived perennial, with hard, knotted rhizomes and long solitary stems bearing one or more, biternate-triternate leaves near or above the base; rhizome thick, in horizontal, matted clumps, attaining a maximum length of approximately 15 cm., up to approximately 3 (commonly 2) cm. in diameter, often branched, containing numerous, short, upward-curved branches, which give the main rhizome a rough, irregular appearance, frequently bearing, deep, cup-shaped, radiating scars, each showing radiate structure of terminated stem bases, wood in shape of cross, the entire lower half thickly covered with roots; roots

8-23 cm. long, 1-5 mm. in diameter; stems 7-25 (mostly 12-16) dm. high, erect, stout at base, diminishing in size towards summit, green to greenish brown, almost terete throughout, not usually sulcate, smooth and glabrous or with a few recurved, delicate hairs up to the inflorescence, there usually hirtellous; petioles 1.5-6 dm. long, usually straight, angled but occasionally almost terete, usually not sulcate on the upper face, glabrous, enlarged below, clasping stem with wings in a manner that results in rounded contours; leaves biternate-triternately divided, the divisions pinnate and the ultimate leaflets often again quinate compound, central and lateral divisions containing numerous leaflets (20-35); petiole of central divisions 10-15 cm. long, terete-slightly angled, not usually sulcate, glabrous; petioles of lateral divisions 5-14 cm. long, nearly equal; petiolules of lateral leaflets of the central division usually about 1-5 mm. long, slightly sulcate, glabrous; petiolules of leaflets of lateral divisions similar; terminal leaflet of central division 6-16.5 (mostly 6-8) cm. wide between apices of the two largest lobes, ovate-obovate in outline, equilateral, acute or acuminate, palmately three-lobed, subcuneate-subcordate, dentate to deeply serrate toothed, incised or lobed, green above, paler beneath, glabrous to sparsely ciliate, rarely sparsely pubescent along veins beneath, 3 prominent veins arising at base; other leaflets usually smaller and inequilateral, commonly 4-12 cm. long, 3-8 cm. wide; mean stomate length 43.16 μ ; inflorescence a simple panicle of 4-9 terminal and subterminal virgate racemes, 1-6 dm. long; rachis and pedicels usually rather densely pubescent with short hairs; pedicels (in flower)

approximately 4 mm. long, stout, about the same diameter throughout, sometimes in pairs, rarely branched, subtended by a subulate bract which is commonly 3-4 mm. long, pedicel (in fruit) 7-11 mm. long; sepals 4 fugacious, approximately 5 mm. long, 4 mm. wide, ovate, concave, greenish-white; petals none; staminodes 1-8 (usually 4), whitish, oblong, pedicellate, approximately 3 mm. long, bifid (clawed and rounded) at the apex; stamens 55-110 (mostly about 70); filaments 7-10 (mostly 8) mm. long; anthers about .7 mm. long; truncate, lobes often unequal; pistil 1, rarely 2, sessile about 3 mm. long from base of ovulary to summit of the stigma; stigma broadly depressed; style short, thick, flattened laterally, persistent; ovulary about 1 mm. in diameter, glabrous (to rather densely pubescent); fruit a follicle; follicles 5-10 (commonly 7) mm. long, ovoid, often puberulent to pubescent, sessile, somewhat laterally compressed, obliquely beaked apically, pale green to brownish in color, walls thick, reticulate; seeds usually 8-10, arranged in two rows smooth to scarcely rough-ridged, 3 mm. long, 1.5-2 mm. wide, compressed laterally, lunate, brown.

Type locality: "Habitat in Florida, Virginia, Canada (Linnaeus, 1753). Type specimen: Preserved in the Linnaean Herbarium, No. 665.3. The type was not seen but a photograph obtained (Fig. 8) from the International Documentation Centre was examined.

In moist, rich, mixed deciduous forest, wooded slopes and ravines, coves, creek margins, thickets, moist meadowlands, mountainous terrain, Niagara Peninsula of southern Ontario, eastward to northern Massachusetts, south through New Jersey, eastern Virginia and

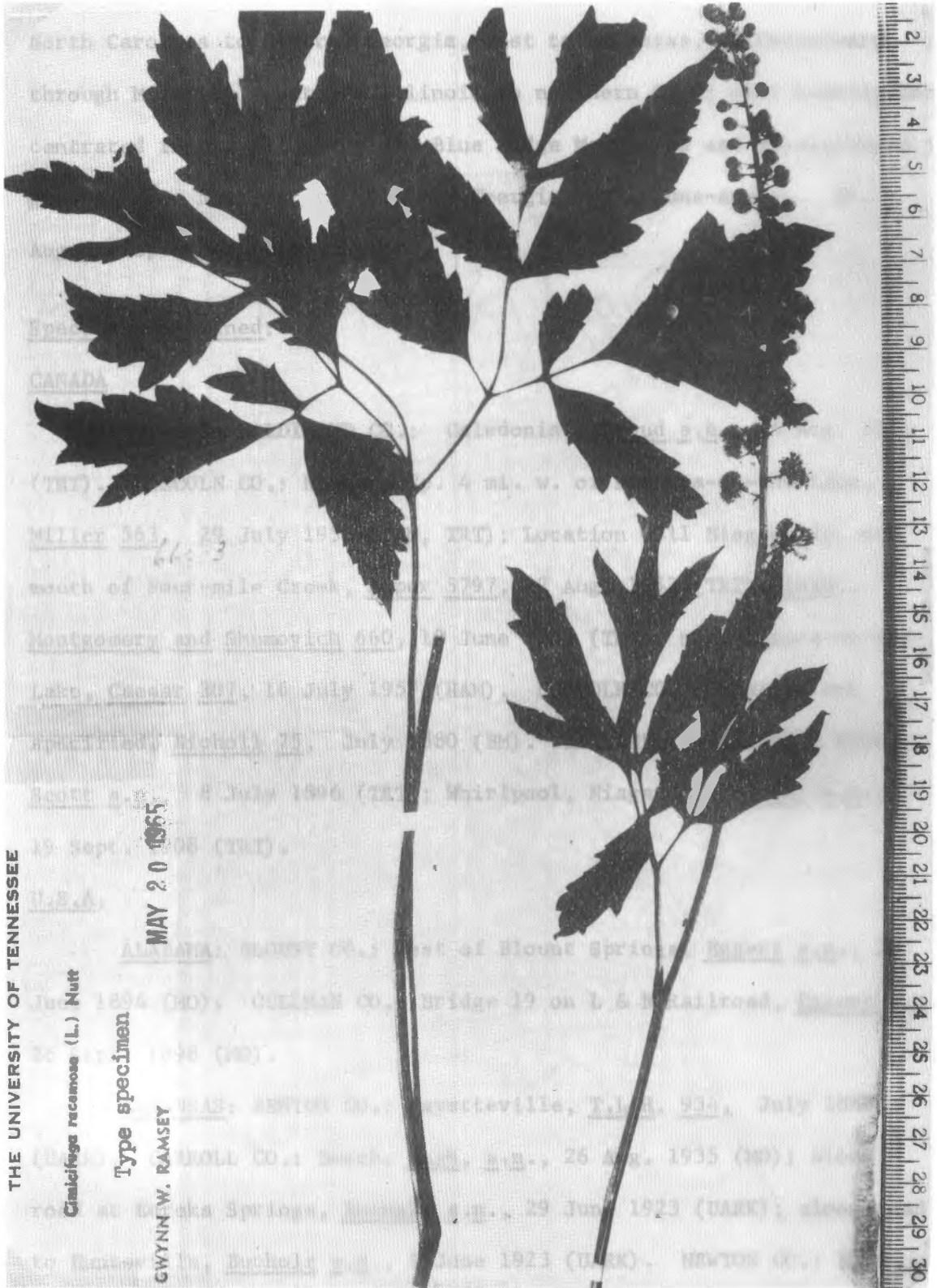


Figure 8. Type specimen of Cimicifuga racemosa.

North Carolina to central Georgia, west to Arkansas, northeastward through Missouri, southern Illinois to northern Ohio; most heavily concentrated in the Alleghany and Blue Ridge Mountains and Appalachians in general from New York to northern Georgia. Fl. June-August. Ft. August-September (Fig. 9).

Specimens Examined:

CANADA

ONTARIO: HALDIMAND CO.: Caledonia, Stroud s.n., 14 Aug. 1934 (TRT). LINCOLN CO.: Niagara Tp. 4 mi. w. of Niagara-on-the-Lake, Miller 563, 29 July 1952 (HAM, TRT); Location #411 Niagara Tp. nr. mouth of Four-mile Creek, Soper 5797, 12 Aug. 1952 (TRT); ibid., Montgomery and Shumovich 660, 19 June 1953 (TRT); nr. Niagara-on-the-Lake, Caesar 307, 16 July 1957 (HAM). NORFOLK CO.: location not specified, Nicholl 75, July 1880 (BM). WELLAND CO.: Niagara Falls, Scott s.n., 8 July 1896 (TRT); Whirlpool, Niagara R., Scott s.n., 19 Sept. 1908 (TRT).

U.S.A.

ALABAMA: BLOUNT CO.: west of Blount Springs, Eggert s.n., 20 June 1894 (MO). CULLMAN CO.: Bridge 19 on L & N Railroad, Eggert s.n., 26 Sept. 1898 (MO).

ARKANSAS: BENTON CO.: Fayetteville, T.L.H. 934, July 1880 (UARK). CARROLL CO.: Busch, Bush, s.n., 26 Aug. 1935 (MO); along road at Eureka Springs, Bucholz s.n., 29 June 1923 (UARK); along road to Huntsville, Bucholz s.n., 1 June 1923 (UARK). NEWTON CO.: Poue

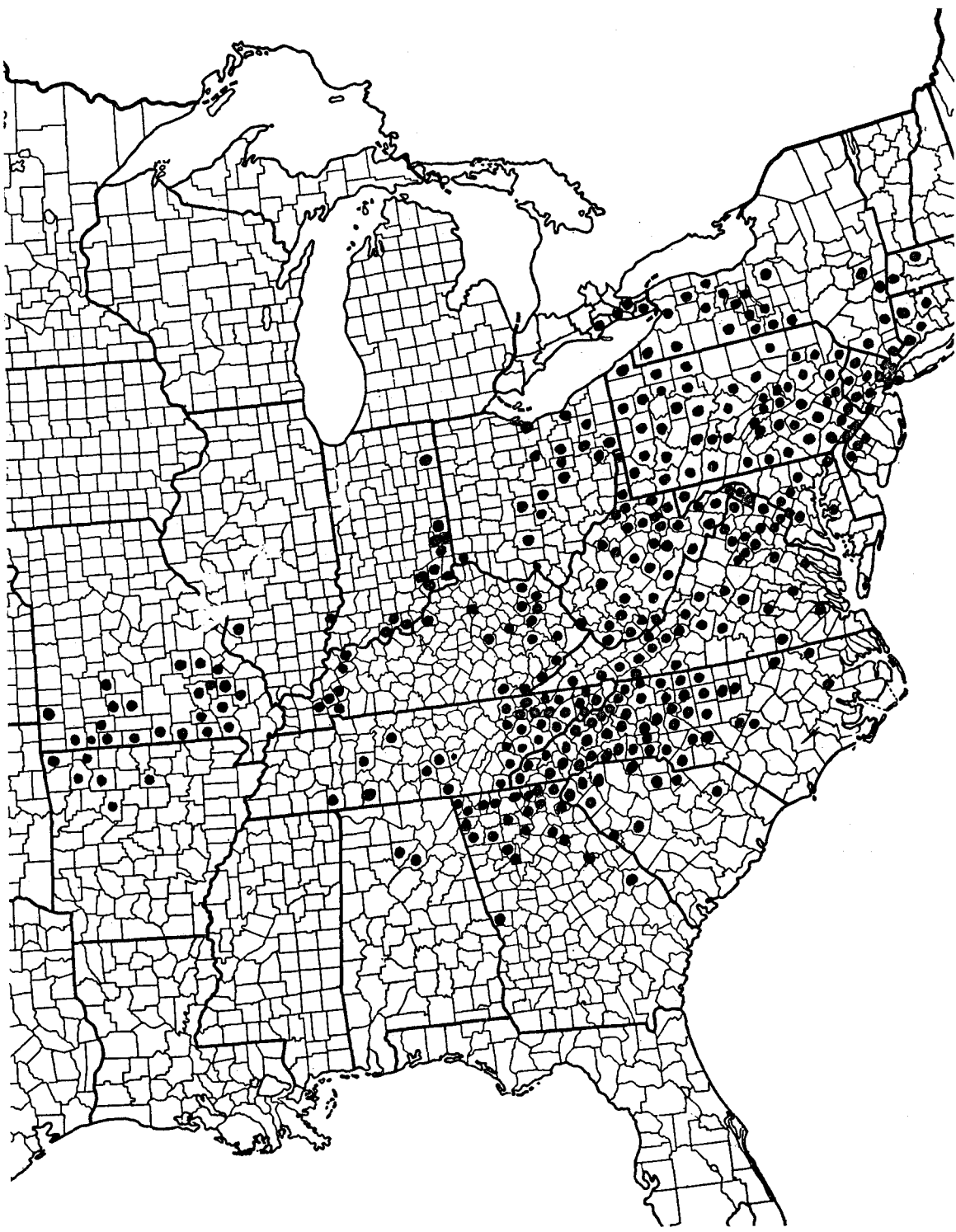


Figure 9. Distribution of Cimicifuga racemosa.

(river flat), Moore 32501, 17 June 1932 (UARK). POPE CO.: Freeman Springs, Moore 4544, 10 July 1939 (UARK). STONE CO.: Blanchard Springs, Moore 450579, 18 June 1945 (UARK).

CONNECTICUT: FAIRFIELD CO.: in the vicinity of Green's Farms, Pollard 123, 4 July 1894 (US); Fairfield, Eames s.n., 26 Sept. 1895 and 19 July 1896 (US, GH); Fairfield, Eames s.n., 4 Sept. 1898 (NEBC); Stratford, Churchill s.n., 20 Sept. 1899 (NEBC, MO); Norwalk, Bissell s.n., 16 July 1902 (NEBC); Danbury, Emerton s.n., 15 July 1912 (NEBC); Ridgefield, anon. s.n., 18 July 1912 (NEBC); Greenwich, Weatherby s.n., 20 June 1913 (NEBC); Norwalk Eames s.n., 19 June 1939 (GH); Easton, anon s.n., no date (GH); Indian Wells Parks, Shelton, Lucian s.n., 5 July 1942 (NY). HARTFORD CO.: Southington, Bissell s.n., 20 July 1898 (GH); Southington, Andrews s.n., 20 July 1899 (NEBC).

LITCHFIELD CO.: Salisbury, Weatherby s.n., 17 May 1922 (NEBC); Norfolk, Clark s.n., 17 July 1903 (US). NEW HAVEN CO.: Moose Hill, Oxford, Harger s.n., 15 Sept. 1901 (NEBC); New Haven, Eaton s.n., 1856 (C); New Haven, Allen s.n., 12 July 1879 (NEBC); Southbury, Shepardson s.n., 19 June 1898 (NEBC); Middlebury, Dewitt s.n., 23 July 1912 (NEBC).

DELAWARE: NEW CASTLE CO.: Centreville, Commons s.n., 29 June 1876 and 13 Sept. 1876 (GH); Greenback, Commons s.n., 10 July 1885 (GH, NY); Greenback, Commons s.n., 12 Aug. 1885 (GH); Wilmington, Tatuall s.n., July 1889 (GH); Brandywine, Tatuall s.n., July 1890 (GH); n. of Wilmington, Canby s.n., 20 Sept. 1901 (NY); Brandywine Creek above Rockland, Tatuall s.n., 5 July 1931 (GH).

DISTRICT OF COLUMBIA: Washington, Ward 208, 22 June 1873 (US); in vicinity of Washington, Chickering s.n., 24 June 1873 (ILL); Washington, Vasey s.n., 1873 (US); Washington, McLean s.n., 1877 (US); Washington, Vasey s.n., (US); nr. the Sligo, n. of Takoma, Pollard s.n., 10 July 1895 (US); Lower Rock Creek, Steele s.n., 30 June 1896 (US); Chevy Chase Circle, Pieters s.n., 1 July 1897 (MICH); n. of Reno. Chase 2493, 18 July 1904 (ILL.).

FLORIDA: NO COUNTY: No locality stated, Mattaner s.n., 1829 (US).

GEORGIA: BARTOW CO.: along Boston Creek, Forman s.n., 10-20 June 1959 (PENN); in ravine approx. 3/5 mi. s.w. of Allatoona Dam, Duncan 8509, 18 July 1948 (GA). BURKE CO.: in ravine at Shell Bluff, Duncan 3404, 20 June 1941 (GA). CHATTOOGA CO.: 2.4 mi. e. 35 s. of Trion, Harris & Duncan 12837, 16 July 1951 (GA). CLARK CO.: Tallassee Shoals, Reade E8298, 17 May 1930 (GA). COBB CO.: 1 mi. s.w. of bridge over Chattahoochee River at Pace's Ferry Rd., Vernald & McDowell V-400, 20 June 1947 (GA, GEO). DADE CO.: Lookout Mt., Ruth s.n., July 1898 (NY); w. side of Lookout Mt., road above Sulphur Springs Station, about half-way to summit, McVaugh 8999, 2 July 1948 (MICH, MO). GANNIN CO.: Blue Ridge Mts., Smith 2497, 23 July 1900 (F, WIS). FLOYD CO.: Mount Berry, Azalea Gulch, Jones-677, 18 June 1938 (GA). FORSYTH CO.: in ravine 7.8 mi. e. 8° n. of Cumming, Adams 18768, 1955 (GA). FULTON CO.: Atlanta, Fattig s.n., 1 June 1927 (GEO). HARRIS CO. along standing Bay Creek directly n. of Columbia, Duncan 9666, 4 June 1949 (GA). JACKSON CO.; on w. bank of Middle Oconee River, Harper s.n., 5 May 1897 (NY). LUMPKIN CO.: Hillside nr. stream 9 mi. se. of

Dahlonega, Justice s.n., 21 May 1948 (GA). MURRAY CO.: 1 mi. e. of Cisco, Leeds 2173, 15 June 1934 (PH); on top of Bald Mt., Duncan 7269, 19 Sept. 1946 (GA). PICKENS CO.: Tate, Holder E7916, 20 July 1929 (GA). RABUN CO.: on mountain side overlooking Nachoochee Reservoir, Duncan 3304, 25 May 1941 (GA); nr. base of Estaloah Falls, 2 mi. ne. of Dillard, Harper 1366, 12 July 1939 (PH); Mountain City, Reade E2121, 3-4 July 1911 (GA). STEPHENS CO.: on n. slopes of hills overlooking Panther Creek, Fitzgerald s.n., 22 June 1962 (GA). TALIAFERRO CO.: nr. junction of Little River and Williams Creek, Harper 1096, 8 June 1939 (PH). TOWNS CO.: just below Mose Gap nr. Titus, Duncan 6963, 18 Aug. 1946 (GA). UNION CO.: 3 mi. w. of Vogel State Park, Hardin 253, 7 Aug. 1954 (GA). WALKER CO.: valley between Lookout Mt. & Pigeon Mt., Cronquist 5414, (GA, GH, IND, NY, PH, US). WHITE CO.: $\frac{1}{2}$ mi. n. of Unicoi Gap, Duncan 1484, 8 July 1939 (GA). WHITEFIELD CO.: a few feet above Freeman Springs 6.0 mi. s. 21 w. of Tunnel Hill, Duncan 12664, 21 June 1951 (GA).

ILLINOIS: ST. CLAIR CO.: locality not stated, Brendel s.n., no date (ILL); Mascoutah, Welsch s.n., no date (ILL). WABASH CO.: Mt. Carmel, Schneck s.n., no date (ILL).

INDIANA: ALLEN CO.: 3 mi. above Cedarville, Deam 14277, 14 June 1914 (IND). CRAWFORD CO.: in ravine nr. Wyandotte Cave, Deam s.n., 11 July 1899 (IND). FAYETTE CO.: Bear Creek Boy Scout Reservation, 3 mi. s. of Nulltown, Buser 2458, 15 June 1953 (ILL). FRANKLIN CO.: 3 mi. w. of Metamora, Deam s.n., 17 Sept. 1915 (IND): nr. Brookville, McCoy 4166, 3 Aug. 1935 (DPU). HARRISON CO.: 2 mi. se. of Corydon,

Deam s.n., no date (IND). JEFFERSON CO.: Clifty Falls State Park, Martens s.n., 2 July 1931 (IND); Hanover, Young s.n., July 1875 (IND, NY, PH); Hanover, Young s.n., Aug. 1877 (IND); Approx. ½ mi. n. of North Madison, Deam s.n., 4 Sept. 1910 (IND); Clifty Falls State Park, Daubenmire s.n., 12 July 1928 (OSC, WIS, WTU). JENNINGS CO.: north fork of Muscatuck River, approx. 1 mi. n. of Vernon, Deam 9151, 9 July 1911 (IND). OHIO CO.: Laughery Creek, 1.7 mi. e. of Hartford, Friesner 12,037, 18 June 1938 (WVA). PERRY CO.: on the Ohio River about 6 mi. e. of Cannelton, Deam 16577, 29 June 1915 (IND). RIPLEY CO.: 2 mi. w. of Cross Plains, Deam 16149, 19 June 1951 (IND). UNION CO.: Liberty, Overholts s.n., 2 July 1910 (MO).

KENTUCKY: BELL CO.: n. side of Hwy. 25E, just e. of Pineville City limits, Ramsey & Holt 482, 11 Sept. 1962 (TENN); BREATHITT CO.: Robinson Forest, Smith 1574, 17 June 1957 (KY). CALDWELL CO.: w. of Dawson Springs, Wharton & Beckett 195, 27 June 1951 (KY). CARTER CO.: e. of Tygarts River nr. Cascade Caverns, Smith et al. 3481, 4 July 1937 (GH, NY, US). GAYETTE CO.: Lexington, Galliher s.n., 8 July 1930 (KY); Louisville, Mueller s.n., May 1889 (WTU). FLOYD CO.: Estill Springs, Anderson 332, 5 July 1926 (MO). JEFFERSON CO.: Southern Hills 3 mi. s. of Louisville, Bergmann s.n., 30 July 1892 (MO); Indian Hills Road, Crulskamp 122, 27 June 1955 (KY); 4 mi. w. of Piedmont on U. S. 25W-70, Ahles & Smith 54396, 16 June 1961 (NCU). LETCHER CO.: nr. U.S. 119 on n. side of Pine Mt., McIntaer 1889, 21 June, 1952 (KY). LEWIS CO.: 2 mi. sw. of Petersville, Wharton 5450, 1 June 1940 (KY); 2 mi. sw. of Petersville, Wharton 5443, 1 July 1940 (TENN). LYON CO.: nr.

Eddyville, Palmer 17851, 14 June 1920 (MO). MADISON CO.: w. pinnacle of Berea College Forest, Grossman 398, 28 June 1960 (KY). MARSHALL CO.: Calvert City, Eggleston s.n., 16-19 June 1909 (NY). TRIGG CO.: just w. of Cadiz, Gleason s.n., 26 June 1940 (NY). WHITLEY CO.: on Hwy. 11E 6 mi. e. of its junction with Hwy. 92, Ramsey & Holt 483, 11 Sept. 1962 (TENN); 6 mi. e. of Williamsburg on Hwy. 92, Ramsey & Holt 484, 11 Sept. 1962 (TENN). POWELL CO.: 1.5 mi. nw. of Stanton, Wharton 2764, 21 June 1938 (KY). ROWAN CO.: woods s. of Triplett, Wharton 6502, 4 July 1949 (KY). WEBSTER CO.: woods s. of Dixon, Wharton & Beckett 182, 27 June 1957 (KY).

MAINE: YORK CO.: North Berwick, Parlin 1223, 6 Sept. 1899 (GH, NEBC); North Berwick, nr. Bauneg Beg Pond, Perkins s.n., 25 July 1953 (NEBC), (perhaps originally planted).

MARYLAND: BALTIMORE CO.: Mt. Washington, Knowlton s.n., 25 June 1920 (GH); locality not stated, anon. s.n., July 1887 (GH). CECIL CO.: Aikin, Sempers 1506, 23 June 1899 (ILL). GARRETT CO.: locality not stated, Smith s.n., 2 Oct. 1882 (US); vicinity of Jennings, 4 mi. sw. of Grantsville, Stone s.n., 8-16 Aug. 1911 (PENN, PH); n. of Oakland, Eggleston 22875, 1928 (US). HOWARD CO.: Ellicott City, Arsene s.n., 6 July 1916 (NY). Va. side of the Potomac River, from Chain Bridge to opposite Cabin John Bridge, Morris s.n., 1 July 1899 (F); Plummer's Island, in the Potomac River, nr. Cabin John, Standley 11730, 20 June 1915 (US). PRINCE GEORGE CO.: nr. Collington, Maxon 5987, July 1913 (US); nr. Friendly, Blake s.n., 27 June 1926 (GH). TALBOT CO.: 3 mi. ne. by n. of Trappe, Earle 2737, 5 July 1940 (PENN); County not

specified; location not specified, Blake 9514, 27 June, 1926 (BM).

MASSACHUSETTS: BERKSHIRE CO.: New Marlboro, Hoffmann s.n., 15 July 1912 (NEBC); Sheffield, Walters s.n., 23 July 1915 (NEBC); Sheffield, Churchill s.n., 19 July 1920 (NEBC, MO); Sheffield, Churchill s.n., 21 July, 1920 (GH, NEBC); Mt. Washington, Meredith s.n., 27 July 1923 (PH); FRANKLIN CO.: E. Bernardston, Murdoch, s.n., 22 July 1913 (F, NEBC); E. Bernardston, Churchill s.n., 23 June 1925 (MO, NEBC).

MISSOURI: BOLLINGER CO.: along the Castor River, 5 mi. w. of Grassy, Steyermark s.n., 1 Aug. 1934 (MO). BARRY CO.: Eagle Rock, Bush 61, 21 June 1897 (F, MO, NY). BUTLER CO.: along tributary of Mud Creek, 2 mi. nw. of Rombarrer, Steyermark s.n., 7 July 1936 (MO). CARTER CO.: along Current River, w. of Elm Spring Hollow, just sw. of Chilton, 2 mi. e. of Big Spring State Park Boundary, Steyermark s.n., 19 June 1949 (F); along Big Barren Creek, 10 mi. nw. of Bennett, Steyermark 5332, 22 May 1938 (F). CHRISTIAN CO.: along Swan Creek, $3\frac{1}{2}$ mi. sw. of Chadwick, Steyermark 23042, 6 July 1937 (F, MO). CRAWFORD CO.: along Courtois Creek, $\frac{1}{2}$ -1 mi. sw. of Butts P.O., Steyermark s.n., 14 June 1941 (F). DALLAS CO.: along Niangua River, $3\frac{1}{2}$ mi. se. of Windyville, Steyermark 64675, 4 July 1947 (DAO, F). HOWELL CO.: along Eleven Point River, 5 mi. ne. of Peach Valley, Steyermark s.n., 12 Aug. 1934 (MO). IRON CO.: Pilot Knob, Eagelmann s.n., July 1807 (MO); Ironton, Savage & Stull 254, 11 June 1897 (F); Des Arc., Smith s.n., 8 June, 1908, (F); Des Arc., Palmer s.n., 2 July 1914 (MO). JASPER CO.: Carthage, Palmer 1102, 25 Aug. 1907 (MO); Carthage, Palmer 2325, 23 June 1909 (GH, MO, NY, US, WVA); along

Spring River, nr. Forest Mill, Palmer 18360, 15 July 1920 (GH, ILL, NY).

MADISON CO.: along St. Francis River 3-3½ mi. se. of Jewett, Steyermark s.n., 18 June 1941 (F); Mine La Motte, Eggert s.n., 24 June 1898 (MO).

OREGON CO.: along "the Narrows" nr. Blue Spring, Palmer & Steyermark s.n., 13 July 1933 (MO); along Fiddlec Spring 4 mi. s. of Irish Wilderness, Steyermark 5402, 24 May 1937 (F). OZARK CO.: along river nr. Pontiac, Palmer 34775, 27 June 1928 (MO, PH, US), along Spring Creek, w. of Rickbridge, Steyermark s.n., 9 June 1939 (F). REYNOLDS CO.: along Black River, ¼ mi. n. of mouth of Sinking Creek, 9 mi. e. of Redford, Steyermark s.n., 2 Aug. 1934 (MO). RIPLEY CO.: along Current River about ½ mi. s. of mouth of Buffalo Creek, e. of Bennett, Steyermark s.n., 6 Aug. 1934 (MO). ST. FRANCIS CO.: Bonne Terre, Eggert s.n., 31 Aug. 1891 (F)(US); Stony Hills, Eggert s.n., 3 July and 31 Aug. 1892 (GH); Chung Hills, Eggert s.n., July 1892 and Aug. 1891 (US); Doe Run, Kellogg s.n., 26 June 1928 (MO). ST. LOUIS CO.: St. Louis, Sherff s.n., 5 July 1910 (F). STONE CO.: along White River 2 mi. ne. of Dorcas, Steyermark 22684, 26 June 1937 (MO); along river 3 mi. nw. of Ponce de Leon, Steyermark s.n., 22 June 1941 (F); along White River, e. of Tibbett's Ferry, ½-1½ mi. e. of Dorcas, Steyermark s.n., 29 April 1949 (F). TANEY CO.: along valley of Beaver Creek, 2-2½ mi. se. of Kisse Mills, Steyermark s.n., 27 April 1947 (F); along Long Creek, 1-1½ mi. n. of Oasis, Steyermark 67410, 28 April 1949 (F); along Beaver Creek, 3 mi. sw. of Bradleyville, Steyermark 22948, 5 July 1937 (F, MO). WASHINGTON CO.: along Courtois Creek, ½-1½ mi. s. of Ishmael P.O., Steyermark s.n., no date given (F); 5 mi.

s. of Ishmael P.O., Steyermark s.n., no date given (F); 5 mi. s. of Potosi, Wehmeyer s.n., 27 June 1923 (MICH); along Brazil Creek, 6 mi. ne. of Berryman, Steyermark s.n., 14 Aug. 1936 (MO). WAYNE CO.: Williamsville, Wislizenns s.n., July 1889 (MO); nr. lake of Markham Spring, 3 mi. w. of Williamsville, Steyermark s.n., 28 June 1936 (MO); along Otter Creek and Wet Fork, between Rucker and Ojibway, Steyermark 6622, 4 Sept. 1939 (F). WEBSTER CO.: locality not stated, Bush s.n., 10 Aug. 1892 (MO); vicinity of Rogersville, Standley 9818, 3 Sept. 1912 (US). WRIGHT CO.: along headwaters of Bryant Creek, 2 mi. se. of Cedar Gap, Steyermark 23680, 26 July 1937 (F, MO).

NEW JERSEY: BERGEN CO.: Englewood, Churchill s.n., 8 July 1883 (MO); Seadi, Woolson s.n., July 1873 (F). CAMDEN CO.: Camden, Martindale s.n., 1876 (ILL); along Cooper Creek ne. of Haddenfield, Long 44969, 10 Oct. 1934 (PENN). ESSEX CO.: Mackenzie s.n., 12 July 1903 (IND); Eagle Rock, Mackenzie s.n., 4 July 1905 (MO). GLOUCESTER CO.: Parker Farm, Swedesboro, Lippincott s.n., 26 June 1892 (GH); ibid., Lippincott s.n., 2 July 1893 (GH); along streamlet tributary to Raccoon Creek, Swedesboro, Long 16113, 6 June 1917 (GH). HUNTERDON CO.: along tributary to Musconetcong River, Musconetcong Mt. se. of Ludlow, Fogg 8947, 5 July 1935 (PENN); ca. 1 mi. e. of Cherryville, Long 47413, 27 Aug. 1935 (PENN). MERCER CO.: Princeton, Schott s.n., 17 July, 1885 (F). MORRIS CO.: Budd Lake, Heritage s.n., 26 Sept. 1894 (PENN); Mt. Tabor, Tate 11365, July 1924 (GH); ibid., Moldenke s.n., 30 July 1925 (NY); 3/4 mi. nw. of Ledgewood, Fogg 12413, 10 July 1937 (PENN). SALEM CO.: Oldmans Creek, ca. 1.5 mi. n. ne. of Eldridges Hill, Long

33956, 30 May 1928 (PENN); along Oldmans Creek, 1½ mi. n. nw. of Auburn, Fogg 6644, 1 June 1934 (PENN); Oldmans Creek, ca. 1.5 mi. n. ne. of Eldridges Hill, Long 34785, 15 June 1930 (GH). SOMERSET CO.: "Second Mt.," Watching, Mildenke s.n., 5 July 1931 (NY); Sourland Mts., ca. 4 mi. nw. of Blawenburg, Fogg 12311, 7 July 1937 (PENN, GH). SUSSEX CO.: Hamburg Mts., Van Sickle s.n., 1 Aug. 1894 (US); Barricade Mts., Bartram s.n., 21 Oct. 1917 (PH). WARREN CO.: ne. of Johnsonburg, Griscom 12138, 24 Aug. 1924 (GH). Location not specified, Torrey s.n., 1833 (BR).

NEW YORK: ALBANY CO.: Tarrytown, Forbes s.n., 7 Sept. 1908 (GH). BROOME CO.: Binghamton, anon. s.n., no date (F); ibid., Millspaugh s.n., 1886 (US). BRONX CO.: Pelham Park, Clute s.n., 12 July 1899 (NY); Mosholu, Van Courtlandt Park, Burnham 162, 16 July 1901 (GH); Van Courtlandt Park, Edmondson s.n., 20 July 1902 (NY). CATTARAUGUS CO.: along stream, seneca Junction, Muenschner 15494, 27 Sept. 1924 (GH); on Three-Sisters Mt., Alexander & House 12409, 18 July 1926 (GH). CHAUTAUQUA CO.: Chautauqua, Guttenburg s.n., July 1880 (F); Sheridan, Southworth s.n., 30 July 1885 (MICH); Findley's Lake, Guenman 187, Aug. 1891 (MO); Chautauqua, Keys s.n., Aug. 1891 (ILL); Bemus Point, Lake Chautauqua, Churchill s.n., 1 Aug. 1896 (MO); along Cattaraugus Creek, nr. Irving, Johnson s.n., 14 July 1918 (NY). CHEMUNG CO.: locality not specified, Lucy 50, 30 July 1897 (F, ILL, WIS); ibid., Lucy 50, 5 Aug. 1896 (GH); nr. Elmira, Rhodes s.n., July 1935 (DPU). COLUMBIA CO.: 1 mi. n. Kinderbook, McVaugh 1282, 28 June 1933 (PENN). DUTCHESS CO.: Pine Plains, Hoysradt s.n., July 1875 (US). ERIE CO.:

Buffalo, Gillman s.n., 15 July 1864 (NY); Englewood, Churchill s.n.,
 July 1883 (PH). GENESSEE CO.: Leroy, Hill s.n., 7 July (ILL).
 LIVINGSTON CO.: Mt. Morris, Gilman s.n., 18 July 1880 (WTU). MONROE
 CO.: Mumford, Hill 90, 1879, 7 Aug. 1879 (ILL). ONONDAGA CO.:
 Onondago Valley, Cowles s.n., 1867 (MICH). Syracuse, Underwood s.n.,
 July 1890 (NY). ONTARIO CO.: locality not specified, Hall s.n., 1828-
 1834 (F). ORANGE CO.: West Point, Mearns s.n., no date (NY). QUEENS
 CO.: Long Island, Thurber s.n., 6 July 1853 (GH); Bayside, Long Island,
Bisky s.n., July 1886 (NY). RICHMOND CO.: Clove Lake, Staten Island,
Britton s.n., 12 July 1890 (NY); ibid., Dowell 5414, 4 July 1905 (GH).
 SCHUYLER CO.: Watkins Glen, Eames 2339, 19 July 1914 (GH); w. of
 Reynoldsville, Hector, Eames 2338, 19 July 1914 (GH); Watkins Glen,
Lee s.n., July 1898 (NY). SENECA CO.: Cayuta Lake, anon. s.n., 30
 July 1875 (US). STEUBEN CO.: Oak Hill, n. side of Canisteo River,
 Canisteo Township, Clausen 2710, 25 July 1937 (PENN). TIOGA CO.:
 Tioga Center, Chase s.n., 1885 (WIS); Mutton Hill Pond, Appalachin,
 Owego, Wright et al. 12074, 18 July 1919 (GH). TOMPKINS CO.: hills
 w. of Dryden Lake, Eames et al. s.n., 20 July 1919 (MO). WESTCHESTER
 CO.: Yorktown, Greene s.n., no date (WIS); Peekskill, Russell s.n.,
 4 Aug. 1885 (WIS); Peekskill, T.A. Puissant s.n., 4 July 1874 (BR).
 Mohegan, Martens s.n., 22 July 1888 (GH); Sing Sing, Barnhart s.n.,
 6 July 1889 (NY); North Tarrytown, Barnhart s.n., (NY); Bedford,
Wilkes s.n., 25 June 1905 (TRT); Scarsdale, Williams s.n., 12 Aug.
 1906 (GH); vicinity of New Rochelle, Garvens s.n., 1908 (F); nr.
 Mamaroneck, L.M.A. 2-157, 19 July 1955 (HAM); YATES CO.: Penn Yan,

Sartwell s.n., no date (US); Dresden in Lake Glen, Phillips 172, 24 July 1932 (ARIZ).

NORTH CAROLINA: ALAMANCE CO.: Richmond Hill, anon. s.n., July 1890 (C). ALLEGHANY CO.: 1 mi. nw. of Whitehead, Radford 38413, 31 July 1958 (NCU). ASHE CO.: 0.5 mi. e. of Bina, Radford s.n., 31 May 1958 (GH); 3.2 mi. e. of Bina, Radford 38659, 1 Aug. 1958 (NCU); 2 mi. se. of Bina on New River, Sharp et al. 32522, 27 Oct. 1963 (TENN).

AVERY CO.: vicinity of Roan Mt., Meehan & Porter s.n., July 1880 (PENN): s. side of Roan Mt., Cannon 114, 18 July 1902 (NY, US); 2.7 mi. n. of Ingalls on U.S. Hwy. 19E, Ahles & Duke 47390, 24 July 1958 (NCU).

BUNCOMBE CO.: Black Mt., Gibbes s.n., Aug. 1854 (NY); Biltmore, anon 571, 21 June 1896 (F, US); ibid., anon 571b, 5 June & 25 Sept. 1897 (BM, F, GH, ILL, NY, PENN, US, WIS); Asheville, Robinson s.n., 30 July 1893 (GH); under slopes of Craggy Mt., anon. 1966, 31 Aug. & 6 Oct. 1897 (ILL); Asheville Common, Mohr s.n., 8 July 1900 (US); ibid., Schneck s.n., 13 June 1902 (ILL); Biltmore, anon., s.n., no date (US); Black Mt., Buckley s.n., 1 Sept. (NY); ibid., Davis 1491, 22 June 1920 (MICH); Asheville, Kraus s.n., June 1925 (WIS); Bent Creek Forest St., Jester s.n., 29 June 1938 (PH); 14 mi. nw. Asheville, above French Broad River, Ramsey & Ramsey 30371, 25 June 1962 (TENN).

BURKE CO.: .5 mi. n. of Morganton on N. C. Hwy. 18, Bell 8687, 10 June 1957 (NCU); off U.S. 64 just s. of Bailey Fork, n. of Brindletown, Bradley 851, 15 June 1963 (NCU).

CALDWELL CO.: 3 mi. nw. of Collettsville nr. Johns River, Radford 14957, 4 Aug. 1956 (NCU).

CATAWBA CO.: nr. Henry Fork River at Brookford, Bell 9040, 12 June 1957 (NCU).

CHEROKEE CO.:

4.5 mi. ne. of Grand View, Radford 17555, 31 Aug. 1956 (NCU); just below Hiwassee Dam, Ramsey & Ramsey 524, 17 Aug. 1963 (TENN). CLAY CO.: 1 mi. w. of Glade Gap on Hwy. 64, Ramsey & Ramsey 527, 18 Aug. 1963 (TENN); CLEVELAND CO.: Maple Creek, 0.5 mi. n. of Lawndale, Ahles & Leisner 15162, 22 June 1956 (NCU). DAVIDSON CO.: 2.5 mi. nw. of Churchland nr. Yadkin River, Radford 12895, 16 June 1956 (NCU). DAVIE CO.: 3.4 mi. s. of fork in Yadkin River, Radford 14828, 3 Aug. 1956 (NCU); 12 mi. w. of Winston-Salem, Godfrey s.n., 21 Aug. 1938 (GH); 1.7 mi. n. of U.S. Hwy. 158 along the Yadkin River, Ahles & Duke 45359, 2 July, 1958 (NCU). GASTON CO.: 1 mi. s. of Mt. View nr. Crowders Mt., Ahles & Leisner 15086, 21 June 1956 (NCU). GRAHAM CO.: 0.2 mi. w. of Graham-Swain Co. line, ne. of Roundtop Mt., Ahles & Radford 13203, 29 May, 1956 (NC); 4 mi. s. of Robbinsville, Radford 14194, 19 July 1956 (NCU). GUILFORD CO.: 10 mi. e. of Greensboro, Wiegand & Manning s.n., 29 June 1927 (GH); ca. 1 mi. s. of Reedy Fork Creek, nr. Hwy. 29, Melvin s.n., 18 June 1953 (NCU). HARNETT CO.: ca. 3 mi. nw. of Lillington along Cape Fear River, Laing 717, 18 Oct. 1956 (NCU); Cedar Creek, ca. 3.5 mi. sw. of Cape Fear River, Laing 1267, 15 May 1957 (NCU); HAYWOOD CO.: coves of Caney Fork, Balsam Mt., Smith s.n., 11 Aug. 1882 (US); Balsam Mt., Williamson s.n., Aug. 1896 (PH); Fincher Mt., Lake Junaluska, Price s.n., 12 June 1935 (NY); Swallow Fork, Mt. Sterling, Jennison & Bain 1135, 29 Aug. 1935 (TENN); 5.2 mi. e. ne. of Crabtree, Ahles & Duke 42143, 5 June 1958 (NCU); 5.1 mi. nw. of Crabtree, on road paralleling the Pigeon River, Ahles & Duke 46645, 15 July 1958 (NCU). HENDERSON CO.: 0.5 mi. n. of U.S. Hwy. 64, 6 mi. ne. of Hendersonville, Pittillo 220 & 226, 1 July

1956 (KY, GA); Flat Rock, Memminger s.n., 15 July 1885 (NCU). IREDELL CO.: 1.3 mi. e. of Hustonville, then 0.8 mi. se., Ahles & Duke 48947, 7 Aug. 1958 (NCU). JACKSON CO.: Cullowhee, Thaxter s.n., June-July 1887 (GH); 1.4 mi. sw. of Balsam, Radford s.n., 26 June 1946 (NCU); Cedar Cliff Mt. e. of Tuckaseegee, Godfrey 51393, 17 July 1951 (NCU); se. slope of Judaculla Ridge, Ramseur 3851, 1 Aug. 1957 (NCU). LEE CO.: just up river from mouth of Patterson's Creek, Kessler 341, 20 June 1955 (NCU, WTU). LINCOLN CO.: Little Creek sw. of Cat Square, Bell 15342, 9 Sept. 1958 (NCU). MACON CO.: Highlands, Dunham s.n., 13 July 1888 (F); below Cullasaga Falls, on U.S. Hwy. 64, between Highlands and Franklin, Hechenbleikner & Stewart, s.n., 31 July 1938 (NCU); Corundum Hill 1½ mi. nw. of Gneiss, Radford s.n., 15 June 1946 (NCU); ½ mi. sw. of Ellijay, Radford s.n., 24 Aug. 1946 (NCU); on farm of Clifford Dalrymple sw. of Franklin, Ramsey & Ramsey 530, 18 Aug. 1963 (TENN). MADISON CO.: nr. Hot Springs, Wehmeyer 626, 13 Aug. 1924 (MICH); 1 mi. nw. of Hotsprings, Radford & Hassloop 7276, 8 June 1953 (NCU); 3.5 mi. se. of Trust on N. C. Hwy. 36, Ahles & Duke 46485, 14 July 1958 (NCU). MARTIN CO.: nr. Conoho Creek 4.3 mi. nw. of Williamston, Radford 35272, 16 June 1958 (NCU). MCDOWELL CO.: 4.6 mi. e. ne. of U. S. Hwy. 221 along n. shore of Lake James, Bell 3583, 11 June 1956 (NCU); Blue Ridge Parkway nr. Singe Cat Ridge, Channell & Rock s.n., 28 July 1956, (GH). MECKLENBURG CO.: 0.4 mi. n. of junction of Catawba River and U.S. 29-74 on road to Thrift, Ahles & Duke 44906, 30 June 1958 (NCU). MITCHELL CO.: 1.4 mi. ne. of Hawk, Ahles & Duke 47209, 23 July 1958 (NCU). MONTGOMERY CO.: nr. Wadeville, Correll s.n., 15 June 1935 (GH).

NORTHAMPTON CO.: 1.1 mi. e. of Henrico, Ahles & Duke 41993, 31 May 1958 (NCU). ORANGE CO.: locality not specified, Slidensticken s.n., 12 July 1887 (PH); by Meeting-of-the-Waters Branch, Totten s.n., 5 July 1916 (NCU); Eagle's Sponge Farm 2 mi. n. of Carboro, Reasoner s.n., 13 Oct. 1917 (NCU); locality not specified, Totten s.n., 9 May 1920 (NCU); n. side of Morgan's Creek at Laurell Hill, Koch s.n., 12 June 1942 (NCU).

POLK CO.: Columbus, Townsend s.n., 2 June 1899 (WTU); nr. Tryon, Millspaugh s.n., June 1918 (F); Vaughan's Creek, Peattie 989A, 19 July 1921 (F); Rich Glen-Melrose, Peattie 1098, 8 Aug. 1921 (F); Tryon, Peattie 1135 & 1135A, 9 Aug. 1921 (NCU); Pacolet River below Hyneote Hill, Peattie 601A, 20 June 1921 (F, NCU). RANDOLPH CO.: .4 mi. n. of U.S. Hwy. 64 & 22 mi. e. of county line, nr. Uwharrie River, Bell 14203, 1 Aug. 1958 (NCU). ROCKINGHAM CO.: 3 mi. n. of Reidsville nr. N.C. Hwy. 14, Radford 13602, 7 July 1956 (NCU); Spray, de Chalmot s.n., no date (US). ROWAN CO.: nr. Fourth Creek n. of Cleveland, Horton 1397, 14 June 1957 (NCU). RUTHERFORD CO.: nr. the Broad River, 2½ mi. sw. of Harris, Freeman 57480, 29 June 1957 (NCU). STANLEY CO.: between Morrow Mt. and Stony Mt., ca. 1 mi. w. of Pee Dee River, Ahles & Leisner 19944, 24 Sept. 1956 (NCU). STOKES CO.: Belews Creek, 1.2 mi. se. of Pine Hall, Radford 377009, 26 July 1958 (NCU). SURRY CO.: Mt. Airy, Rusby s.n., 21 June 1909 (NY); 3 mi. nw. of Low Gap, Radford 13145, 23 June 1956 (NCU). SWAIN CO.: Cherokee Reservation, Qualla, Mooney s.n., 1888 (US); locality not specified, Beardslee & Kofoid s.n., 5 Aug. 1891 (GH); vicinity of Swayney, Mooney s.n., 18 Sept. 1913 (US); 2.6 mi. e. from N. C. 28 on Mica Knob Road, Ahles 14146, 6 June 1956

(NCU); along Hwy. 441 5 mi. below Newfound Gap, Ramsey & Ramsey 529, 18 Aug. 1963 (TENN); along Hwy. 28 just se. of Bryson City, Ramsey & Ramsey 528, 18 Aug. 1963 (TENN). TRANSYLVANIA CO.: 2 mi. se. of Rosman, Freeman 57450, 27 June 1957 (NCU). UNION CO.: Rocky River on N. C. 742, Ahles & Haesloop 31486, 14 July 1957 (NCU). WARREN CO.: ca. 4 mi. n. of Church Cross Roads on Jordons Creek nr. the Roanoke River, Ahles & Bell 12853, 24 May 1956 (NCU). WATAUGA CO.: 3.9 mi. w. of Triplett, Ahles 47637, 25 July 1958 (NCU); Blowing Rock, Carter s.n., 14 Aug. 1889 (PENN). WILKES CO.: Brushy Mts., nr. Sunland, Stewart s.n., 23 June 1937 (NCU); nr. Mart Branch, ca. $\frac{1}{2}$ mi. nw. of Ball's Mill, Brushy Mt., Stewart 1712, 9 July 1940 (NCU); 7 mi. nw. of Parsonville nr. Phillip Gap, Radford 15177, 5 Aug. 1956, (WYU). YADKIN CO.: s. Depp Creek 4 mi. w. of Yadkinville, Radford 15315, 6 Aug. 1956 (NCU). YANCEY CO.: Mt. Mitchell, Rhoades s.n., July & Aug. 1925 (WIS); 4.4 mi. n. of Swiss, Ahles & Duke 46803, 16 July 1958 (NCU).

OHIO: ASHTABULA CO.: Geneva, Hill 41,1877, 13 July 1877 (ILL). CARROLL CO.: Pekin, Moseley s.n., 23 July 1894 (WIS). COLUMBIANA CO.: Salem, Hasse s.n., 10 July 1887 (NY). CUYAHOGA CO.: Watson s.n., 4 July 1894 (ILL); ibid., Watson s.n., (F, MICH, WIS). ERIE CO.: Birmingham, Boothe s.n., 30 July 1901 (WTU); base of Cedar Point, MacDaniels s.n., 17 July 1914 (GA). FIARFIELD CO.: Columbus, anon. s.n., no date (WIS). HAMILTON CO.: Locality not specified, Lea s.n., July (PH); Cincinnati, Frank s.n., July 1837 (NY); nr. Cincinnati, Lloyd s.n., 25 June 1881 (PH); ibid., Lloyd s.n., 1 July 1883 (CAN, GH); Fernbank, "North Bend," Short s.n., no date (NY, BM). HOLMES CO.:

locality not specified, Drushel s.n., 22 July 1913 (C). LICKING CO.:
 Fort Hill Farm, Granville, Bodley s.n., 20 Aug. 1864 (PH). PORTAGE CO.:
 Hiram TWP, Webb s.n., 1 Aug. 1922 (GH). RICHLAND CO.: locality not
 specified, Wilkinson 511, 28 June & 18 Sept. 1892 (ARIZ, US). ROSS CO.:
 Chillicothe, Safford 394, 1 July 1885 (US). SCIOTO CO.: Camp Gordon,
 CCC Friendship, Demaree 10763, 27 June 1934 (MO); Shawnee State Forest,
 Camp Gordon, CCC Friendship, 27 June 1954 (GH). STARK CO.: Louisville,
Drummond s.n., 1832 (BM). WAYNE CO.: W. Salem, Wilkinson s.n., 10 July
 1887 (MICH); Orville, Bogue s.n., July 1890 (WTU).

PENNSYLVANIA: ADAMS CO.: nr. Gettysburg, Rhoades s.n., Aug.
 1933 (DPU); ridge 1 mi. e. of Center Hill, Wahl et al. 6350, 9 June
 1949 (PENN). ALLEGHNEY CO.: location not specified, anon. s.n., July
 1824 (BR). Pittsburg, Halz s.n., 1831 (BM); Pittsburg, Shaffer 556,
 Aug. 1884 (F); nr. Buena Vista, Tidestrom 7297, 18 Aug. 1914 (US).
 BEDFORD CO.: in vicinity of Hyndman, Small s.n., 19-23 Aug. 1890 (F,
 PH); 1½ mi. sw. of Weyant, Berkheimer 1024, 4 July 1939 (PENN); 3 mi.
 e. se. of Bedford, Berkheimer 9543, 19 Sept. 1947 (PENN); 3½ mi. se.
 of Hopewell, Berkheimer 13887, 6 July 1952 (PENN); Rt. 522, 8 mi. sw.
 of McConnellsburg, Rossback s.n., 17 July 1954 (WVA); 1 5/8 mi. n. nw.
 of Breezewood, Berkheimer 17595, 10 July 1957 (PENN). BERKS CO.:
 along branch of West Swamp Creek, .5 mi. s. of Bechtelsville, Fender
 967, 6 Sept. 1935 (PENN); along fence row 2 mi. s. of Wernersville,
Steckbeck s.n., 27 June 1942 (PENN); 1 3/4 mi. e. ne. of Kennys, Wherry
 s.n., 17 July 1955 (PENN); 1 mi. s. of New Schaefferstown, Berkheimer
 19921, 2 Oct. 1959 (PENN). BLAIR CO.: 4 mi. e. of Altoona, Yuncker

10540, 6 July 1941 (DPU). BRADFORD CO.: Sayre, Barbour 271, 15 July 1898 (ILL); along Susquahanna River 2 mi. n. nw. of Wyalusing, Wagner s.n., 8 June 1938 (PENN). BUCKS CO.: Plumsteadville, Moyer s.n., July 1866, (MO); e. of Rich Hill, Fretz s.n., 8 July 1922 (GH); 1½ mi. ne. of Feasterville, Benner s.n., 28 July 1927 (GH); Springfield, Witte s.n., 20 Aug. 1933 (PENN); nr. county line ¾ mi. nw. of Zionhill, Wherry s.n., 1 Aug. 1945 (PENN). BUTLER CO.: e. of Yellow Creek, 4 mi. ne. of Harmony, Henry 574, 10 July 1937 (F, NCU, PH, US); ibid., Henry 743, 15 July 1939 (NCU); Thom Creek Valley, 3 mi. se. of Renfrew, Jennings s.n., 23 July 1939 (PENN); Slippery Rock, Christley's Mill, Russell NR-2318, 31 July 1946 (PENN); Muddy Creek Isle, Kvovse s.n., 17 July 1948 (NCU). CAMBRIA CO.: Carrolltown, Stone 8817, 21-27 July 1907 (PENN); .5 mi. n. nw. of Fallentimber, Wahl 10277, 11 Sept. 1950 (PENN). CENTRE CO.: 8 mi. se. State College, Thompson s.n., 19 July 1937 (WIS); Union T., State Game Lands No. 103, Westerfield 631, July 1941 (PENN). CHESTER CO.: Westchester, W.D. s.n., 1827 (UPS, S); Valley Forge, Wetherill s.n., 1876 (PENN); locality not specified, Rutnoch s.n., 13 July 1879 (F); ibid., Jeffries s.n., 1886 (F); Westtown, Pennell s.n., 28-31 Aug. 1923 (NY); 1 mi. e. of Black Horse, Fogg s.n., 5 Aug. 1933 (PENN); 1 mi. ne. Birchville, s. of French Creek, Fosberg 15683, 10 July 1938 (PENN); ¾ mi. e. of Rosedale, Wherry s.n., 15 July 1957 (PENN); 1 1/8 mi. s. of Chatham, Wherry s.n., 24 June 1960 (PENN). CLEARFIELD CO.: 2 mi. e. of Curwensville, Lisi s.n., 11 June 1935 (PENN); 9 mi. nw. of Clearfield, Wade 1426, 18 July 1939 (PENN, WIS); nr. Garway, 40° 41' n. & 78° 41' w., Duman 654, 27 July 1840 (PENN);

3 mi. sw. of Penfield, Wahl 2983, 13 July 1947 (PENN). CLINTON CO.:
 Bear Swamp, 5.5 mi. nw. of Beech Creek, Earle 2984, 15 Aug. 1940 (PENN);
 along Susquehanna River, 4.5 mi. nw. of Farrandsville, Travis 2819, 15
 Aug. 1940 (PENN). COLUMBIA CO.: Willow Spring, 4 mi. w. of Berwick,
Fosberg s.n., 6 June 1938 (PENN); 4 mi. e. ne. of Shumans, Wherry s.n.,
 6 Aug. 1958 (PENN). DAUPHIN CO.: Mts. E. Dauphin, Small s.n., 10 July
 1888 (F); along Susquehanna River, 0.5 mi. se. of Dauphin, Wagner 8416,
 10 June 1940 (PENN); 2 mi. e. of Enterline, Berkheimer 14090, 13 July
 1952 (PENN); 2 3/4 mi. s. se. of Millersburg, Berkheimer 13693, 30
 June 1952 (PENN); 2 3/4 mi. n. ne. of Hershey, Berkheimer 15393, 24
 July 1953 (PENN); 2 mi. s. of Hershey, Berkheimer 15855, 30 Sept.
 1953 (PENN). DELAWARE CO.: Gewolden, Brinton s.n., 15 July 1888 (PENN);
 locality not specified, Brinton s.n., 29 Aug. 1888 (PENN); Secane,
Stone 10842, 9 Sept. (PENN); Haver Township Eckfeldt s.n., 10 Aug. 1908
 (PENN); Springfield Township, Eckfeldt s.n., 18 July 1911 (PENN);
 Moylan, Pennell 14756, 16 July 1929 (GH, ILL, NCU, NY, TRT, WVA, GA);
 along Green Creek 1 mi. n. of Swartheware, Earle 476, 17 July 1935
 (TENN); Brooveal, Earle 623, 12 Oct. 1935 (TENN); between Lansdocone
 Ave. & Springfield Rd., Thompson 390, 18 Sept. 1937 (TENN); 1/2 mi. w.
 sw. of Elam, Wherry s.n., 21 July 1957 (PENN); 7/8 mi. e. ne. of
 Edgemont, Wherry s.n., 15 July 1958 (PENN). ELK CO.: Spring Creek,
 along trail in State Game Preserve s. of Croyland, Rood & Simon s.n.,
 20 June 1953 (PENN). ERIE CO.: ne. Erie Co., Honey s.n., 8 Aug. 1920
 (PENN); on lake, North Girand, Phillips s.n., 14 July 1919 (PENN).
 FAYETTE CO.: Dawson, Harper s.n., 1889 (WIS); Johnathan Run Valley,

Bright 7567, 3 Sept. 1932 (WIS); 2 mi. se. of White House, Buvinger s.n., 20 July 1952 (PENN). FOREST CO.: Tionesta, Chandler 2007, 4 Aug. 1938 (PENN); along Tionesta Creek from Henry's Mill to Kelleetville, Morris & Berd, 17637, 5 July 1945 (BR). FRANKLIN CO.: Mercersburg, Porter s.n., 1850 (PENN, PH); Mongul, Erisman s.n., 15 June 1950 (PENN). HUNTINGDON CO.: along Spruce Creek nr. mouth of Warriors Mark Creek, Graham s.n., 11 July 1932 (PENN); Grave Mt., 1 mi. nw. of Cooks, Pohl 3029, 23 June 1941 (PENN); along Raystown Branch 1 mi. ne. of Entriken Bridge, Wahl et al. 5637, 20 July 1948 (PENN). JEFFERSON CO.: 1 mi. wnw. of Allens Mill, Wahl s.n., 15 Sept. 1950 (PENN). JUNIATA CO.: Run Gap, Tuscarora Mt., 3.5 mi. s. of Port Royal, Wagner 8604, 13 June 1940 (PENN); 3/4 mi. e. se. of Doyles Mills, Wherry et al. 7046, 14 July 1949 (PENN). LACKAWANNA CO.: n. of Holling Springs, 1½ mi. s. se. of Ransom, Glowenke 620, 14 July 1937 (PENN); 3/4 mi. ne. of Mescapeck, Glowenke 2636, 15 July 1938 (PENN); on w. slope of West Mt., 2 mi. s. sw. of Chinchilla, Glowenke 1945, 26 July 1946 (PENN); base of slope nr. Virginia Station, 1 mi. se. of Minooka, Glowenke 9874, 5 July 1947 (PENN). LANCASTER CO.: locality not specified, Gaelen s.n., no date (ORE); Conestoga, anon. s.n., June 1864 (GH); Mountville, Ely s.n., Aug. 1889 (MO); Beechdale, Bird-in-Hand, Brubaker 306, 20 May 1934 (PENN); Fry's Mill, ½ mi. ne. of Fryville, Brubaker s.n., 20 July 1934 (PENN); ½ mi. ne. of Snysue, Brubaker s.n., 25 July 1934 (PENN); nr. edge of Rawlinsville, Brubaker 1019, 27 July 1934 (PENN); along small stream 1 mi. w. of IVA, Brubaker 1755, 1 June 1936 (PENN); ½ mi. nw. of Rohrerstown Woodland, Tanger s.n., 28 June 1938 (PENN); ½ mi. e.

of Narvon, Wherry s.n., 27 July 1956 (PENN); 3 mi. n. of Mt. Joy, Wherry s.n., 23 June 1958 (PENN); 1 mi. e. ne. of Bellaire, Berkheimer 18183, 9 July 1958 (PENN); 1 mi. w. nw. of Cresswell, Wherry s.n., 26 Sept. 1960 (PENN); 2 mi. ne. of Bainbridge, Wherry s.n., 26 June 1961 (PENN). LEBANAN CO.: Grandmothers Woods, Kauffman s.n., 6 July 1889. (MICH); Bunkerhill, Ulrich s.n., 13 July 1901 (PENN); Mt. Gretna, Stone s.n., 29 July 1907 (PENN). LEHIGH CO.: Allentown, Arndt s.n., 10 July 1912 (PENN); Valley of the Lehigh River, Treichler, Churchill s.n., 24 Aug. 1923 (GH); Reservoir PK-Bethlehem, Trembley s.n., 3 July 1935 (PENN); 1 mi. w. of Fogelsville, Schaeffer 2702, 3 July 1939 (PENN). LUZERNE CO.: $\frac{1}{4}$ mi. s. of Neseapeck, Glowenke 2701, 15 July 1938 (PENN); Mt. Hemlock Creek, Glowenke 2863, 29 July 1938 (PENN); Wilkes-Barre Mt., 0.5 mi. s. sw. of Warrior Run, Glowenke 8990, 3 Sept. 1946 (PENN). LYCOMING CO.: Essick Heights, Taylor s.n., 1913 (PENN); Picture Rouis, Delong 241, 26 July 1915 (PH); $2\frac{1}{2}$ mi. s. of Slate Run, Wahl 16500, 4 Aug. 1955 (PENN). MCKEAN CO.: along Willow Creek $8\frac{1}{2}$ mi. w. of Bradford, Fogg et al. 20022, 16 Aug. 1950 (PENN). MERCER CO.: 1 mi. n. of Carlton, Wahl 4120, 29 Aug. 1947 (PENN); 1 mi. s. of Sandy Lake, Wahl 14637, 8 July 1954 (PENN). MONROE CO.: Delaware Water Gap, Dreisbach s.n., 4 July 1922 (PENN); Franklin Hill, Dimmick s.n., June 1928 (DAO); along River Road to Bushkill ca. 7 mi. ne. of Shawnee, Synder s.n., 4 July 1933 (PENN); nr. Cool Baugh, Ripley & Barneby s.n., 29 July 1945 (NY). MONTGOMERY CO.: Fishers, Germantown, Edmondson 1446, 26 June 1899 (NY); $\frac{1}{2}$ mi. se. of West Conshohocken, Wherry s.n., 28 July 1954 (PENN); $1\frac{3}{4}$ mi. ne. of Sassamansville, Wherry s.n., 16 July 1959

(PENN); 1 mi. se. of Zieglersville, Wherry s.n., 16 July 1959 (PENN).
 MONTOUR CO.: 2 mi. se. of Washingtonville, Wherry s.n., 7 Aug. 1958
 (PENN). NORTHAMPTON CO.: College Hill, Easton, Porter 15075, 15 July
 1891 (PENN); Easton, Tyler s.n., 14 July 1896 (NY); 3.5 mi. n. nw. of
 Johnsonville, Fogg 14001, 1 Oct. 1937 (PENN); 1½ mi. e. of Wassergass,
Schaeffer s.n., 6 Aug. 1941 (PENN). NORTHCUMBERLAND CO.: 3 mi. se. of
 Riverside, Wade 1755, 14 July 1940 (PENN); vicinity of Mandata, Wagner
8767, 16 July 1940 (PENN); along a branch of Susquahanna River, 1.3 mi.
 e. of Sunbury, Wagner 9024, 18 July 1940 (PENN); along stream 4 mi. n.
 nw. of Turbotville, Travis 2642, 13 Aug. 1940 (PENN); 2½ mi. se. of
 Stonington, Wherry s.n., 13 July 1961 (PENN). PERRY CO.: Upper Henry
 Valley, Abbott s.n., 5-9 Sept. 1920 (PH); ibid., Abbott s.n., 16 July
 1922 (US); 1¼ mi. nw. of New Bloomfield, Adams 1443, 4 July 1934 (PENN);
 1.5 mi. nw. of New Bloomfield, Adams 2094, 4-7 July 1935 (US).
 PHILADELPHIA CO.: locality not specified, anon. s.n., 11 July 1869 (US);
 East Park, Philadelphia, Harshberger s.n., 6 July 1889 (PENN); Bycot,
 vicinity of Philadelphia, Brinton s.n., 15 July 1894 (PENN); 50th and
 Cedar Sts., Philadelphia, Stewart s.n., 16 July 1901 (NY); 1½ mi. ne.
 of Mount Airy Station, Wherry, s.n., 20 July 1948 (PENN); along bridle
 path on Pennyback Creek 1.5 mi. ne. of Fox Chase, Erisman s.n., 21 July
 1945 (PENN). PIKE CO.: Bushkill, Bartram s.n., 23 July 1917 (PH); 2
 mi. n. of Dindman's Ferry, Eggleston & Wiegand 22515, 13 Sept. 1928
 (GH, MO, US); 2-2½ mi. sw. of Matamoras, Glowneke 10171, 1 Aug. 1947
 (PENN). SCHUYLKILL CO.: Schuylkill River ½ mi. s. of Schuylkill Haven,
Wagner 7482, 6 July 1938 (PENN); along Schuylkill River, w. nw. of Port

Clinton, Wagner 6044, 21 Sept. 1937 (PENN). SNYDER CO.: along w. branch Mahantago Creek, 1.5 mi. se. of Meiserville, Wagner 7942, 20 June 1939 (PENN); along Beaver Creek, 3 mi. e. ne. of McClure, Fogg 15964, 21 June 1939 (PENN). SOMERSET CO.: Allegheny Plateau, nr. Buckstann, True s.n., 12 July 1933 (PENN); Moonshine Hollow, 2.4 KM n. ne. of Davidsville, Shelter 87, 6 July 1955 (NY). UNION CO.: ravine on South White Deer Ridge, 1½ mi. n. nw. of White Deer, Wagner 8130, 22 June 1939 (PENN). VENANGO CO.: 2 mi. e. ne. of Petroleum Center, Aharrah 164, 6 July 1952 (PENN). WARREN CO.: Irvineton, Eggleston & Kelly s.n., 29 Sept. 1928 (US); along Allegheny River, 1.5 mi. s. se. of Corydon, Wahl et al. 9892, 16 Aug. 1950 (PENN); .5 mi. n. of Spring Creek, Fogg et al. 20797, 20 June 1951 (PENN); 1½ mi. w. nw. of Tidioute, Fogg et al. 20894, 21 June 1951 (PENN); along w. side of Allegheny River, 4.5 mi. s. sw. of Irvine, Wahl et al. 11740, 21 June 1951 (PENN). WASHINGTON CO.: on the McCarrell Farm, .5 mi. from County Fairgrounds nr. Washington, Wilson 177, 29 June 1952 (WVA). WESTMORELAND CO.: locality not specified, Pierron s.n., 10 July 1876 (ILL); locality not specified, Pierron s.n., 25 July 1877 (F); locality not specified, Pierron s.n., 6 Aug. 1877 (C); Big Spring Summit of Laurel Hill, Eggleston 22841, 3 Oct. 1928 (US); 2 mi. e. of Jeannette, Shaw s.n., 1 Sept. 1960 (PENN). WYOMING CO.: 1 mi. s. se. of Skinners Eddy, Glowenke 10453, 30 Aug. 1947 (PENN). YORK CO.: locality not specified, Glaefelter s.n., 1 Oct. 1892 (MICH); nr. York Furnace, MacElwee 1178, 27 June & 30 Aug. 1899 (PENN); s. end of Hoffacker Valley, 5 3/4 mi. se. of Hanover, Moul 668, 26 Sept. 1945 (PENN); 2.5 mi. n. Hallam, Moul 1974, 21 Aug. 1946 (PENN).

SOUTH CAROLINA: ANDERSON CO.: locality not specified, Earle s.n., 1885 (VPI); ibid., Gribbes s.n., no date (NY); Beaverdam Creek, 1.8 mi. n. of Seneca-Tugaloo River Junct., Radford 12096, 31 May 1956 (NCU). CHEROKEE CO.: 0.5 mi. sw. of junct. County 110 & 39 on County 110, w. of Gaffney, Ahles 34370, 18 Sept. 1957 (NCU). CHESTER CO.: below Fishing Creek Pond Dam, Bell 7441, 13 May 1957 (NCU). DARLINGTON CO.: Lauther's Lake, Hartsville, Smith 200, 25 June 1940 (NCU). GREENVILLE CO.: Stone's Lake, Greenville, Hester s.n., June 1942 (DAO). LANCASTER CO.: s. side of Flat Creek, nr. U.S. 601, ca. 8 mi. ne. of Kershaw, Williamson 1638A & B, 31 July 1961 (NCU). MCCORMICK CO.: Stevens Creek, 1.5 mi. ne. of Clarks Hill, Radford 34777, 8 June 1958 (NCU). OCONEE CO.: Seneca, McCarty s.n., June 1888 (US); locality not specified, Anderson 1543, 10 Sept. 1898 (US). PICKENS CO.: along Keonse River, nr. Six-Mile Creek, House 3090, 22 Oct. 1906 (MO); ca. 12 mi. n. of Pickens, Duncan 11293, 8 July 1950 (GA). SALUDA CO.: Big Creek nr. S.C. 194, 6.5 mi. ne. of Saluda, Radford 26938, 8 July 1957 (NCU).

TENNESSEE: ANDERSON CO.: along road 1 mi. ne. of Clinton, Wilkins 3554, 2 Aug. 1934 (PENN); nr. Norris, Cole s.n., 21 June 1940 (TENN); s. of Solway Bridge, Melton Hill Reservoir, 73,500 ft. e. and 22,000 ft. n., Ellis 28813, 26 June 1961 (TENN); along Clinch River 2 mi. below Norris Dam on Hwy. 441, Ramsey & Holt 30239, 6 June 1962 (TENN); ibid., Ramsey & Holt 30245, 6 June 1962 (TENN); along Clinch River, 2 mi. below Norris Dam on Hwy. 441, Ramsey & Griffin 506, 13 July 1963 (TENN). BLOUNT CO.: trail to Gregory's Bald, Cain s.n., 3

Aug. 1929 (TENN); in cave at Scott Gap, Sharp 344, 30 Aug. 1934 (TENN); Thunderhead Mt., Jennison 344, 22 July 1935 (TENN); 10 mi. nw. of Topoco, N. C. on Hwy. 29, Ramsey & Ramsey 525, 17 Aug. 1963 (TENN). CAMPBELL CO.: Cedar Creek, Sharp et al. 1474, 11 July, 1934 (TENN); ibid., Sharp et al. 2277, 11 July 1934 (TENN). CARTER CO.: base of Roan Mt., Britton s.n., 1 Sept. 1885 (NY); ibid., Britton s.n., 11 Sept. 1885 (NY); Sinking Creek area, Pearman s.n., 26 June 1955 (TENN); Pond Mt. nr. Cedar Gap, Sharp et al. 29590, 12 Sept. 1961 (TENN); ca. 10 mi. above village of Roan Mt., Chester & Rogers 32880, 19 July 1964 (TENN); Doe River Gorge, off 19E s. of Hampton, beyond the second tunnel of Old Tweetsie Railroad bed, Ramsey et al. 31611, 20 Sept. 1963 (TENN); slopes along Hwy. 143, above Roan Village (4200 ft.), Ramsey et al. 31608, 20 Sept. 1963 (TENN). CHEATHAM CO.: 6 mi. e. of Ashland City nr. Marrowbone Creek, Hwy. 12; Chester 913, 914, 5 July 1965 (TENN). CLAIBORNE CO.: Cumberland Gap, Shimek s.n., 1891 (TENN); along Tenn. Hwy. 33 n. of Norris Lake, Sharp et al. 30364, 10 June 1962 (TENN); Gap Creek w. of Arthur, Sharp et al. 30336, 10 June 1962 (TENN). COCKE CO.: nr. Lemon's Gap, Kearney 606, 8 Sept. 1897 (TENN, US); English Mt., Chapman s.n., 15 June 1955 (TENN); 10 mi. nw. of Hot Springs, N. C. above French Broad River nr. bridge on Hwy. 25 & 70, Ramsey & Ramsey 494, 5 June 1963 (TENN). COFFEE CO.: at edge of escarpment in w. part of Co., DeSelm 594, 28 June 1955 (TENN). DAVIDSON CO.: hills nr. Nashville, Gattinger s.n., no date (AUA). GRAINGER CO.: Lea Lakes, Hesler & Sharp 1631A & B, 19 June 1934 (TENN); ca. 2 mi. n. of Thornhill, along Hwy. 25E, Sharp et al. 30425; 1 mi.

sw. of Coffman Camp on Log Mt. between Dutch Valley and Cracker Valley, Berquist 504, 26 June 1963 (TENN); 30 Sept. 1962 (TENN). GREEN CO.: Nolichucky River, ca. 5 mi. s. of Greenville, Ahles & Smith 54605, 16 June 1961 (NCU). 3 mi. se. of Tusculum on Hwy. 107 along the Nolichucky River, Ramsey 31573, 2 Sept. 1963 (TENN). HAMBLEN CO.: along Cherokee Lake at bridge on Hwy. 25E n. of Morristown, Ramsey 416, 21 July 1962 (TENN). HANCOCK CO.: ca. $\frac{1}{2}$ mi. up Clinch River from Kyles Ford, Ramsey et al. 502, 22 June 1963 (TENN). HARDIN CO.: along Steele Creek e. of Savannah, Sharp et al. 9479, 10 July 1948 (TENN). HAWKINS CO.: gap on first Mt. n. of Rogersville, Hwy. 66, Ramsey et al. 30171, 27 May 1962 (TENN); ibid., Ramsey 423, 424, 426-B, 21 July 1962 (TENN); 2 mi. se. of Surgoinsville on s. side of Holston River, Ramsey & Ramsey 517, 10 Aug. 1963 (TENN); Cherokee Lake, Cloud Creek Embayment, w. side of rock quarry, Hwy. 11W w. of Rogersville, Ramsey 477-478, 6 Sept. 1962 (TENN). HICKMAN CO.: along creek of Beaver Dam Springs, Sharp & Clebsch 303A & B, 10 July 1947 (TENN). JEFFERSON CO.: Jefferson City, Rugel 128, June 1844 (DAO, NY, BM, US); Mill Springs Road, $\frac{1}{2}$ mi. below Cherokee Dam on Holston River, Ramsey & Ramsey 509, 5 Aug. 1963 (TENN). KNOX CO.: nr. Knoxville, Ruth s.n., 15 June 1890 (ILL); locality not specified, Kearney s.n., 17 June 1893 (DAO); Knoxville, Ruth s.n., July 1893 (F); ibid., Ruth s.n., 5 Aug. 1894 (GH); ibid., Ruth 5392, June 1895 (WIS); ibid., Ruth s.n., June 1895 (F, GH, MICH); locality not specified, Ruth s.n., do date (NY); Knoxville, Ruth s.n., July 1896 (ILL); ibid., Ruth s.n., June & July 1897 (NY); Maxey's Bluff, Sharp 1231, 9 June 1934 (TENN); University Farm, Sharp 1739, 30 June

1934 (TENN); Carter's School, Sharp & Underwood 2146, 10 July 1934 (TENN); along Clinch River, Gallaher's Ferry Road, Sharp 16784, 13 July 1952 (TENN); U.T. Farm, Grear s.n., 22 Aug. 1960 (TENN); Hewitt's Bluff, Ramsey 430,434, 30 June 1962 (TENN); ibid., Ramsey 439 & 440-441, 30 June 1962 (TENN); ibid., Ramsey 449, 28 July 1962 (TENN); ibid., Ramsey 456, 8 Aug. 1962 (TENN); along bluffs of Loudon Lake, 2 mi. w. of Knoxville, across from U.T. Agricultural College, Ramsey & Ramsey 31341, 3 June 1963 (TENN); above junction of Little River and Fort Loudon Lake, Ramsey 31604, 6 Sept. 1963 (TENN); nr. Island Airport Bridge, up river from Knoxville, Ramsey & Ramsey 519, 14 Aug. 1964 (TENN). LAWRENCE CO.: nr. West Point, Sharp et al. 9777, 12 July 1948 (TENN). LOUDON CO.: Hickory Bend on Clinch River, Ramsey & Griffin 31266, 2 May 1963 (TENN). MARION CO.: on Tennessee River 10 mi. w. of Lookout Mtn. on Hwy. 11 & 64, Ramsey & Rogers 33171, 25 Aug. 1964 (TENN). MEIGS CO.: off Hwy. 58 at Decatur, below Eaves Ferry on the Tennessee River at mile 623 on TVA Navigation Map, Ramsey & Berquist 31552, 22 Aug. 1963 (TENN). MONROE CO.: on Hwy. 72, 3 mi. s. of Tennessee Hwy. 411 on s. side of Little Tennessee River, Ramsey et al. 31317, 19 May 1963 (TENN). OVERTON CO.: Big Sunk Cave Sink, Obey City Quadrangle, Clebsch et al. s.n., 1 June 1965 (TENN). POLK CO.: Hiwassee River, ca. 5 mi. e. of Hwy. 411 on Hwy. 30, Ramsey et al. 31315, May 1963 (TENN). SEVIER CO.: GSMNP, Bull Head, McKee 1655, 4 July 1934 (DPU); Snag Mt., Cosby, Jennison & Raper 3376, 17 Aug. 1936 (TENN); n. end of Chilhowee Mt., Sharp et al. 24989b, 15 June 1958 (TENN); Buckeye Nature Trail, GSMNP, Ramsey 450-452, June 1962 (TENN);

Gatlinburg, W.T. s.n., July 1924 (ILL); Elkmont, GSMNP, Wehmeyer 418, 1 Aug. 1924 (GA, MICH, NY); Fort Harry Cove, nr. Hwy. 441, GSMNP, Ramsey & Norris 31602, 13 Sept. 1963 (TENN); just below Douglas Dam between Dam & Bridge, Ramsey & Ramsey 518, 14 Aug. 1963 (TENN).

SULLIVAN CO.: 550 yds. below Fort Patrick Henry Dam on South Fork Holston River, s. of Kingsport, Ramsey & Ramsey 514, 10 Aug. 1963 (TENN); nr. railroad trestle across n. fork Holston River, off U.S. 11E out of Kingsport, Ramsey & Ramsey 513, 10 Aug. 1963 (TENN).

UNICOI CO.: Big Butt Mtn., Price 878, 27 June 1936 (DFU); vicinity of Ernestville, James 16832, 21 July 1952 (TENN); Nolichucky River Gorge, Unaka Springs, nr. "mud cut," Lyle 19411, 18 June 1955 (NCU, TENN). UNION CO.: Valley of Higgins Creek, e. side Rich Mtn., Shanks et al. 8853, 7 Sept. 1949 (TENN); Hwy. 33, 0.2 mi. n. of Maynardville, Ramsey et al. 503, 22 June 1963 (TENN). WARREN CO.: 1 mi. ne. of Morrison, Shanks et al. 5579, 2 Aug. 1947 (TENN); N. C. State line along Appalachian Trail s. of Tenn. Hwy., Norris & Frodin 33066, 12 July 1964 (TENN). WASHINGTON CO.: location not specified, Rugel 164, July 1844 (BM).

VERMONT: WINDHAM CO.: (in cultivation) Jamaica, Moldenke 10261, 6 Aug. 1937 (ILL, MO, NY, BR, BM).

VIRGINIA: ALLEGHANY CO.: George Washington Nat. Forest, Douthat State Park, ca. 5 mi. n. of Clifton Forge, Iltis s.n., Aug. 1941 (WIS). AMELIA CO.: locality not specified, Lewis, 3419-3421, 25 June 1936 (VPI); ibid., Lewis 22366 & 22367, 17 June 1937 (VPI). ARLINGTON CO.: Fort Meyer, Meams s.n., 12 July 1895 (US); Glen Carlyn, House 1045,

25 June 1905 (US). BEDFORD CO.: locality not specified, Curtiss s.n.,
 10 Sept. 1868 (F); locality not specified, Curtiss s.n., July 1868
 (CAN); locality not specified, Curtiss s.n., 3 July 1871 (GH); locality
 not specified, Curtiss s.n., July 1898 (MICH); Peaks Road, by bridge
 4.1 mi. below Mons, Freer s.n. 1619, 8 July 1947 (GH, LYN). BOTETOURT
 CO.: Blue Ridge, Seymour s.n., 22 July 1891 (GH, MO); Stony Man Mtn.
 vicinity in Blue Ridge nr. Luray, Steele & Steele s.n., 10 Aug. 1901
 (GH); along Appalachian Trail, Black Rock; Bryant's Ridge to Middle
 Creek Forest Camp, Freer 2243, 4 Aug. 1954 (LYN); along Appalachian
 Trail, Black Rock-Bryants Ridge to Middle Creek nr. Eagle Rock,
Sharp & Ellis 30059, 15 May 1962 (TENN); Forest Camp, Freer s.n.,
 4 Aug. 1954 (GH). BRUNSWICK CO.: Maberrin R., Lewis 22362, June
 1942 (VPI). BUCKINGHAM CO.: w. base of Willis Mt. nr. Rosney, Fosbery
15571, 22 June 1938 (PENN). CAMPBELL CO.: nr. Lynchburg, Britton &
Vail s.n., 1 July 1892 (NY). CLARK CO.: 4.5 mi. se. of Millwood,
Hermann 9621, 7 Aug. 1938 (MICH). ESSEX CO.: vicinity of Lorelto,
Leonard & Killip 591, 5 June 1921 (GA, US). FAIRFAX CO.: Brookland,
Holm s.n., 7 Aug. 1893 (C); Great Falls, Eseltine 31, 4 July 1913 (US);
 locality not specified, Hunnewell 22369, 25 June 1918 (VPI); Great
 Falls, Leonard 500, 27 July 1919 (US). FANQUIER CO.: w. slope of Bull
 Run Mts., 1 mi. n. of Hopewell Gap, Allard 730, 30 June 1935 (GH, NY,
 US). FREDERICK CO.: Cedar Creek, Hunnewell 22368, 24 June 1933 (VPI);
 nr. Middletown, Hunnewell 22357, 30 June 1935 (VPI). GILES CO.: Mt.
 Lake, Buckland s.n., 31 July 1930 (VPI); along trail from top of Flat
 Top Mt. to Dismal Creek, Massey 22357, 25 June 1936 (VPI); on Clover

Hollow Road ca. 4 mi. from Newport, Massey 22355, 29 June 1936 (VPI); s. slope Beanfield Mt., 1 mi. w. of Mountain Lake P.O., Fogg 12901, 2 Aug. 1937 (PENN); along New River, $\frac{1}{2}$ mi. n. nw. of Klotz, Fogg 17257, 13 July 1940 (PENN, WVA); Mt. Lake area, Shaffer s.n., 9 Aug. 1947 (VPI); nr. Big Stoney Creek, Gentry 1553, 28 July 1953 (DPU, WTU); ca. 3 mi. w. Pembroke, Kral 10742, 11 July 1960 (VPI). GRAYSON CO.: White Top Mt.; Roller s.n., 14 Sept. 1940 (VPI). GREEN CO.: nr. Pocosin Shelter, Walker 2906, 28 July 1940 (US). HENRICO CO.: $\frac{3}{4}$ mi. e. of S. Boulevard, River Side Drive, Richmond, Hopkins s.n., 3 June 1945 (VPI). LOUDON CO.: vicinity of Purcellville, Hambleton 158, 3 July 1960 (US); Bluemont, Standley 10609, 11 July 1914 (US); nr. Limestone Branch, 1 mi. from Rt. 7, Allard 21492, 14 June 1953 (US). MADISON CO.: Ridge Trail, Old Rag Mt., Shenandoah, Balls 7750, 20 Sept. 1941 (BM, US). MONTGOMERY CO.: Brush Mt., Massey 22358, 4 Oct. 1940 (VPI); from woods of VPI., McIntosh 15226, 3 July 1947 (VPI). NELSON CO.: along roadside, Tye River above Massie's Mill, Freer 957, 12 June 1935 (LYN); nr. Massie's Mill, Freer 918, 24 June, 1936 (LYN). PAGE CO.: Stony Man Mt. & vicinity, nr. Luray, Steele & Steele 67, 10 Aug. 1901 (MO, NY, US); Stony Man Mt., between Skyland and foot of Mt., Harshberger s.n., 28 May 1925 (PENN); 4-H Camp, Strickler 22356, May 1939 (VPI). PATRICK CO.: between Stuart and Lover's Leap, Heller 1083, 17 July 1893 (DAO, F, GH, NY, PENN, PH, US); locality not specified, Shelar s.n., no date (VPI); Lover's Leap, Davis s.n., 12 July 1935 (VPI); locality not stated, Pendleton s.n., 1939 (VPI). PRINCE WILLIAMS CO.: Thoroughfare Gap, Tidestrom 4944, 4 July 1911 (GH, US);

1.5 mi. sw. of Woodbridge, Randolph s.n., 14 June 1922 (GH). PULASKI CO.: locality not specified, F.S.H. s.n., 3 Aug. 1909 (VPI). ROANOKE CO.: Bent Mt. ca. 3/4 mi. n. of Airpoint, P.O., Wood 3124, 3 July 1942 (PENN); Brushy Mt. ca. 2 mi. w. nw. of Salem, P.O., Wood 2383, 21 June 1942 (PENN). ROCKBRIDGE CO.: Natural Bridge, Bartram s.n., 30 May 1909 (PH); 2 mi. above Irish Gap along Appalachian Trail, Rocky Mt., Freer 260, 27 Aug. 1933. SCOTT CO.: 2 mi. n. of Va.-Tenn. State Line & ca. 9 mi. s. of Clinchport on Clinch River, Ramsey & Drumke, & Deal 500-501, 22 June 1963 (TENN); on s. side of North Fork Holston River just e. of Hwy. 23 between Kingsport, Tennessee & Gate City, Va., Ramsey & Ramsey 515, 10 Aug. 1963 (TENN); 1/4 mi. of Tenn.-Va. State Line on Clinch River, Ramsey et al. 31614, 22 Sept. 1963 (TENN). SHENANDOAH CO.: Long Mt., Hunnewell s.n., 27 June 1931 (GH). SMYTH CO.: Hills e. of Marion, Britton & Vail s.n., 12 June 1892 (NY); Island, Marion, Small s.n., 8 July 1892 (F); at Falls of Holston (Middle Fork), Small s.n., 9 July 1892 (F, MO, NY); n. side of Mt. Rogers, Shields 22354, 20 July 1954 (VPI). SPOTSYLVANIA CO.: Four-Mile Run, Hitchcock s.n., 9 June 1905 (ILL); ibid., Chase 2902, 14 June 1905 (ILL, MICH). SURRY CO.: Va. side of Potomac River from Chain Bridge to opposite Cabin John Bridge, Morris 122, 1 July 1899 (US); along James River, below Sunken Meadow Beach, Fernald & Long s.n., 14 June 1938 (GH); ravines w. of Claremont, Fernald & Long s.n., 28 Aug. 1940 (GH); ravines nr. James River, w. of Ingersoll, Fernald & Long s.n., 17 June 1941 (GH). WASHINGTON CO.: Hwy. 19 above North Fork of Holston River at Holston, Ramsey & Holt 490, 12 Sept. 1962 (TENN). WYTHE CO.: ca. 8

mi. w. of Wytheville, Kral 22371, 28 July 1960 (VPI).

WEST VIRGINIA: BARBOUR CO.: Cove Run Road, w. of Rt. 92, Haller s.n., 26 June 1951 (WVA); Donald Triplett's house ne. Moatsville, Nester & Triplett s.n., 20 July 1958 (NCU). BERKELEY CO.: Pine Hills, Martinsburg, Shreve s.n., 4 July 1942 (WVA). BRAXTON CO.: Sugar Creek s. of Grassaway, Boggs 83, 8 May 1953 (WVA). CALHOUN CO.: Arnoldsburg, Harris s.n., 15 June 1933 (WVA). DODDRIDGE CO.: along Rt. 55, 1 mi. s. of Sedalia, Core s.n., 8 July 1937 (WVA). FAYETTE CO.: locality not specified, Nuttall s.n., 25 June 1892 (WVA); 2.5 mi. s. of Rainelle on Rt. 20, McCutcheon s.n., 6 Apr. 1952 (WVA). GREENBRIER CO.: White Sulphur Springs, Hunnewell s.n., 4-6 July 1914 (GH). HAMSHIRE CO.: Hanging Rock, Frye s.n., 23 July 1938 (WVA). HARDY CO.: along mt. road on Howard's Lick Mt., Wilson 23, 27 June 1941 (WVA). HARRISON CO.: Shinnston, Martin 253, 31 July 1933 (WVA); nr. Clarksburg, Judy s.n., 1934 (WVA). JEFFERSON CO.: Charlestown, Harper & Harper s.n., 10 Aug. 1894 (WTU). KANAWHA CO.: Loudoun Heights, nr. Harper's Ferry, Tidestrom 4860, 18 June 1911 (MICH); Gilligans Hill, Charleston, Greenlee s.n., 21 Aug. 1934 (WVA); Queen Shoals, Randolph s.n., Sept. 1935 (WVA); ibid., Randolph 166, 15 May 1936 (WVA). MARSHALL CO.: Glencoe Rocks, 2 mi. w. of Bellton, Core 5319, 6 July 1937 (WVA). MCDOWELL CO.: East River Mt., Dickson s.n., 4 Aug. 1950 (WVA). MINERAL CO.: Elks Garden Rt. 42, Brown s.n., 22 July 1950 (WVA). MINGO CO.: locality not specified, anon. s.n., 6 July 1929 (GH); nr. Birch, Berkley 953, 6 July 1930 (MO); Kermit, Harris s.n., 3 June 1933 (WVA). MONONGALIA CO.: Cheat River, Morgantown, Hatry s.n., 6 July

1902 (PH); Uffington, Fling s.n., 30 June 1917 (WVA); between Iron Bridge & Sauver School House, anon. s.n., 16 July 1918 (WVA); Rt. 56 nr. Halleck, Core s.n., 11 July 1931 (IND); Morgantown, Eucchers s.n., Aug. 1931 (WVA). MONROE CO.: nr. Salt Sulphur Springs, Griscom & Hunnewell s.n., 5 July 1933 (GH). PENDLETON CO.: on Rt. 5, 1 mi. w. of Onega, Core 6166, 16 July 1937 (WVA). PONCAHONTAS CO.: CCC Rd. 3 mi. sw. Cass, Clarkson 148, 16 June 1950 (WVA). PRESTON CO.: Aurora & vicinity, Steele & Steele s.n., 16 Aug. 1898 (NY, US). RALEIGH CO.: nr. Beckley, Core s.n., 17 July 1931 (NY). RANDOLPH CO.: Pickens, Smith s.n., 28 June 1908 (F); w. slope of Cheat Mt. at Rt. 250, Rossbach s.n., 13 Sept. 1952 (WVA). SUMMERS CO.: nr. Bellpoint, Boone 296, 23 June 1933 (WVA); Barger's Springs, Fox s.n., 23 June 1938 (WVA). TAYLOR CO.: locality not specified, McCauley s.n., 9 July 1948 (WVA). TUCKER CO.: Parsons s.n., Moore s.n., 8 Sept. 1904 (GH, PENN). TYLER CO.: road leading to Indian Creek Road from Eight Mile Ridge, McElroy District, Bartholomew & Wilson T-263, 8 July 1956 (WVA). UPSHUR CO.: nr. Buckh'n, Pollock s.n., 19 July 1895 (US); Sago, Edward & Grose s.n., 3 July 1946 (WVA). WEBSTER CO.: Camp Caesar nr. Cowen, Williams 489, 18 July 1936 (F, GH, NY, PH, TENN, TRT, WIS, WVA). WETZEL CO.: woods s. of Littleton, Haught 588, 3 July 1931 (WVA). WIRT CO.: locality not specified, Millspaugh 307, 2 July 1890 (WVA). WYOMING CO.: Pineville, 13 July 1929 (PENN).

Cimicifuga racemosa has a complicated taxonomic history in comparison to the other North American species. According to Huth (1892), Plukenet (1705) in his Amaltheum Botanicum, p. 54, first

described this plant by using the polynomial "Christophoriana facie, Herba spicata, ex Provincia Floridana." His inaccurate, but sufficient, drawing establishes its identity. His specimen of the plant is still preserved in the British Museum Herbarium (Wintermute, 1905).

Tournefort (1719) supplied the first binomial, Christophoriana racemosa, while Dillenius (1732), using Tournefort's earlier work, listed the same plant as Christophoriana americana. He used Tournefort's genus but supplied a different epithet and claimed the authorship. Most pre-Linnaean writers placed this species in the genus Actaea, which was included in Tournefort's Christophoriana.

Linnaeus (1753) gave this plant the name Actaea racemosa, and it was retained in this genus for sixty-one years, even though he had already coined the name, Cimicifuga, in 1750.

Gronovius (1739) listed it as "Actaea spicis longissimis," under which name it was illustrated by Linnaeus (1749) in Materia Medica.

Walter (1788) in Flora Caroliniana, listed it as Actaea monogyna, using Linnaeus' generic name and a specific epithet which indicates flowers containing one pistil. Later Rafinesque (1808), by reason of the fact that "the fruit of the plant does not accord with that of either Actaea or Cimicifuga," proposed the new genus Macrotrys, and named the plant Macrotrys actaeoides, changing it to Botrophis serpentaria in 1828 in Desveaux's Journal of Botany. The latter name was used by Fischer and Meyer (1835).

Pursh (1814) was the first to assign this plant to the currently accepted genus under the name Cimicifuga serpentaria, using Linnaeus'

new generic name, with a specific epithet, indicating that "the flower racemes may occasionally be curiously twisted" (Irving, 1923).

When Nuttall (1818) enumerated the then known plants of the United States, he restored Linnaeus' original specific name thus establishing the correct binomial, Cimicifuga racemosa. Elliott (1824) used the same binomial as did Nuttall. The authorship was falsely assigned to Elliott by other American botanists even though his Botany of South Carolina and Georgia first appeared in 1824, six years after Nuttall's name was published.

Eaton (1829) followed Rafinesque, calling the plant Macrotys serpentaria, the latter being Pursh's name, but incorrectly spelling the generic name which should have been Macrotrys. This error was perpetuated by De Candolle and others, and has been frequently figured as Macrotys serpentaria or Macrotys racemosa.

Kuntz (1891), in keeping with the genus which he erected, called the plant Thalictrodes racemosum. In spite of the fact that many synonyms have been assigned to this plant, its characteristics are remarkably stable throughout its range.

1A. CIMICIFUGA RACEMOSA (L.) Nutt
forma dissecta (Gray) Fernald

Several varieties (Robinson in Gray, 1895) or formas (Fernald, 1940) have been named. For a discussion of Gray's Cimicifuga racemosa var. cordifolia the reader should examine the treatment of Cimicifuga rubifolia Kearney (page 145).

The following is a historical review of what collectors have called Cimicifuga racemosa var. dissecta Gray or Cimicifuga racemosa forma dissecta (Gray) Fernald.

Albert Commons found a Cimicifuga with extremely dissected leaflets in 1864, near Centreville, New Castle County, Delaware. The New York Botanical Garden possesses a specimen to which is attached the following note written by A. Commons, dated December 15, 1876:

A rare form with dissected leaves. A few specimens only of this rare form or variety of Cimicifuga racemosa were found in 1864 growing in a densely shaded woods. I found it necessary to remove a root of it to a more open situation in order to obtain specimens of flowers and fruits. I have never met with it before.

A letter from Commons to N. L. Britton 1890 regarding this form of Cimicifuga racemosa reads as follows:

Dear Sir: In compliance with your request I forward specimens of Cimicifuga racemosa var. dissecta. This variety was found some 25 years ago growing in a dense woods on the west bank of the Brandywine a few miles north of Wilmington. The locality has not been visited for some years, but I have reason to believe the variety can be found there yet. I do not find any flowers or fruits among my duplicates therefore had to content myself with sending some leaves of it. Yours very truly, A. Commons.

The plant found by Commons was called Cimicifuga racemosa var. dissecta Gray in Gray's Manual (1890), and it was described thus: "Leaves irregularly pinnately decomposed, the rather small leaflets incised. Local from s. w. Connecticut (Eames) to Del. (Commons)."

The plant described and named by Gray is similar to the ones illustrated in Figure 10. Fernald (1940) reduced Gray's variety to a form of Cimicifuga racemosa.

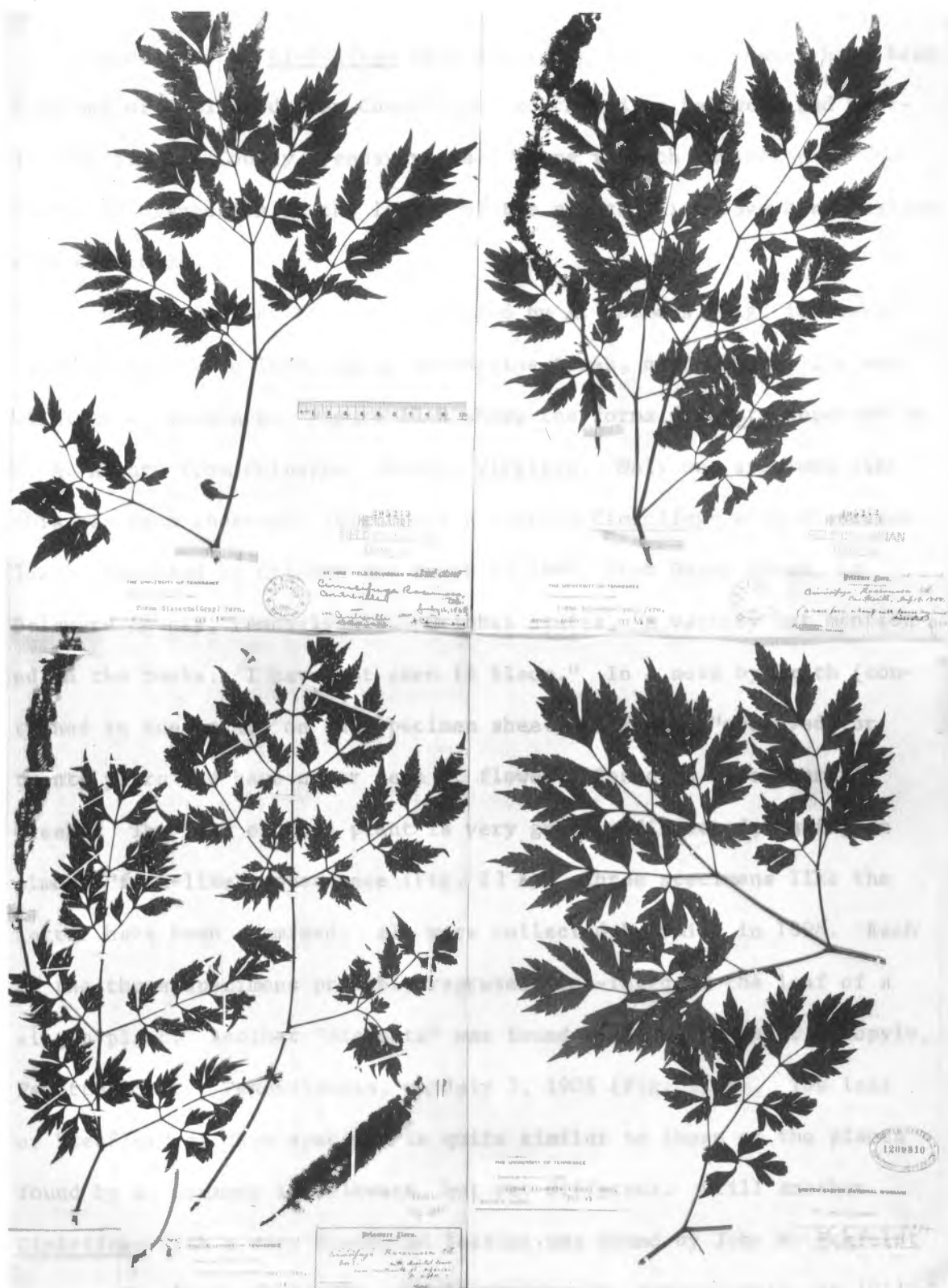


Figure 10. Representative specimens of *Cimicifuga racemosa* forma dissecta.

Specimens of Cimicifuga with extremely dissected leaves have been reported or collected from Connecticut southward to Delaware and westward to Fayette County, Pennsylvania. There is much variation in the degree of dissection in the leaves of the plants which have been labeled with this name.

Plants similar to that collected by A. Commons (Fig. 10) were found from 1864 to 1893, along Brandywine Creek, near Centreville and Wilmington, Delaware. Figure 11 D shows the forma dissecta reported by H. A. Allard from Culpepper County, Virginia. Only one specimen like this has been observed. Figure 11 A shows a Cimicifuga with dissected leaves reported by Gribbes and Smith in 1898, from Darby Creek, in Delaware County, Pennsylvania. Gribbes states, "A variety not mentioned in the books. I have not seen it bloom." In a note by Smith (contained in the packet on the specimen sheet) is found, "observed for twenty years and have never seen it flower. Found on upper Darby Creek." The leaf of this plant is very greatly dissected, having an almost "fern-like" appearance (Fig. 11 A). Three specimens like the latter have been examined. All were collected by Smith in 1898. Each of the three specimens probably represent one-third of the leaf of a single plant. Another "dissecta" was found by B. H. Smith at Ohiopyle, Fayette County, Pennsylvania, on July 3, 1905 (Fig. 11 B). The leaf or "leaflet" of this specimen is quite similar to those of the plants found by A. Commons in Delaware, but yet different. Still another Cimicifuga with a very dissected leaflet was found by John W. Eckfeldt on Drum Creek, Springfield, in Delaware County, Pennsylvania, in 1911

FIGURE 11. Teratological forms of North American Cimicifuga.

- (A) Specimen collected in 1898, by Dr. George Smith at Darby Creek, Pennsylvania.
- (B) Specimen collected July 3, 1905, by Benjamin H. Smith, at Ohio Pyle, Fayette County, Pennsylvania.
- (C) Specimen collected, June 18, 1911, by John W. Eckfield, on Drum Creek, Delaware Co., Pennsylvania.
- (D) Specimen collected June 21, 1936, by H. A. Allard, on Buzzards Mtn., Culpepper County, Virginia.



Figure 11. Teratological forms of North American Cimicifuga.

(Fig. 11 C, p. 101). The plants collected by Allard, Smith and Gribbes, B. H. Smith, and Eckfeldt are considered to be teratological forms.

Dr. John M. Fogg, Jr., Director of the Morris Arboretum, and Curator of the Herbarium of the University of Pennsylvania states (personal communication, 1964):

Specimens of the dissected-leaved form of Cimicifuga racemosa from Darby Creek are in many eastern herbaria. Despite this fact, the plant is totally unknown to us today, nor, to my knowledge, has it been collected during the present century. In this respect it is comparable to a collection of Tiarella cordifolia made from near the same locality during the 90's but not seen there since. In our studies of the Pennsylvania Flora we have no knowledge of the present day existence of any unusual form of Cimicifuga racemosa.

The range for Cimicifuga racemosa (L.) Nutt. forma dissecta (Gray) Fernald, as given in many of our manuals, is from Connecticut to Virginia. Thus, all of the specimens illustrated in Figure 11 and those reported from Connecticut have been included in this taxon even though Gray and Fernald had reference to specimens similar to those shown in Figure 10, page 98.

Out of approximately 2000 specimens of Cimicifuga racemosa examined in this study sixteen have been labeled "dissecta." Of the sixteen specimens four (specimens by George Smith and Gribbes are believed to represent one-third of the same plant) are considered to be teratological forms (Fig. 11, p. 101).

Specimens Examined:

PENNSYLVANIA: DELAWARE CO.: Upper Darby, Gribbes s.n., no date (NY); Darby Creek, G. Smith s.n., 1898 (US); on upper Darby Creek,

G. Smith s.n., 1898 (US); on upper Darby Creek, G. Smith s.n., no date (NY); Drum Creek, Springfield, Eckfeldt s.n., 18 July 1911 (PENN).

FAYETTE CO.: B.H. Smith s.n., 3 July 1905 (PH).

VIRGINIA: GULPEPPER CO.: Buzzards Mt., Allard 1798, 21 June 1936 (US).

Of the sixteen specimens, flowers or fruits appeared only on two, and these flowers and fruits (and seeds) were those of typical Cimicifuga racemosa. The Delaware plants are different from typical Cimicifuga racemosa only in the dissected and incised condition of the leaves.

Because there is limited knowledge concerning this dissected leaf form, and since plants similar to those referred to by Gray and Fernald have not been collected this century this form is believed to be of doubtful taxonomic significance. The author has not searched for this dissected leaf form in Delaware but in all probability it does not exist today. However, being unable to show that these plants do not exist today, and until further field work can be done, the name Cimicifuga racemosa (L.) Nutt. forma dissecta (Gray) Fernald is accepted. Only the specimens below should be listed in this taxon.

Specimens Examined:

DELAWARE: NEW CASTLE CO.: nr. Brandywine Creek above Wilmington, Commons s.n., 10 July 1865 (NY); on Brandywine Creek, Commons s.n., 15 July 1865 (NY); Centreville, Commons s.n., 13 July 1868 (GH); Centreville, Commons s.n., 25 May 1869 (GH); Centreville, Commons s.n., 19 & 16 July 1868 (F); Centreville, Commons s.n., 5 July & 11 Sept. 1871 (US); along

Brandywine Creek above Rockland, Commons s.n., 10 July 1890 (US);
Wilmington, Canby s.n., July 1893 (MICH); no locality stated, Canby
s.n., no date (GH).

2. CIMICIFUGA ELATA

(Tall Bugbane)

SYNONYMY

Cimicifuga elata Nutt., Torr. and Gray, Fl. N. Amer. 1:316 (1838);

Robinson in Gray, Syn. Fl. N. Amer. 1:54 (1895); Huth, Engl. Bot.

Jahrb. 16:315 (1892); Bailey, Stand, Cyc. Hort. 1:769 (1933);

Peck, Man. Higher Pl. Ore. 317 (1941); Abrams, Illus. Fl. Pa.

Sta. 2:179 (1944); Hitchcock, Vas. Pl. Pac. NW. 2:337 (1964)

Cimicifuga foetida Pursh (non L.), Fl. Am. Sept. 2:373 (1814).

Macrotys foetida Eaton, Sensu Pursh, N. Am. Bot. ed. 5, 288 (1829);

ed. 6, 218 (1833); ed. 7, 285 (1836); ed. 8, 311 (1840) non Linn.

Actaea cimicifuga Hooker and Arnott (non L.), Bot. Beec. Voy. (1841).

Actaea elata Prantl, Bot. Jahrb. 9:246 (1888).

Thalictrodes elatum Kuntze, Rev. Gen. Pl. 1:4 (1891).

A rather tall, long-lived perennial, with hard, knotted rhizomes and solitary, wand-like stems bearing several large, biternate leaves near and above the base. Rhizome horizontal, attaining a maximum length of about 8-9 cm., 1-1.5 cm. in diameter, bearing numerous weak, fibrous roots on the lateral and lower surfaces, cross-section showing radiate arrangement of vascular bundles, brown; stems 6-24 (mostly 12-18) cm. high, erect to curved, stout (sometimes almost fleshy) at the base, diminishing gradually toward the summit, usually greenish-brown, becoming dark brown with age, angled at the base, terete towards the summit, shallowly grooved (occasionally deeply so) up to the inflorescence

sparsely puberulent to slightly glandular up to the inflorescence, there usually glandular to lanate; petioles .5-4 dm. long, slender, straight, angled, broadly and deeply sulcate on the upper face, glabrous to densely pubescent in the groove, sometimes grooved on the lower, rounded face, only slightly dilated at the apex, slightly enlarged at the base with thin, short, wing-like margins clasping the stem, upper leaf petiole margins not completely ensheathing the stem; leaves biternate, the central division 1-9-(usually 3-) foliate, terminal leaflets largest, lateral divisions 3-9-(usually 3-7-) foliate, (thus leaves may possess 7-27 leaflets), petioles of central division 9.5-27 cm. long, angled, sulcate like the main petiole, sparsely pubescent with rather short silvery hairs, the groove densely so, sometimes long pubescent; petioles of lateral divisions, 8-24 cm. long, equal or one as much as 4 cm. longer than the other; petiolules of the lateral leaflets of the central division about 3-6 cm. long, deeply sulcate on the upper face, very pubescent especially in the groove; petiolules of leaflets of the lateral divisions somewhat shorter, otherwise similar; terminal leaflet of the central division 8-18 (mostly 10-14) cm. long, 9-23 (mostly 12-16) cm. wide between the apices of the 2 largest lobes, broadly ovate-orbicular in outline, equilateral, acute to acuminate at the apex, deeply cordate with sinus widening towards the mouth, coarsely dentate to dentate-serrate, teeth gland-tipped, deeply and broadly palmately three-lobed, the primary lobes themselves less deeply 2-3 lobed and the secondary lobes in turn slightly 2-3 lobed, rather thick and occasionally almost coriaceous, green above, paler beneath, usually glabrous

and except near sinuses, relatively long ciliate, especially in sinuses, pubescent below, especially on the veins, with rather stiff lustrous hairs, 5-7 veins prominent, the two largest lateral ones as strong as the mid-vein, the others not quite as heavy; other leaflets smaller and inequilateral, otherwise similar; mean stomate length 46.50 μ ; inflorescence a panicle of 4-14 slender racemes; the terminal raceme not necessarily the longest, 6-17 (commonly 12-14) cm. long; rachis and pedicels densely pubescent with lustrous hairs tapered apically; pedicels (in flower) about 1-8 (commonly 2-4) mm. long, slender, about same diameter throughout, occasionally branched, subtended by a lance-subulate bract about 1-3 mm. long, with thin membranous margins, bearing at the base 2 laterally disposed, ovate-triangular, acute bractlets about .5-1 mm. long, pedicels (in fruit) about 2-4 mm. long; sepals 5, fugacious, 3.5-4 mm. long, 3-4 mm. wide, rounded at the apex, narrowed at the base; petals or staminodia none; stamens usually numbering in the 20's; filaments about 6 mm. long, expanded near the summit; anthers about .5 mm. long, ovate; pistils 1-3 (usually 1), sessile, about 2.5-3 mm. long from base of ovulary to summit of stigma; style short but well differentiated; stigma minute but occasionally very slightly expanded or crested and tending to be recurved; ovulary about .7-1 mm. in diameter, glabrous, rounded, sides oblong-lanceolate in outline; fruit a follicle; follicles usually 1 but not infrequently 2 or 3, 8-12 (commonly 9-11) mm. long, sessile to subsessile, glandularly pubescent, slightly compressed laterally, oblong in outline, beaked apically with short hardened style and stigma, beak almost at right angles;

dull brown, walls thin, transverse veins prominent; seeds 6-12 (commonly 9-11), in two rows, about 2 mm. long, 1 mm. wide, lenticular, reddish-brown to purplish-brown, short-squamose to verrucose, bearing a groove on the side of the follicle media.

Type locality: "Shady woods of the Oregon." Type specimen: Columbia River Gorge, Nuttall s.n., date not specified (PH). (Fig. 12).

Moist, rich, wooded slopes, damp forest margins and roadsides, along shaded streams, rather open to closed woods, humid transition and Canadian Zones, extending from southern New Westminister County, British Columbia and Clallam County, Washington, to Lane and Douglas Counties in Oregon, mainly in the Coast Ranges. Fl. early June-late July or early August. Ft. late June-August. (Fig. 13).

Specimens Examined:

CANADA:

BRITISH COLUMBIA: NEW WESTMINISTER CO.: Mt. Cheam, Chilliwack, Gowen 7604, 1 Aug. 1895 (CAN); Chilliwack River, Macoun 33565, 15 Aug. 1901 (CAN); Liumchen Trail, nr. end of logging road, Beamish & Vrugtman 25 Aug. 1957 (UBC).

U.S.A.

OREGON: BENTON CO.: Willamette River bottom opposite Corvallis, Culver s.n., 30 May 1913 (OSC). COLUMBIA CO.: ca. 10 mi. w. of Clatskanie, Thompson s.n., June 1950 (WTU). DOUGLAS CO.: Oakland, Rader s.n., July 1951 (OSC). LANE CO.: above Wendling, Andrews 148, 22 June 1934 (ORE); Triangle Lake, Henderson s.n., 4 July 1935 (ORE); nr. Ford #5, Big Tapp Creek, Andrews & Detling s.n., 11 July 1938 (ORE);

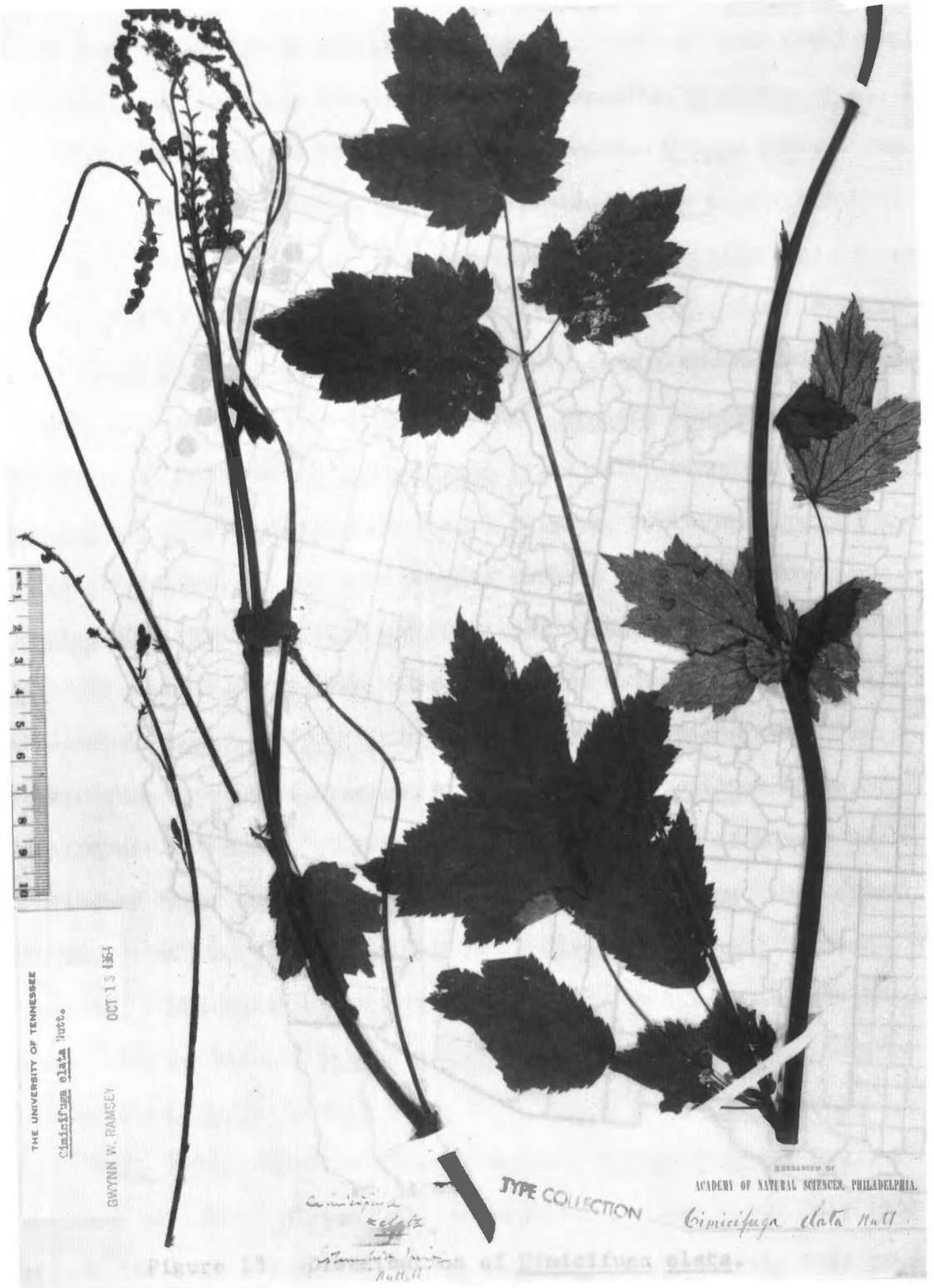


Figure 12. Type specimen of Cimicifuga elata.

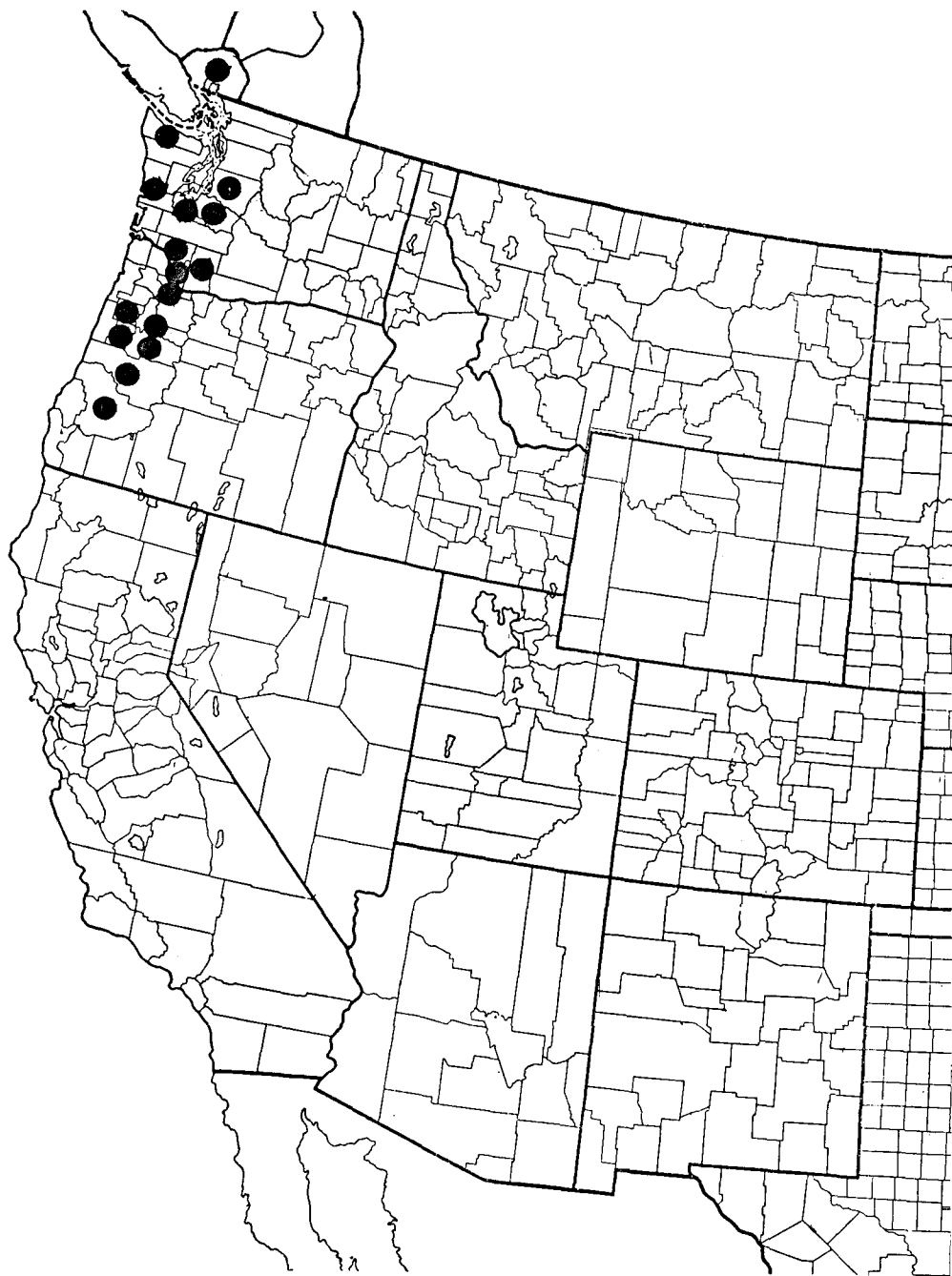


Figure 13. Distribution of Cimicifuga elata.

McKenzie River at Cobung Bridge, Detling s.n., 3 June 1939 (ORE). LINN CO.: bluffs of the south Santian River nr. Cascadia, Henderson s.n., 12 June 1931 (ORE). MARION CO.: 2 mi. e. of Orville, Nelson 3757, 4 June 1921 (PH); Banks of Powers Creek nr. Silverton, Fosty s.n., 15 July 1910 (ORE). MULTNOMAH CO.: Columbia River Gorge, Nuttall s.n., (type) date not stated (PH); locality not stated, Howell s.n., July 1877 (GH); Portland, Henderson s.n., 13 & 22 June, 1882 (ORE); nr. Bridal Veil, Suksdorf 498, 16 July 1885 (GH); Portland, Drake & Dickson s.n., May 1888 (F); nr. Portland, Drake & Gorman 14, 4 July 1890 (ORE); Linton, Howell s.n., 20 June 1891 (MO); Barnes Heights, Portland, Gorman s.n., 30 June 1904 (ORE) on the Hwy. down to Corbett on the Columbia, Thompson 3015, 17 July 1927 (WTU, OSC); nr. Bannerville, Thompson 4963, 25 June 1928 (MO, PH); along stream in Columbia Gorge nr. Warrendale, Thompson 11848, (IND, NY, PH, WTU) e. side of Hwy. from Corbett down to Corbett Station, Ramsey & Chambers 33155, 5 Aug. 1964 (TENN); 2.8 mi. e. of Bridal Veil on the e. side of Scenic Hwy. in Columbia River Gorge, Ramsey & Chambers 33152, 5 Aug. 1964 (TENN). POLK CO.: 1 mi. up Teal Creek from Falls City, Smith s.n., 27 June 1954 (OSC, WTU); E. Independence, Nelson 1561, 4 July 1917 (GH). Fir Forest, Sauvies Island, Thomas Howell, s.n., July 1887 (BR); location not specified, Hall 17, 1871 (BM).

WASHINGTON: CHEHALIS CO.: nr. Satsop, Heller & Heller s.n., 8 July 1898 (MO, NY). CLALLAM CO.: Olympic Mts., Elmer 2662, July 1900 (MO, NY, US); Elwha River, Olympic, Penn., Jones 3399, July 1931 (PH, WTU); in timber trail to Wolf's above McDonald's, King s.n., no date

(LA). CLARK CO.: Manor, Piper s.n., 14 July 1899 (US); nr. La Center, Jones 7651, 19 June 1935 (ILL). COWLITZ CO.: Oak Point, John s.n., 22 June 1927 (F). KING CO.: Roadside between Renton and Issaquah, Thompson 6846½, 24 June 1931 (GH, MO, PH, WTU); Creek bottoms nr. Issaquah, Thompson 9289, 3 July 1933 (GH, MO, NY, US, WTU); nr. Issaquah, Thompson 10518, 30 May 1934 (MO, NY, US, WTU). PIERCE CO.: Mishell Mt., Piper 660, 6 Aug. 1889 (GH, US). SKAMANIA CO.: no locality stated, Suksdorf 1990, 7 July 1894 (F, GH, MO, NY, ORE, LA, US); Cape Horn, Detling 7335, 3 July 1953 (ORE). THURSTON CO.: Mishell Mt., Piper s.n., Aug. 1889 (WTU); approx. 1 mi. n. of Bucoda, Meyer 587, 7 July 1936 (MO).

Cimicifuga elata was the first member of the genus to be found in Western North America. According to Lloyd and Lloyd (1886), it was first observed and collected about 1805 in Oregon by the Lewis and Clark Expedition. Frederick Pursh met Meriwether Lewis who had recently returned from the expedition across the continent and was at that time governor of upper Louisiana. Lewis gave Pursh about one hundred and fifty of the plants which he had brought from the northwest. Pursh had agreed to describe and illustrate these plants so Lewis could publish them in his account of the expedition. Lewis died and Daniel Clark attempted to complete Lewis' work. As far as is known Pursh never returned the plants that were loaned him, and presumably the first specimens of Cimicifuga elata were in this loan. Pursh (1814) considered the plant to be identical with the Eurasian Cimicifuga foetida L., and named it thus. However, it is clearly different from Cimicifuga

foetida L. in its non-scaly seeds, sessile pistils, and absence of staminodes.

Pursh (1814), classed the plant in his Polyandria Dipentagyna, and described it: "foliis decompositis, foliolis ovatis incisus dentatis, dentibus acutis, racemis panicularis nutantibus, floribus 5-gynis, capsulis ovatis uncinatis." Hooker and Arnott (1841) supported Pursh's idea that the plant was Cimicifuga foetida L., but used Linnaeus' old binomial of Actaea cimicifuga.

According to Merrill and Reeder (1946), "Eaton assigned the binomial Macrotys foetida to Pursh's plant. The authority is erroneously given as Willdenow, no synonyms are cited, and the range is indicated as "W" = Western North America. The accepted name would be Cimicifuga foetida L., a Eurasian not an American species." The basis of the description was probably Cimicifuga foetida sensu Pursh non Linnaeus.

Realizing that Pursh's plant was a different entity from the Eurasian Cimicifuga foetida, Nuttall (in Torr. and Gray, 1838) first described this plant as a proper species supplying the binomial, Cimicifuga elata.

Since then, several interpretations have been assigned to this taxon. Prantl (1888) using Nuttall's specific name, placed it in Actaea, the genus into which Linnaeus first placed Cimicifuga species. Kuntz (1891) assigned it the name of Thalictrodes elatum.

3. CIMICIFUGA JAPONICA (THUNB.) SPRENGEL

(Obashoma)

SYNONYMY

Cimicifuga japonica (Thunb.) Sprengel, Syst. Veget. 2:628 (1825).

Actaea japonica (Thunb.) Fl. Jap. 221 (1784); DC. Prodr. Syst. Nat. 65 (1824); Willdenow, Sp. Pl. 2:1140 (1817).

Pityrosperma acerinum Sieb. et Zucc., in Abh. Akad. Wiss. Muench. (3): 3:735 (1843); (4) 2:184 (1845).

Cimicifuga japonica (Thunb.) Miq., Ann. Mus. Bot. Lugd. Batav. 3:9 (1867); Prolus. Fl. Jap. 197 (1867).

Actaea acerina (Sieb. et Zucc.) Prantl, in Engler, Bot. Jahrb. 9:246 (1888).

Thalictodes japonicum (Thunb.) O. Kuntz, Rev. Gen. Pl. 1:4 (1891).

Cimicifuga japonicum Spreng. var. acerina Huth, in Engler, Bot. Jahrb. 16:316 (1892).

Cimicifuga japonicum Spreng. var. obtusiloba (Miq.) Huth, in Engler, Bot. Jahrb. 16:316 (1892).

Cimicifuga japonica Spreng. f. peltata Makino, in Bot. Mag. Tokyo 24: 140 (1910).

Cimicifuga acerina (Sieb. et Zucc.) Tanaka, in Bult. Sci. Fak. Terk. Kjusu. Imp. Univ. (1) 4:203 & 209 (1925).

Cimicifuga acerina (Sieb. et Zucc.) Koidzumi, in Bot. Mag. Tokyo 44: 100 (1930).

Cimicifuga chinensis Koidzumi, in Bot. Mag. Tokyo 44:102 (1930).

Cimicifuga macrophylla Koidsumi, in Bot. Mag. Tokyo 44:101 (1930).

Cimicifuga peltata (Makino) Koidzumi, in Bot. Mag. Tokyo 44:101 (1930).

Cimicifuga acerina var. obtusiloba Nakai ex Makino et Nemoto, Fl. Jap. ed. 2, 321 (1931).

Cimicifuga acerina var. obtusiloba f. peltata (Makino) Makino et Nemoto, Fl. Jap. ed. 2, 321 (1931).

Cimicifuga japonica var. acerina (Sieb. et Zucc.) Handel-Mazzetti in Acta. Hort. Gotob. 13:47 (1939).

Cimicifuga japonica Spreng. var. obtusiloba Makino, Illus. Fl. Jap. 569 (1940); Maekawa, Hara, and Tuyama, Makino's Illus. Fl. Jap. 173 (1963).

Cimicifuga acerina (Sieb. et Zucc.) Tanaka var. typica Hara, in Phytotax. et Geobot. 13:200 (1943).

Cimicifuga acerina (Sieb. et Zucc.) Tanaka var. intermedia Hara, in Phytotax. et Geobot. 13:200 (1943).

Cimicifuga acerina (Sieb. et Zucc.) Tanaka var. macrophylla (Koidzumi) Hara, in Phytotax. et Geobot. 13:201 (1943).

Cimicifuga acerina (Sieb. et Zucc.) Tanaka var. Peltata (Makino) Hara, in Phytotax. et Geobot. 13:201 (1943)

A short perennial, with hard, knotted rhizomes and solitary stems bearing ternate (rarely biternate) leaves which are always attached at the base of the aerial stem and are never cauline. Rhizomes woody, horizontally or obliquely oriented, sometimes branched, attaining a maximum length of 9 (mostly 6-7) cm. long, 0.5-2 cm. wide, bearing numerous fibrous roots; stems 2.5-9.5 (mostly about 6) dm.

high, erect, never stout or fleshy at the base, diminishing in size to the summit, greenish-brown to straw-colored, terete or flattened laterally at the base, terete above, lightly furrowed toward the base, glabrous to sparsely strigose up to the inflorescence, there rather densely short pubescent with grey hairs, somewhat glandular; petioles 10-26 (mostly 18) cm. long, straight, narrowly sulcate on the upper face, glabrous in the groove, enlarged at the base with wing-like margins clasping and sometimes completely ensheathing the stem, pubescent at the petiolule nodes; leaves ternate (rarely biternate), the central division 1-3-(mostly 1-) foliate, the lateral divisions similar (thus, the leaves may possess up to 9, but usually only 3 leaflets); petiole of the central division 8-14 (mostly 9) cm. long, narrowly sulcate, glabrous or with rarely scattered lustrous hairs in the groove; petioles of the lateral divisions 6-12 cm. long, equal or occasionally noticeably unequal; terminal leaflet of the central division 7-24 (mostly 12-14) cm. long, 6-24 (mostly 11-13) cm. wide between the apices of the two widest lobes, equilateral, 5-7 palmately lobed, lobe tips obtuse to acuminate or caudate (usually acuminate-caudate), lobes distinct to obscure, sinus depths varying, margin incised-serrate, teeth gland-tipped, base deeply cordate, upper surface (including veins) glabrous, with exception to a striking, narrow zone of short stiff hairs along the margin, veins of the lower surface possess strigose hairs while the remaining surface area is glabrous, 5-9 prominent veins arising at the base, green above, paler below, thin to coriaceous (the usual condition); leaflets of the lateral

divisions scarcely smaller, inequilateral, commonly 6-22 (mostly 9-14) cm. long, 5-20 (mostly 9-14) cm. wide; inflorescence a simple, elongate spike, or spicate raceme which frequently is branched at the base, rarely much branched throughout, 5-32 cm. long, branches commonly 6-8 cm. long, possessing a dense, short pubescence; pedicel negligible; flowers appear to be sessile to the axis of the inflorescence, subtended by three small, fugacious bracts which are scarcely 0.5 mm. long, one rather broad, obtuse and concave, and two lateral ones which are smaller, otherwise similar; sepals 4, elliptical, concave, fugacious, 3.5 -4.5 mm. long, 3.5 - 4.0 mm. wide, slightly tapered at the base; apetalous; staminodia 2-3, broadly elliptical to spatulate, concave, slightly retuse or broadly emarginate, not bifid, not antheroid, short stipitate, about 3 mm. long, 2 mm. wide, possessing a nectariferous area near the base; stamens 21-32 (mostly about 25-27); filaments unequal, 5-8 mm. long, filiform; anthers oblong; pistils 1-3 (usually 1), 3 mm. long, stipitate (attenuate to the base), glabrous; style elongate and laterally flattened; stigma broad and flat; ovary about 1 mm. in diameter; fruit a follicle; follicles 1-3 (mostly 1), 5-8 (mostly 7) mm. long, 3-4 mm. wide, shortly stipitate, glabrous, oblong, beak oriented at 90° , walls coriaceous; veins oriented perpendicular to the long axis of the follicle; stipe generally curved upward; seeds 5-7, 1.5-1.9 mm. long and 1 mm. wide, lunate, reddish-brown, bare (usual condition) or rugose to rarely, lightly covered with minute scales on the angles.

Type Locality: "Japonia." Type Specimen: Preserved with the

Thunberg collection at Uppsala. The actual specimen was examined and described by Dr. Rolf Santesson, Keeper of the Herbarium, University of Uppsala, upon request. A representative specimen is shown in Figure 14.

In partial or dense shade of moist deciduous forest in mountainous terrain, ravines, on wooded slopes and occasionally in moist grassy fields near forest margins from Aomori Prefecture of northern Honshu southward to Shikoku and southern Kyushu Islands; also in Korea on Cheju (Quelpart) Island and China from Shansi Province southward to Yunnan Province. Fl. July-October. Ft. late August-November (Fig. 15).

Specimens Examined:

CHINA

HUPEH PROVINCE: Locality not specified, Wilson 2509, July 1901 (NY); Locality not specified, Wilson 2239, Sept. 1901 (K, NY); Locality not specified, Wilson 2581, no date (NY); Locality not specified, Henry 4763, no date (MO); Locality not specified, Henry 6083, 1885-1888 (BM, GH, MO, NY, US). KWEICHOW PROVINCE: Tating, Tsiang 8922, 12 Sept. 1930 (NY). SHANSI PROVINCE: southern Shansi, Yüan-chü district, Smith 6716, 24 July 1924 (UPS); Hsiatschuan, Yaoschan, Licent 12588, 19 Oct. 1935 (GH). SZECHWAN PROVINCE: Eastern Szechwan, Tchen-Keoutin District, Farges 1260, 6 Sept. 1893 (BR, K, NY, P); YUNNAN PROVINCE: Yunnan-Sen District, Cavalerie 7868, no date 1900-1920 (K). PROVINCE NOT SPECIFIED: Mt. Lean-san, Hugh s.n., 1898 (BM); Kay-Techeou, Cavalerie 3155, 24 July & 9 Aug. (P).

JAPAN

HONSHU: AOMORI PREFECTURE: Shiwa-mura, Kamikita-gun, Mizushima

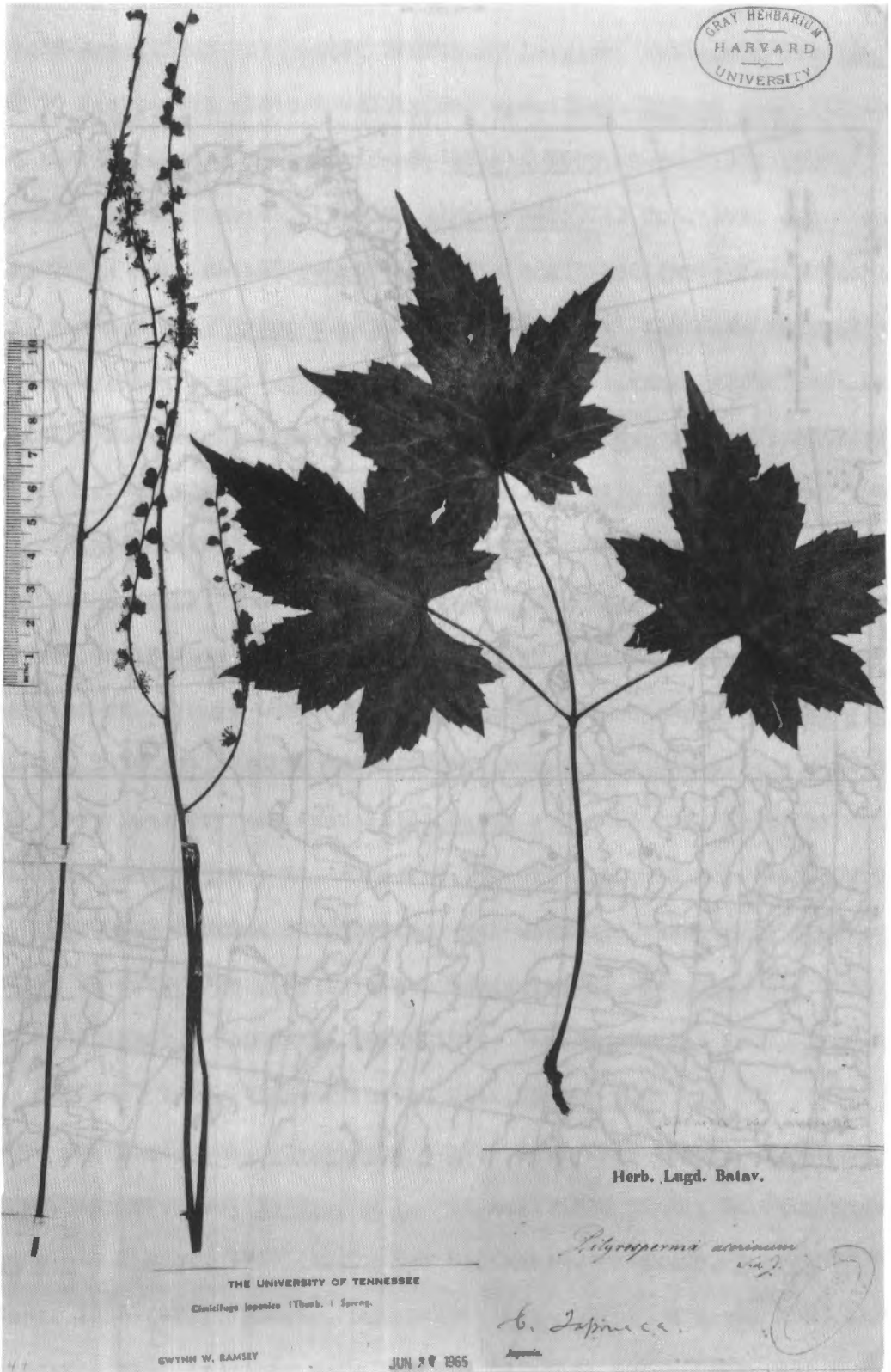


Figure 14. Representative specimen of Cimicifuga japonica.

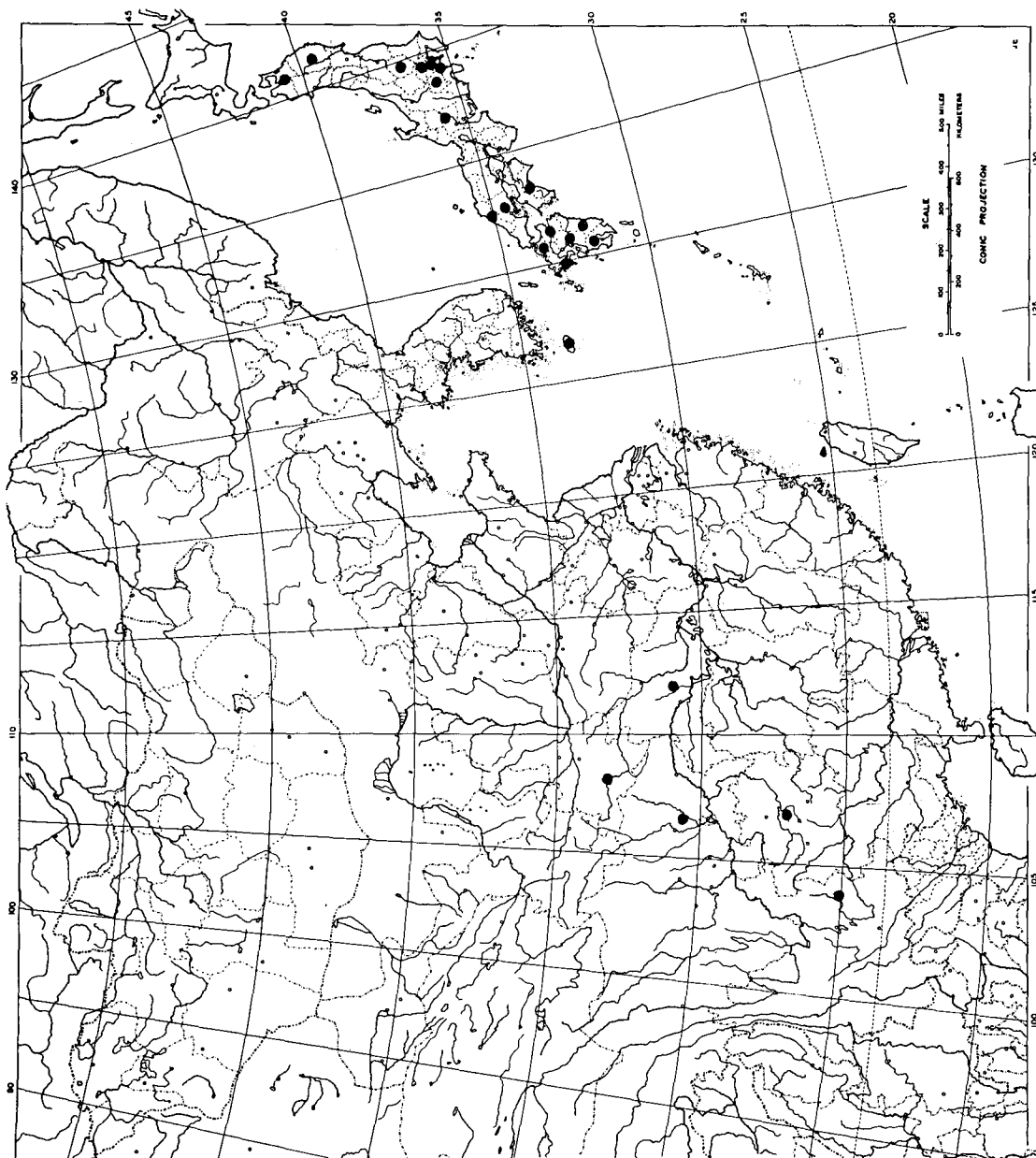


Figure 15. Distribution of Cimicifuga japonica.

s.n., 8 Sept. 1948 (S). GIFU PROVINCE: Locality not specified, Shiota 536, 20 Sept. 1921 (GH); Locality not specified, Shiota 6376, 28 Sept. 1933 (GH); Locality not specified, Shiota 9003, Sept. 1935 (GH).

HIROSHIMA PREFECTURE: Taishaku, Tamura 8885, 12 Oct. 1961 (S). IWATE

PREFECTURE: Mt. Gansu, Faurie 5906, 13 Aug. 1890 (MO); Tsuchibuchii-mura, Kamihei-gun, Hosoi s.n., 7 Oct. 1950 (S). KANAGAWA PREFECTURE:

Mt. Jimba-yama, Suzuki 271, Oct. 1939 (AA). SAITAMA PREFECTURE: Mt.

Kurotaki, Minamimaki-mura, Kanra-gun, Satomi s.n., 21 Sept. 1957 (S);

Jumoji-toge to Mt. Akasawa, Chichibu-gun, Shimi-ju 13593, 4 Oct. 1962

(S). SHIMANE PREFECTURE: Hakimi-kami-mura, Mino-gun, Naito s.n.,

8 Oct. 1921 (KAG). TOCHIGI PREFECTURE: Mt. Kogashi, Shiroyama-mura,

Kawachi-gun, Furuse s.n., 2 July 1956 (S); from half way up to nr. the

summit of Mt. Hiruga-take, Shiwohara-machi, Shiwoya-gun, Furuse s.n.,

10 Sept. 1956 (S). TOKYO PREFECTURE: Dorwamyama, Anon. s.n., 17 Oct.

1910 (US); Locality not specified, Onuma s.n., 13 Oct. 1912 (S).

YAMANASHI PREFECTURE: Mt. Kuradake, Suzuki s.n., 12 Oct. 1951 (WTU).

KYUSHU: FUKUOKA PREFECTURE: Mt. Wakasugi, Sasakuri, Takikawa

200157, 26 Oct. 1924 (GH, US); Mt. Wakasugiyama, Hatusima s.n., 20

Oct. 1950 (KAG). KAGOSHIMA PREFECTURE: nr. Kagoshima City, Anon.

s.n., 28 Aug. 1912 (KAG); Tarumizu City, Naito s.n., 5 Oct. 1925

(KAG); Mt. Kirishima, Otsukohchi s.n., July 1929 (KAG). KUMAMOTO

PREFECTURE: Mt. Aso, Tatsuno s.n., 15 Aug. 1930 (KAG); Mt. Kunimidake,

Sako s.n., 2 Sept. 1957 (KAG); Aso volcanoes, Onigazyo, Suzuki 2230,

1 Sept. 1956 (WIS); Momiku, Gokanosyo, Sako 1029, 3 Sept. 1957 (KAG);

Gokanosyo, Sako 1132, no date (KAG). MIYAZAKI PREFECTURE: Mt. Dodake,

Hinokagecho, Hatusima, Sako, and Kawanabe 22482, 8 Oct. 1958 (KAG); between Gokasyo and the summit of Mt. Sobo, Hatusima, Sabo, and Kawanabe 22649, 9 Oct. 1958 (KAG); on peak of Mt. Shiraiwa, Hatusima & Sako 26335, 21 Aug. 1961 (KAG). NAGASAKI PREFECTURE: Nagasaki, Anon. s.n., 1863 (BM, GH, S, US); Osendake, Mt. Unzen, Kawagoe s.n., 20 Aug. 1915 (KAG); Osendake, Mt. Unzen, Kawagoe s.n., 1 Sept. 1921 (KAG). OITA PREFECTURE: Ukenokuchi, Mt. Kuju, Naito 6698, 10 Aug. 1922 (KAG).

SHIKOKU: KOCHI PREFECTURE: Nanokawa, Anon. s.n., 24 Aug. 1888 (GH); Nanokawa, Anon. s.n., 25 Sept. 1896 (US).

ISLAND OR PREFECTURE NOT SPECIFIED: middle Japan, Anon. s.n., 1866 (GH, NY); Nanura Valley, Dickens s.n., 11 Sept. 1881 (K); Montagnes de Lambonz, Faurie s.n., Oct. 1886 (P). Insular Japan, Zizogatake, Faurie s.n., Julio 1903 (BM); Insular Japan, Norikura, Faurie 6939, Aug. 1905 (BM); Ura-Kogasi, Suzuki s.n., 17 Oct. 1930 (TAI); Locality not specified, Bisset 567, 12 Oct. 1876 (BM); Locality not specified, Fauri 13536, 1897 (MO). Locality not specified, Zollinger 439, no date (GH, & P); locality not specified, Hance 9, no date (BM); Locality not specified, Savatter s.n., 1875 (K).

KOREA

CHEJU (Quelpart) ISLAND: in mountains, Faurie 170 & 171, 17 Oct. 1906 (BM, P).

This plant was first described by Thunberg (1784) under the name Actaea japonica, and placed in his "Polyandria Monogynia." Sprengel (1825) recognized that Thunberg's specimen did not belong to that genus, thus, transferred it to the genus Cimicifuga. It was

assigned to the genus Pityrosperma, by Siebold and Zuccarini (1845) and Thalictrodes by Kuntz (1891).

This species has not been well understood in the past, by Asian and European botanists, as is indicated by the long list of synonymy. Misinterpretations and confusion of this plant with other species may have arisen because authors have not examined or had first hand descriptions of the type specimens.

The most recent, extensive treatment of the Japanese Cimicifuga with broad, cordate leaflets is that by Hara (1943). In his description of Cimicifuga japonica (Thunb.) Sprengel, Hara writes, "foliola supra praesertim secus venas hispidula." Contrary to Harra's description the type specimen of Thunberg, preserved at Uppsala, has a strikingly different pattern of pubescence on the upper leaflet surface. The veins of the upper leaflet surface are not hispid, but rather as described below.

Dr. Rolf Santesson, Keeper of the Herbarium, at the University of Uppsala, has microscopically examined and described the pattern of pubescence on the leaflets of Thunberg's type specimen as follows:

As to the pubescence on the leaves I can inform you that there is a narrow zone of short stiff hairs along the margins of the leaflets. There are no hairs at all on the veins on the upper surface of the leaflets. On the under surface it is the contrary; there the nerves are furnished with strigose hairs and the surface for the rest has no hairs.

Santesson's description of the pubescence of Thunberg's type specimen agrees with that for C. acerina (Sieb. et Zucc.) Tanaka which is used in Harra's treatment. Hara's description of C. acerina reads, "foliola supra tantum ad marginem hispidula," and this description can fit

no other species except Cimicifuga japonica (Thunberg) Sprengel.

On the basis of Dr. Santesson's description of the pubescence pattern on the leaflets of Thunberg's type specimen, and observations of herbarium specimens possessing a narrow zone of marginal pubescence on the upper leaflet surface, it is believed that C. acerina used by Hara (1943) should be listed as a synonym of C. japonica (Thunb.) Sprengel. It is also believed that Hara's C. japonica is synonymous with C. biternata (Sieb. et Zucc.) Miq. since the latter species has leaflets, which possess strigose hairs along the veins of their upper surface.

4. CIMICIFUGA BITERNATA (SIEB. ET ZUCC.) MIQ.

(Inushoma)

SYNONYMY

Cimicifuga biternata (Sieb. et Zucc.) Miq., Ann. Mus. Bot. Lugd. Batav. 3:9 (1867); Prolus Fl. Jap. 197 (1867); Munesada, Jour. Pharm. Soc. Jap. 51:86 (1931); Huth, in Engler Bot. Jahrb. 16:316 (1892); Makino in Bot. Mag. Tokyo 15:171 (1901); Maekawa, Hara, and Tuyama, Makino's Illus. Fl. Jap. 173 (1963).

Pityrosperma biternatum Sieb. et Zucc. Abh. Akad. Wiss. Muench. (3) 3:735 (1843); (4) 2:184 (1845).

Pityrosperma obtusilobum Sieb. et Zucc. Abh. Akad. Wiss. Muench. (3) 3:735 (1843); (4) 2:184 (1845)

Cimicifuga obtusiloba (Sieb. et Zucc.) Miq., Ann. Mus. Bot. Lugd. Batv. 3:9 (1867); Prolus. Fl. Jap. 197 (1867).

Actaea obtusiloba (Sieb. et Zucc.) Prantl in Engler, Bot. Jahrb. 9:246 (1888).

Actaea biternata (Sieb. et Zucc.) Prantl in Engler, Bot. Jahrb. 9:246 (1888).

Cimicifuga japonica Miq. var. ternata Maxim. ex. Makino in Bot. Mag. Tokyo 4:414 (1890).

Cimicifuga japonica Miq. var. biternata (Miq.) Maxim. ex Makino in Bot. Mag. Tokyo 4:414 (1890).

Thalictrodes biternatum (Miq.) O. Kuntz, Rev. Gen. Pl. 1:4 (1891).

Thalictrodes obtusilobum (Miq.) O. Kuntz, Rev. Gen. Pl. 1:4 (1891).

Cimicifuga japonica Miq. var. obtusiloba (Miq.) Yatabe, Icon. Fl. Jap.

(I) 2:67 (1892).

Cimicifuga heterophylla Makino, Bot. Mag. Tokyo 11:248 (1897); 13:199

(1899).

Cimicifuga japonica Spreng. var. biternata (Sieb. et Zucc.) Finet et

Gagepain, Bull. Soc. Bot. France 51:521 (1904). Koidzumi, in Bot.

Mag. Tokyo 44:100 (1930).

Cimicifuga japonica (Thunb.) Sprengel, sensu Koidzumi in Bot. Mag.

Tokyo 44:100 (1930). Sensu Hara, in Phytotax. et Geobot. 13:198

(1943).

Cimicifuga japonica Spreng. var. acutiloba Hara, in Phytotax. et

Geobot. 13:198 (1943).

A short perennial, with hard, knotted rhizomes and solitary stems bearing biternate (frequently ternate) leaves which are always attached at the base of the aerial stem and never cauline. Rhizomes woody, horizontally or obliquely oriented, sometimes branched, attaining a maximum length of 7 (mostly 5-6) cm. long, 0.5-10.8 (mostly about 7) dm. high, erect, never stout or fleshy at the base, diminishing in size toward the summit, greenish to straw-colored throughout, angled, terete, or flattened laterally at the base, terete above, lightly furrowed to deeply grooved toward the base, glabrous to sparsely strigose up to the inflorescence, there rather densely short pubescent with grey hairs, somewhat glandular or hispid; petioles 5.5-26.0 (mostly 15-19) cm. long, straight or arcuate, narrowly sulcate on the upper face, glabrous to sparsely pubescent in the groove, enlarged at

the base with wing-like margins which always ensheath the stem, glabrous to pubescent at the petiolule nodes; leaves biternate (frequently ternate), the central division 1-3-(mostly 3-) foliate, the lateral divisions similar (thus, the leaves may possess up to 9 leaflets; petiole of the central division 5.5-19 (mostly 12) cm. long, narrowly sulcate, usually lightly pubescent with lustrous hairs in the groove; petioles of the lateral divisions 5.5-11.0 cm. long, equal or noticeably unequal; terminal leaflet of the central division 4.5-12.5 (mostly 8-9) cm. long, 5-15 (mostly 9-10) cm. wide between the apices of the two widest lobes, equilateral, 5-7 palmately lobed, lobe tips obtuse to acute, sinus depths varying, margin sharp dentate to serrate and incised, teeth gland-tipped, base subcordate to deeply cordate (rarely rounded), veins of the upper surface lined with silvery, strigose hairs (pubescence not marginal as in C. japonica), veins of the lower surface possessing strigose hairs while the remaining surface area is glabrous, 5-7 prominent veins arising at the base, green above, paler below, thin (the usual condition) to coriaceous; lateral leaflets of the central division scarcely smaller, inequilateral, 6-11 (mostly 8-9) cm. long, 6-10 (mostly 8-9) cm. wide; inflorescence a spike or spicate raceme which may be branched at the base, rarely much branched throughout, 5-32 cm. long, branches commonly 6-8 cm. long, hispid; pedicel negligible; flowers appear to be sessile to the axis of the inflorescence, subtended by three small, fugacious bracts which are scarcely 0.5 mm. long, one rather broad, obtuse and concave, and two lateral ones which are smaller, otherwise similar; sepals 4-5, elliptical

to obovate, concave, fugacious 3.5-4.5 mm. long, 3.5-4.0 mm. wide, slightly tapered at the base; apetalous; staminodia 2-3, broadly elliptical to spatulate or obovate, concave, emarginate or truncate (the usual condition), not bifid, not antheroid, rather long stipitate, about 2 mm. long, .5-1 mm. wide, possessing a nectariferous area near the base; stamens 42-55 (mostly around 50); filaments unequal, spreading, 4.0-9.0 mm. long, filiform; anthers oblong to elliptical; pistils 1-2 (mostly 1), 3 mm. long, sessile or short stipitate, glabrous; style rather short and laterally flattened; stigma broad and flat; ovary about 1 mm. in diameter; fruit a follicle; follicles 1-2 (mostly 1), commonly 5 mm. long, 3.0-3.5 mm. wide, shortly stipitate, glabrous, oblong to elliptical, beak oriented at a greater angle than 90° , walls coriaceous, veins oriented perpendicular to the long axis of the follicle; seeds 4-8 (usually 6-7), 1.5-1.8 mm. long and 1 mm. wide, lunate, reddish-brown, bare (usual condition) or rugose to rarely lightly covered with very minute scales on the angles.

Type Locality: "Nagasaki." Type specimen; believed to be preserved at Leiden. Description is thought to be conclusive. Representative specimen shown in Figure 16.

In moist deciduous woods, along streams, on mountain slopes and sides of ravines from Tokyo Prefecture, or middle Honshu, west-southwest to Okayama Prefecture in Japan; also in Korea on Cheju (Quelpart) Island. Fl. August-October. Ft. September-November. (Fig. 17).

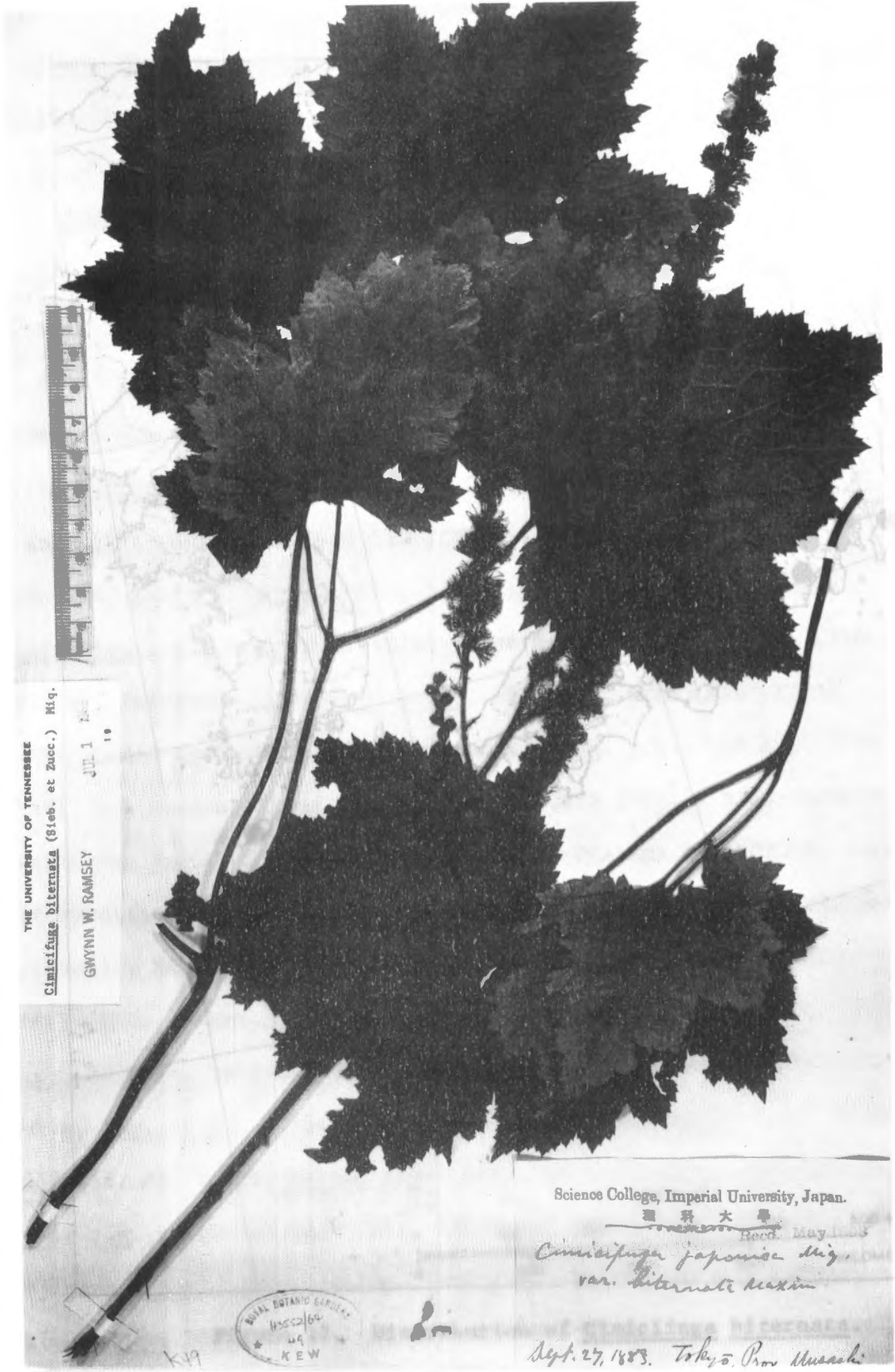


Figure 16. Representative specimen of Cimicifuga biternata.

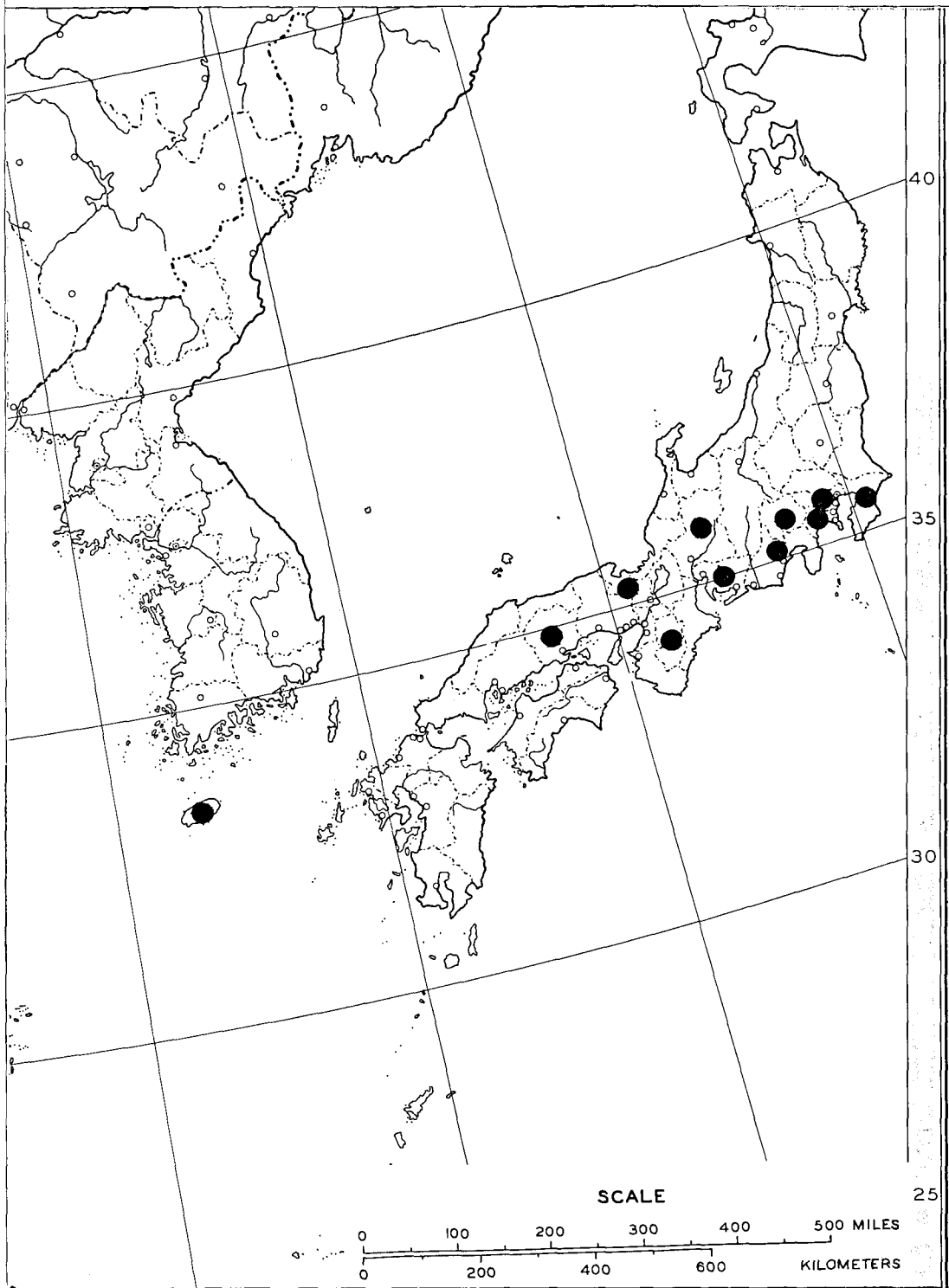


Figure 17. Distribution of Cimicifuga biternata.

JAPAN

HONSHU: AICHI PREFECTURE: Locality not specified, Okada 535, 1924 (GH); along the Kamsa River, Oo-nagura Nagura-mura Kita-shitaro-gun, Furuse s.n., 27 Oct. 1957 (AA, S). CHIBA PREFECTURE: Mt. Kiyosumi, N. Lat. $35^{\circ} 09'$, E. Long. $140^{\circ} 09'$, Suzuki 270, 17 Oct. 1938 (AA); On s. side of Mt. Kiyosumi, Furuse s.n., 1 Nov. 1958 (AA). GIFU PREFECTURE: Locality not specified, Shiota s.n., 11 Sept. 1926 (GH); Kawakami village, Shiota s.n., 8 Aug. 1932 (GH); Kaai Village, Shiota 7707, 1 Aug. 1934 (GH). KANAGAWA PREFECTURE: In grassy woodland nr. Yokohama, Maximowicz s.n., Sept. 1862 (BM, GH, NY, P); Yokohama, Maximowicz s.n., Oct. 1862 (TAI); prope Sagami, Savatier 35, 1866-74 (P); Mt. Shiroyama, Kobavashi 13733, 18 Sept. 1955 (S). KYOTO PREFECTURE: Kyoto City, Mt. Kuramayama, Anon. s.n., 10 Aug. 1906 (KAG); Mt. Kurama, Hiroe 13116, 21 Sept. 1958 (WIS). NARA PREFECTURE: Nishihara, Tamura 2074, 2 Oct. 1954 (S). OKAYAMA PREFECTURE: Locality not specified, Masamune s.n., 20 Sept. 1920 (NY). SHIZUOKA PREFECTURE: Jyohkohji, Mizukubo-cho, Anon. s.n., 12 Aug. 1954 (KAG). TOKYO PREFECTURE: Tokyo, Matsumura s.n., 28 Sept. 1879 (US); *ibid.*, Anon. s.n., 27 Sept. 1883 (K); Katayama, Anon. s.n., 29 Sept. 1893 (US); Tokyo, Anon. s.n., 5 Oct. 1914 (S); Mt. Takawo, Furuse s.n., 24 Oct. 1958 (AA, S); Tokyo, Yatabe s.n., Sept. no year (UPS); Dlokan-yama, Anon. s.n., Oct. no year (K); YAMANASHI PREFECTURE: at foot of Mt. Fujiyama, Faurie s.n., 10 Aug. 1890 (P). PREFECTURE NOT SPECIFIED: Kibune, Ohwi 9019, 24 Sept. 1936 (UPS, WIS); locality not specified,

Uno E63, 5 Nov. 1938 (GH, US); Mt. Kosenzi, Ishikawa s.n., 15 Sept. 1940 (TAI); locality not specified, Zollinger 439, no date (BM); locality not stated, Petersen s.n., no date, (UPS); Unatumuja, Suzuki s.n., no date (TAI); horticultural specimen, J.B.P. s.n., 2 Oct. 1933 (C); in silvis circa yedo, Fauri 677, no date (P); Yokoskia, Franchet 34, 1866-71 (P).

KOREA

CHEJU (Quelpart) ISLAND: Locality not specified, Smith s.n., 5 Sept. 1934 (US).

This plant was first described by Siebold and Zuccarini (1843) under the binomial Pityrosperma biternatum. Later, Miquel (1867) placed this plant in the correct genus, naming it Cimicifuga biternata. It was assigned to the genus Actaea by Prantl (1888) and to Thalictrodes by Kuntz (1891).

This species has often been confused with Cimicifuga japonica (Thunb.) Sprengel as can be seen in the list of synonymy.

Hara (1943) has C. biternata (Sieb. et Zucc.) Miq. listed as a synonym of C. japonica (Thunb.) Sprengel. This interpretation is believed to be incorrect. As stated in a previous section (discussion on C. japonica), Hara's description of C. japonica does not agree with the type specimen of Thunberg which is preserved at Uppsala. Hara's description of C. japonica does agree with the characteristics of C. biternata (Sieb. et Zucc.) Miq. which is treated here as a good species. The latter species does have leaflets which possess pubescence on the upper surface, only along the veins.

Hara's C. japonica var. acutiloba includes specimens with rather deeply sinused leaflets. Only two specimens that might be placed in such a taxon have been examined. These have been included in C. biternata since they have the characteristics of this species.

Cimicifuga biternata appears to be most closely related to C. japonica, have spicate racemes (flowers sessile), deeply cordate leaflets, stipitate pistils, and similar fruits and seeds. The seeds of the former species are lunate and relatively smooth like those of C. racemosa of North America, and have broad and deeply cordate leaves resembling those of C. elata and C. rubifolia of North America.

5. CIMICIFUGA RUBIFOLIA KEARNEY

(Kearney's Bugbane) Nomen Nov.

SYNONYMY

Cimicifuga rubifolia Kearney, Bull. Torr. Bot. Club. 24:561

(1897); Gattinger, Fl. Tenn. 80 (1901); Small, Man. Sou. E.

Fl. 513 (1933); Ramsey, Rhodora 66:766 (1964).

Cimicifuga cordifolia sensu Elliott, Sk. Bot. S.C. & Ga. 2:17

(1824) pro parte; Sims in Curtis' Bot. Mag. 46:2069 (1819)

pro parte; Huth, Engl. Bot. Jahrb. 16:319 (1892) pro parte;

Kearney, Let. to Brit., re: C. cordifolia, Mar. 16, 1893 (NY);

Gattinger, Fl. Tenn. 80 (1901); Britton and Brown, Illus. Fl.

2:91, 1865 (1936) pro parte; Jones and Fuller, Vas. Pl. Ill.

208 (1955); Mohlenbrock and Voigt, Fl. Sou. Ill. 182 (1959);

Non Pursh.

Cimicifuga racemosa (L.) Nutt. var. cordifolia (Pursh) Gray

Kearney, Bull. Torr. Bot. Club, 20:253 (1893); Robinson in

Gray, Syn. Fl. 1:55 (1895) pro parte; Bailey and Swayne, Amer.

Midl. Nat. 46 (1):256 (1951); Jones and Fuller, Vas. Pl. Ill.

208 (1955); Britton and Brown, Illus. Fl. 2:91, 1865 (1936) pro

parte; Fernald, Gray's Man. ed. 8, 671 (1950) pro parte; Gleason,

Illus. Fl. 2:158 (1952) pro parte.

A tall long-lived perennial, with hard, knotted rhizomes and

solitary, wand-like stems bearing one or more often two, large biternate leaves near the base. Rhizome thick, horizontal, attaining a maximum length of about 10 cm. bearing numerous strong fibrous roots; stems 3-22 (mostly 10-14) dm. high, erect, rather stout at the base, but diminishing rapidly towards the summit, usually dark purplish-brown, rather acutely 4-angled below, almost terete towards the summit, more or less sulcate on the faces, especially below, smooth and glabrous or with a few lax delicate hairs up to the inflorescence, there very sparsely to rather densely puberulent or short-pubescent; petiole 2-5 dm. long, rather stout, straight or sometimes arcuate below, angled, rather deeply sulcate on the upper face towards the base, rather densely pubescent in the groove, otherwise nearly glabrous or sparsely pubescent, with lax hairs especially towards summit, somewhat dilated at apex, much enlarged and with thin, wing-like margins clasping the stem at base; leaves ternate-biternate, the central division usually trifoliate, sometimes unifoliate, in any case terminal leaflet always much larger than the others, the lateral divisions usually trifoliate, but occasionally unifoliate (thus, leaves may possess 3,5,7,9 leaflets), very rarely more than 9 leaflets; petiole of central division 10-14 cm. long, angled and sulcate like the main petiole, sparsely pubescent with lax delicate hairs, the groove densely so; petioles of lateral divisions 6-9 cm. long, equal or one as much as 2 cm. longer than the other; petiolules of lateral leaflets of the central division (when present) about 3.5-5 cm. long, deeply sulcate on the upper face, very pubescent, especially in the groove; petiolules of leaflets of lateral divisions

shorter, otherwise similar; terminal leaflet of central division 9-30 (mostly 14-17) cm. long, 9-25 (mostly 15-16) cm. wide between the apices of the two widest lobes, very broadly obovate in outline, equilateral, sharp acuminate at the apex, usually deeply cordate with a sinus of equal width throughout or widening towards the mouth, coarsely and irregularly dentate, deeply and acutely palmately three-five lobed, the primary lobes themselves less deeply 2-3 lobed and the secondary lobes in turn slightly 2-3 lobed, thin, dark green above, paler beneath, smooth and glabrous above, sparsely short-ciliate, sparsely to rather densely pubescent along the veins beneath with rather long appressed, delicate, lustrous hairs; very veiny, 5-7 veins prominent, strongly tending to anastomose, the two largest lateral ones nearly as strong as the mid-vein; other leaflets smaller and in-equilateral, otherwise similar, 8-24 cm. long 6-22 cm. wide; mean stomata length 43.21 μ ; inflorescence a simple panicle of 2-6 slender racemes, the terminal and much the longest one 15-30 (usually about 20) cm. long; rachis and pedicels sparsely, or the pedicels occasionally rather densely pubescent with short straight hairs; pedicels (in flower) about 2 mm. long, rather slender, much thickened at summit, subtended by a lance-subulate bract about 2 mm. long, bearing at base 2 laterally disposed, ovate-triangular, acute, ciliolate bractlets about 1 mm. long, pedicels (in fruit) 4-5 mm. long; sepals 5, fugacious, 4.5-5 mm. long, 3-4 mm. wide, rounded at apex, narrowed at base, concave; petals none; stamens 35-65; filaments about 4 mm. long, flattened especially towards summit; anthers about .5 mm. long; pistil solitary, rarely two, sessile,

about 2 mm. long from base of ovary to summit of stigma, the style and stigma only slightly differentiated from the body of the ovary; ovary about .7 mm. in greatest transverse diameter, perfectly glabrous, strongly compressed laterally, the sides irregularly oblong in outline; style slightly recurved, very short; stigma minute; follicles 8-21 (commonly 16) mm. long, sessile, strongly compressed laterally with sides irregular oblong, rounded towards base on the ventral face, beaked by the short blunt, hardened, apically somewhat enlarged, ascending style which departs from the ventral side of the pod, just below the summit, at an angle of about 45° , pale green, walls thin, becoming almost chartaceous, veins prominent, somewhat reticulated; seeds usually 6, the four middle ones in two rows, the other two solitary, about 3 mm. long, about 1.5 mm. wide, lenticular, cylindrical in appearance, the sides oblong in outline, reddish-brown, not pale brown as C. arizonica, covered with reddish-brown, thin, chaffy scales, especially along the edges where they form a well-developed deeply lacerate wing; scales usually wider than in C. arizonica; (modified from Kearney 1897).

Type locality: "Rich woods, bluffs, on Tennessee River, near Knoxville." Lectotype specimen: Kearney s.n., Sept. 1890 (NY) (Fig. 18).

North-facing, limestone talus slopes from limestone river bluffs, ravines and coves, along rivers and creeks of the Ridge and Valley Province from southwestern Virginia (Scott Co.) southward to Meigs Co., Tennessee. Also, in Montgomery County, Tennessee and three

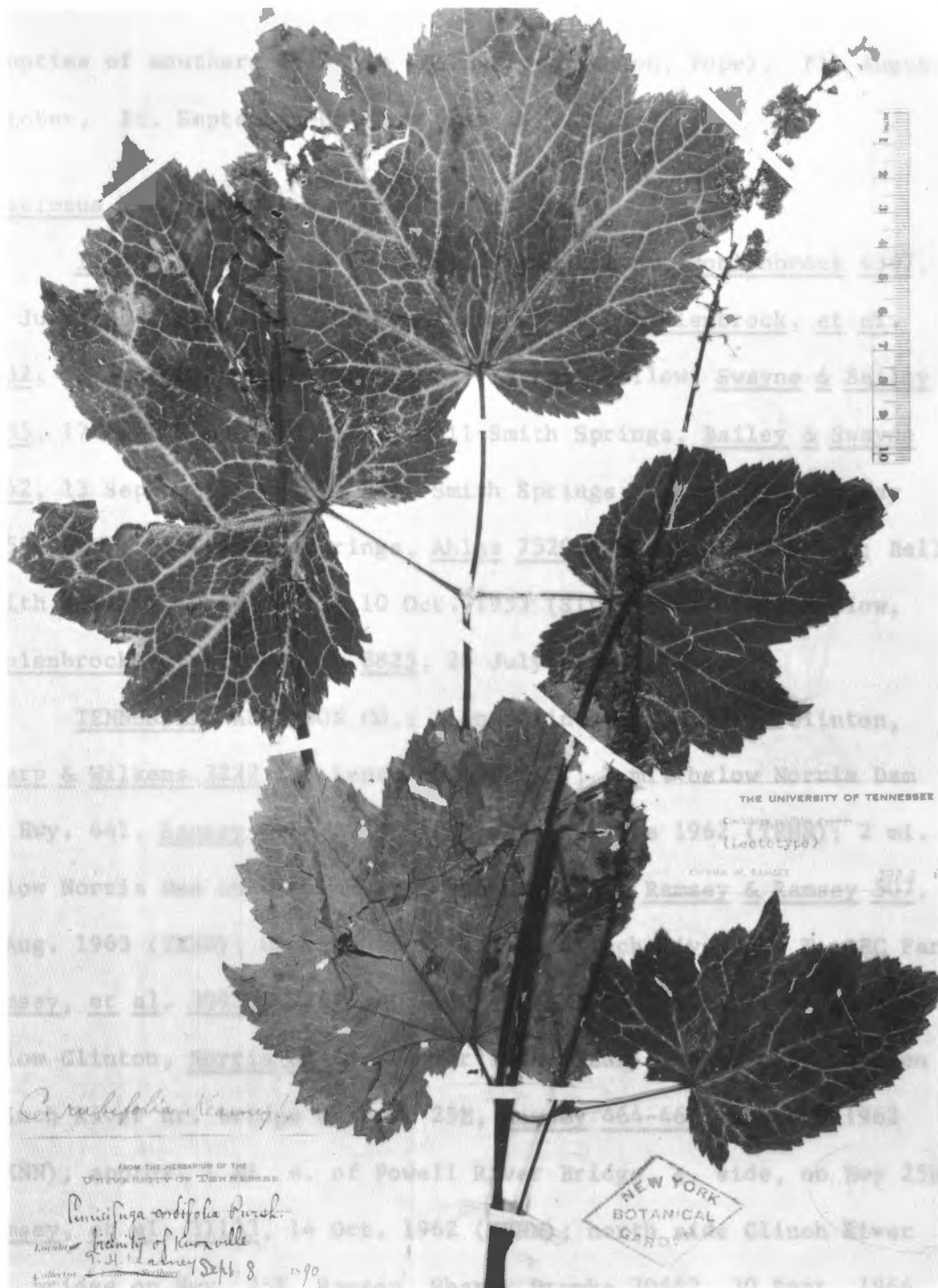


Figure 18. Lectotype specimen of Cimicifuga rubifolia.

counties of southern Illinois (Gallatin, Johnson, Pope). Fl. August-October. Ft. September-October (Fig.19).

Specimens Examined:

ILLINOIS: GALLATIN CO.: Grindstaff Hollow, Mohlenbrock 4367, 27 July 1954 (SIU); JOHNSON CO.: Fern Clyffe, Mohlenbrock, et al. 2832, 15 June 1954 (SIU); POPE CO.: Jackson Hollow, Swayne & Bailey 1135, 17 Aug. 1950 (SIU, ILL); Bell Smith Springs, Bailey & Swayne 1842, 13 Sept. 1951 (SIU); Bell Smith Springs, Voigt 3756, 23 May 1953 (SIU); Bell Smith Springs, Ahles 7520, 21 Aug. 1953 (ILL); Bell Smith Springs, Voigt 4175, 10 Oct. 1953 (SIU); Bear-tract Hollow, Mohlenbrock, et al. 8824 & 8825, 26 July 1954 (SIU).

TENNESSEE: ANDERSON CO.: Along Clinch River below Clinton, Sharp & Wilkens 3222, 30 Sept. 1934 (TENN); 2 mi. below Norris Dam on Hwy. 441, Ramsey & Holt 30241 & 30244, 6 June 1962 (TENN); 2 mi. below Norris Dam on Clinch River and Hwy. 441, Ramsey & Ramsey 507, 4 Aug. 1963 (TENN); Cruickshanks Bend on Clinch River, U. T. AEC Farm, Ramsey, et al. 30930, 12 April 1963 (TENN); on Clinch River Bluffs below Clinton, Norris OR170, summer 1964 (TENN). CLAIBORNE CO.: on Clinch River nr. bridge on Hwy. 25E, Ramsey 464-467, 6 Sept. 1962 (TENN); approx. 1 mi. e. of Powell River Bridge, s. side, on Hwy 25E. Ramsey, et al. 31133, 14 Oct. 1962 (TENN); north side Clinch River nr. bridge on Hwy. 25E, Ramsey, Sharp, Drumke 30442, 30 Sept. 1964 (TENN). GRAINGER CO.: Norris Lake, Indian Creek embayment on Hwy. 25E., Ramsey 473, 6 Sept. 1962 (TENN); Creek along Hwy. 25E. 3 mi. n. of Thornhill, Ramsey, et al. 30421, 30 Sept. 1962 (TENN). HAMBLEN CO.:

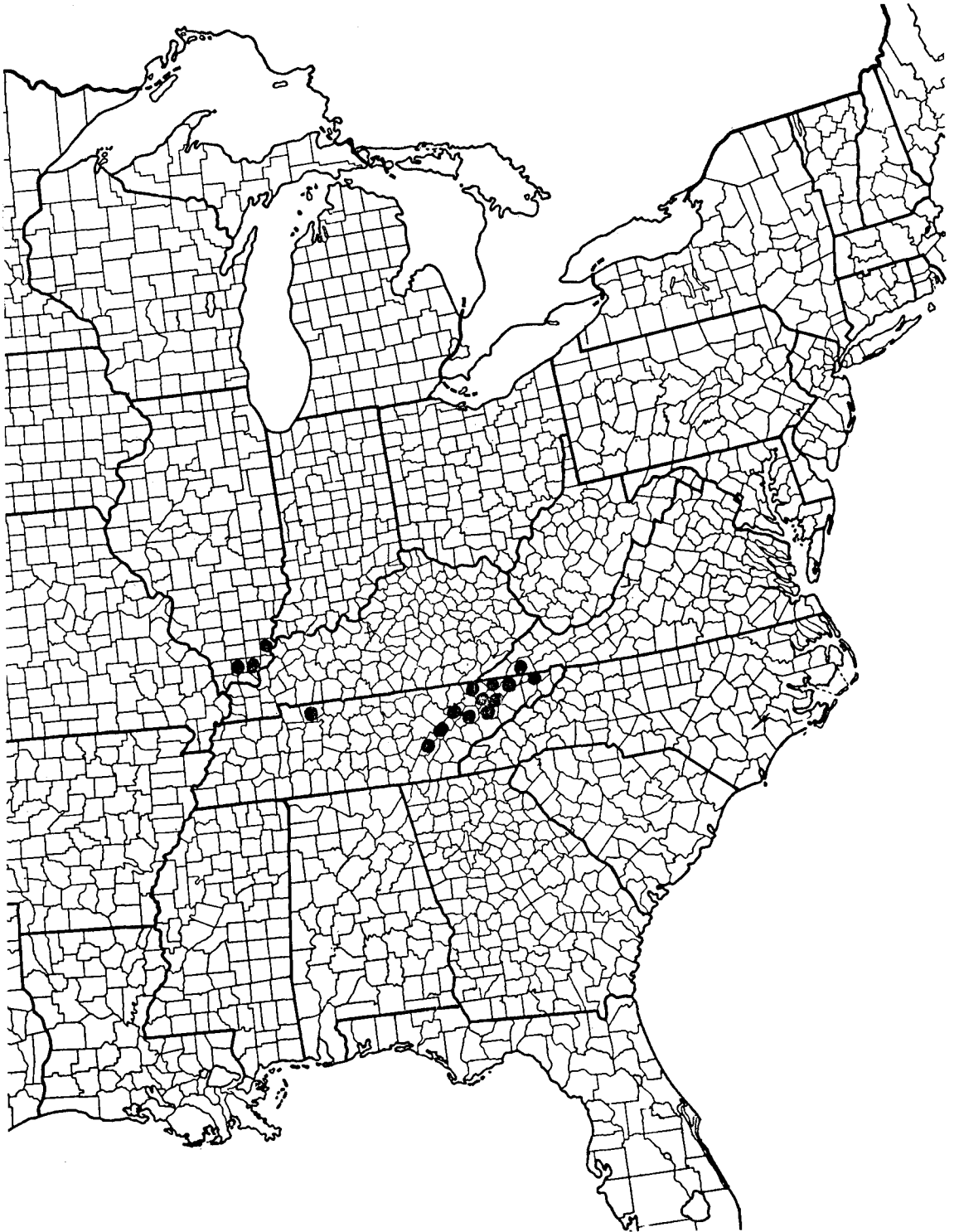


Figure 19. Distribution of Cimicifuga rubifolia.

along Holston River nr. Morristown, Sharp 4573A & B, 31 Aug. 1936 (TENN); 4 mi. n. of Morristown, Wherry s.n., 24 Aug. 1937 (PENN); HANCOCK CO.: $\frac{1}{4}$ mi. up Clinch River from Kyles Ford, Ramsey, et al. 501, 22 June, 1963 (TENN); 1 mi. e. of Edison above Kyles Ford on Clinch River, Ramsey, et al. 497, 22 June 1963 (TENN); 10 mi. up Clinch River from Kyles Ford, Ramsey, et al. 499, 22 June 1963 (TENN); 11 mi. up Clinch River from Kyles Ford, Ramsey, et al. 498, 22 June 1963 (TENN); along bluffs of Clinch River Kyles Ford, Ramsey, et al. 31123, 14 Oct. 1962 (TENN); 6 miles up Clinch River from Kyles Ford, Ramsey & Sharp 32244, 22 Sept. 1963 (TENN); 11 mi. up Clinch River from Kyles Ford, Ramsey & Sharp 31616, 22 Sept. 1963 (TENN); on Hwy. 66 $\frac{1}{2}$ mi. from junction of Hwys. 66 & 33, Ramsey, et al. 467-469 & 474-475, 14 Oct. 1962 (TENN); on Hwy. 66 $\frac{1}{2}$ mi. from junction of Hwys. 66 & 33, Ramsey 31121 6 Sept. 1962 (TENN); 1 mi. from Claiborne-Hancock Co. line up Powell River Ramsey & Griffin 505, 12 July 1963 (TENN). HAWKINS CO.: second gap on Clinch Mt. above Lee Valley, Hwy. 66, Ramsey 417-422, 21 July 1962 (TENN); Gap on Clinch Mt. above Rodgersville, Hwy. 66, Ramsey 470-472, 6 Sept. 1962 (TENN); Cherokee Lake Cloud Creek embayment on Hwy. 11W. w. of Rodgersville, Ramsey 479-481, 6 Sept. 1962 (TENN); 2 mi. s.e. of Surgoinsville on s. side of Holston River, Ramsey & Ramsey 516, 10 Aug. 1963 (TENN); first cove on n. side of Clinch Mt. gap on Hwy. 70 between Kyles Ford & Edison, Ramsey & Rogers 32882, 26 Sept. 1964 (TENN). *ibid.*, Ramsey et al. 32622, 3 May 1964 (TENN); along Big Creek between Rogersville & Surgoinsville, ca. 5 mi. n. of Holston River, Wolfe 520, 15 Aug. 1963 (TENN). JEFFERSON CO.: 6 mi. below Cherokee Dam on south

side of Holston River, Ramsey & Ramsey 510, 5 Aug. 1963 (TENN); $\frac{1}{2}$ mi. below Cherokee Dam on south side of Holston River, Ramsey & Ramsey 508, 5 Aug. 1963 (TENN); $\frac{1}{4}$ mi. below Cherokee Dam on south side of the Holston River, Ramsey & Drumke 32247, 28 Sept. 1963 (TENN). KNOX CO.: Rich woods nr. bluffs of the Tennessee River, Ruth s.n., 5 Sept. 1884 (ILL); Vicinity of Knoxville, Kearney s.n., 8 Sept. 1890 (NY); no locality stated, Ruth s.n., 6 Sept. 1891 (WTU); along the Tennessee River, Knoxville, Ruth 2063, 20 Sept. 1892 (PH, WTU); woods nr. Knoxville, Ruth s.n., Sept. 1896 (ILL); woods along Tennessee River, Knoxville, Ruth s.n., Sept. & Oct. 1897 (NY, NCU); on Tennessee River nr. Knoxville, Kearney s.n., Oct. 1897 (NY, US); nr. Knoxville, Ruth 69, 1 Sept. & 8 Oct. 1898 (ILL, MO, NY, US); Knoxville, Ruth s.n., Sept. & Oct. 1899 (NY); Knoxville, Ruth s.n., 28 July 1900 (GH); Knoxville, Ruth s.n., 19 Oct. 1900 (US); Knoxville, Kearney s.n., 6 Sept. year not stated (F); Gallaher's Ferry Road along Clinch River, Sharp 16789, 13 July 1952 (TENN); Hewitt's Bluff on Clinch River, Sharp & Ellis 26258, 18 April 1962 (TENN); Hewitt's Bluff off Williams Bend Road on Clinch River, Ramsey & Holt 30215, 6 June 1962 (TENN); Hewitt's Bluff on the Clinch River, Ramsey 430-438, 30 June 1962 (TENN); Hewitt's Bluff on Clinch River, Ramsey 442-448, 28 July 1962 (TENN); Hewitt's Bluff on Clinch River, Ramsey 453-462, 8 Aug. 1962 (TENN); Hickory Creek Bend on Clinch River, Gallaher's Ferry Road, Ramsey, et al. 30941, 12 April 1963 (TENN); Bulls Bluff on Clinch River, down river from Gallahers Bend, Ramsey & Ramsey 31264, April 30, 1963 (TENN). LOUDON CO.: Hickory Creek Bend along the Clinch River above Melton Hill

Reservoir, Ramsey & Griffin 31265, 2 May, 1963 (TENN). MEIGS CO.: off Tennessee Hwy. 58 at Dacatur, below Eaves Ferry (abandoned), mile 623 on Tennessee River on Tennessee Navigation Map, Ramsey & Bergquist 31551, 22 Aug. 1963 (TENN). MONTGOMERY CO.: Trahern's Spring, 1½ mi. e. of Clarksville, A. Clebsch 1054, 11 Oct. 1947 (APSC); *ibid.*, Clebsch & Clebsch 33148, 29 July, 1965 (TENN). ROANE CO.: High Point and lake access in the Young's Creek area, along the Clinch River ca. 3 mi. above Kingston, Ramsey & Ramsey 521, 16 Aug. 1963 (TENN). SULLIVAN CO.: nr. trestle across North Fork of Holston River off U.S. 11W out of Kingsport, Ramsey & Ramsey 512, 10 Aug. 1963 (TENN); on Holston River across from Holston Ordinance Depot nr. Kingsport at foot of Bays Mt., Ramsey et al. 32624, 3 May, 1964 (TENN).

VIRGINIA: SCOTT CO.: along Clinch River 2 mi. n. of Tennessee-Virginia State Line, Ramsey et al. 495 & 496, 22 June 1963, (TENN); along Clinch River ¼ mi. n. of Tennessee-Virginia State Line, Ramsey et al. 31613, 22 Sept. 1963 (TENN); along Clinch River 2 mi. n. of Tennessee-Virginia State Line, Ramsey et al. 31615, 22 Sept. 1963 (TENN); along Clinch River 6 mi. North of Tennessee-Virginia State Line, Ramsey et al. 31617, 22 Sept. 1963 (TENN); 1 mi. s.w. of Virginia Hwy. 421 on the Clinch River, Ramsey et al. 31612, 22 Sept. 1963 (TENN); ½ mi. e. of Hwy. 23 on S. side of the n. fork of the Holston River between Kingsport, Tennessee and Gate City, Virginia, Ramsey & Ramsey 511, 10 Aug. 1963 (TENN).

Cimicifuga rubifolia was described and named by T. H. Kearney in 1897. The plants making up the syntype were collected on the bluffs

on the south side of the Tennessee River near Knoxville, one mile downstream from the present day Henley Street Bridge. It gets its name from the fact that the terminal leaflet strongly suggests the leaf of Rubus odoratus. This plant is not recognized in our most-used manuals and is not well understood by taxonomists today, probably because of an existing confusion between it, C. cordifolia Pursh, and C. racemosa (L.) Nutt. var. cordifolia (Pursh) Gray.

Frederick Pursh (1814) described C. cordifolia (see history of C. americana). It is classed under his Polyandria Di-pentagyna. Under his description, Pursh gives Michaux's name as a synonym. Upon examining Michaux's Flora Borealis Americana (1803), we find that he described C. americana. Pursh's description of C. cordifolia indicates that his plant had 2-5 pistils, a character which fits C. americana of the higher Appalachians, and was found in "high mountains of Carolina."

Since Pursh gives C. americana Michx. as a synonym, and since his characteristics and habitat note for Cimicifuga cordifolia are those of C. americana, it is my opinion that Pursh's plant is a biotype of C. americana Michx. It is not probable that Pursh would have omitted from his flora a plant that must have been so familiar to him as this common species of the southern mountains (Kearney, 1897). Pursh in all probability saw an unusual form of C. americana with deeply cordate leaflets. C. cordifolia Pursh is not C. rubifolia Kearney as interpreted by some authors (see synonymy).

The plant illustrated in Curtis' Botanical Magazine (1819) has a leaflet which resembles an undivided terminal leaflet of C. racemosa, sepal number similar to both C. americana and C. rubifolia, and bract number and arrangement that fits none of these. It is described as having "the nauseous smell of its relatives" and "flowers in June and July." C. rubifolia is like C. americana in its total lack of odor and its flowering. Curtis' plant has triternate leaves, which makes it similar to either C. racemosa or C. americana. However, C. rubifolia never develops triternate leaves. The one fruit in the illustration does not fit any North American species.

Torrey and Gray (1838-1840) list C. cordifolia Pursh. The specimen used for this description may be comparable to that collected by "A. Gray et J. Carey, in montibus Carolinae Septentrionalis, Julio 1841," and now preserved in the Gray Herbarium. This specimen was used to reduce Pursh's C. cordifolia to variety of C. racemosa in Patterson's Checklist (1892), and was listed by Robinson in Gray's Synoptical Flora (1895). (See Fig. 20).

Lloyd and Lloyd (1888) write:

Cimicifuga cordifolia Pursh, findet sich auf Hohenzegen der sudlichen Alleghanies, ist selten und geht nicht so weit nordlich als C. americana. Die Pflanze wurde zuerst von Pursh im J. 1805 in den Gebirgen von und Nord Carolina beobachtet und Cimicifuga cordifolia genannt. De Candolle nannte sie Actaea cordifolia and Eaton Macrotys cordifolia. Die Pflanze ist etwa 3 Fuss hoch, hat im allegemeinen den habitus der Cimicifuga racemosa, nur sind die Blatter zweifach gefiedert und die Blattlappen gross und breit herzfornig. Die Fruchte sind denen der Cimicifuga americana sehr ahnlich, nur sind die einzelnen Capseln sitzend.

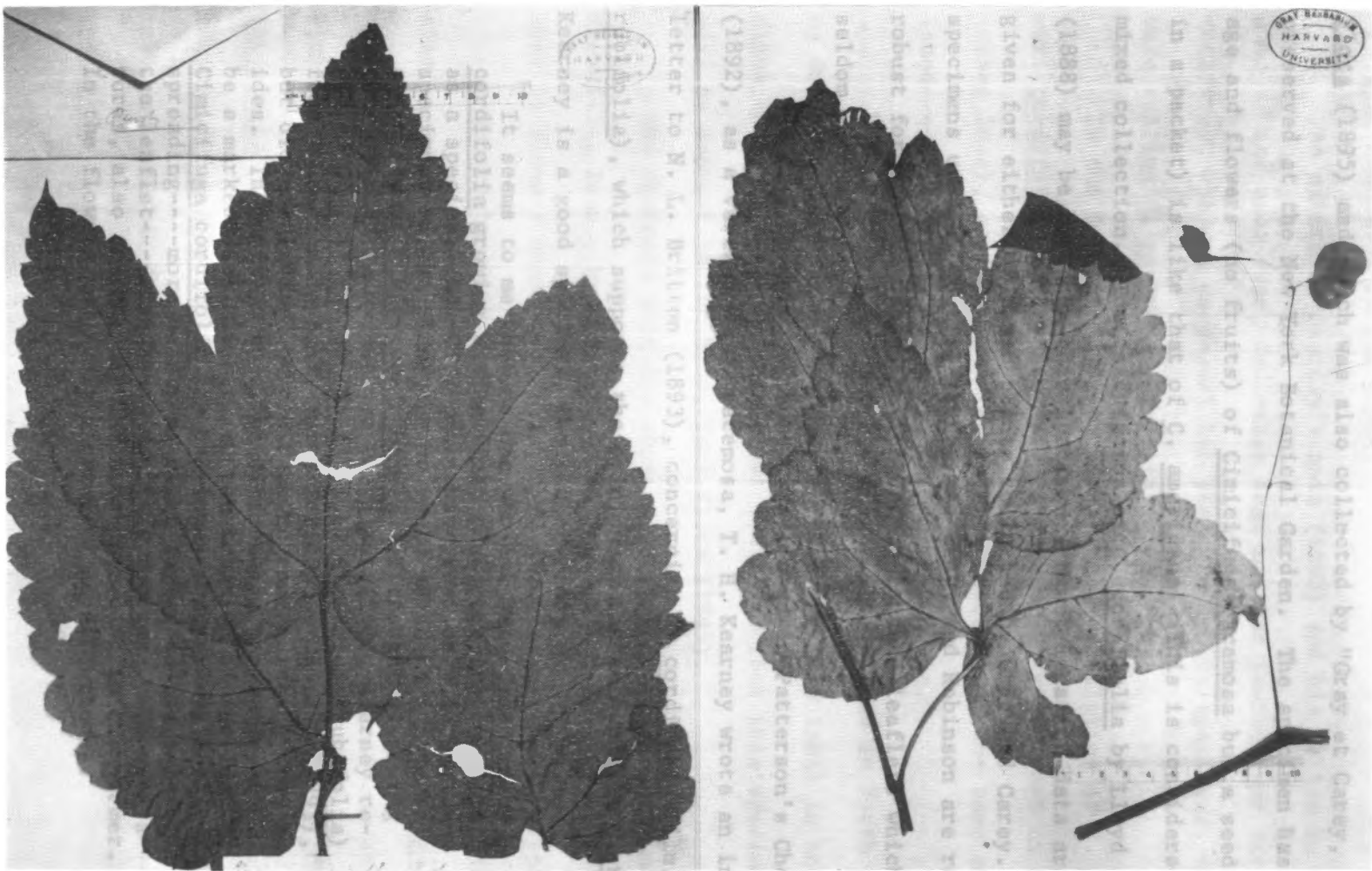


Figure 20. Picture of two herbarium sheets containing portions of one specimen used to reduce Cimicifuga cordifolia Pursh to a var. of Cimicifuga racemosa.

A specimen similar to that used by Robinson in Gray's Synoptical Flora (1895) and which was also collected by "Gray et Carey, 1841," is preserved at the New York Botanical Garden. The specimen has the foliage and flowers (no fruits) of Cimicifuga racemosa but a seed (contained in a packet) is like that of C. americana. This is considered to be a mixed collection. The description of C. cordifolia by Lloyd and Lloyd (1888) may be based on this specimen. Exact location data are not given for either of these plants collected by Gray and Carey. The specimens used by Curtis, Torrey and Gray, and Robinson are rather robust forms of C. racemosa with deeply cordate leaflets which are seldom encountered.

After C. cordifolia Pursh was listed in Patterson's Checklist (1892), as a variety of C. racemosa, T. H. Kearney wrote an interesting letter to N. L. Britton (1893), concerning C. cordifolia (i.e., C. rubifolia), which supports the opinion of the author that C. rubifolia Kearney is a good species. The letter reads:

It seems to me that no one who has seen Cimicifuga cordifolia growing in the field can doubt its validity as a species. Dr. Gray could have seen only herbarium specimens of the plant, or he would never have made it a variety of Cimicifuga racemosa. I thought of giving this opinion in my note on the plant (i.e., Kearney reported Cimicifuga cordifolia (i.e. Cimicifuga rubifolia) from Tennessee in Bull. Torr. Bot. Club. 20:253 (1893), but did not like to be too rash in contradicting Gray's idea. In addition to other differences, there seems to be a marked dissimilarity in the lobation of the leaves. Cimicifuga cordifolia has the lobes sharper and more spreading----more nearly at right angles to the axis of the leaflet----than has Cimicifuga racemosa. The serratures, also are sharper and more spreading in the former. In the flowers and fruit I can find no differences.

But these are enough and more than enough to give specific value to our plant.

The nature of Kearney's note (1893) and his letter to Britton also of the same year, indicates that neither Kearney nor Patterson (nor Gray, who was deceased) had seen the others specimens, which they were calling C. racemosa var. cordifolia.

In the Synoptical Flora (1895), the description of C. racemosa var. cordifolia reads: "Leaflets only about 9, ample (4-6 or even 10 inches long), at least the terminal one cordate at the base and 3-lobed----damp woods, mountains of North Carolina."

This description fits the specimen collected in North Carolina by Gray and Carey in 1841 (Fig. 20, p. 146). The label in the lower right corner of the specimen sheet indicates that this specimen was used as support in the Synoptical Flora (1895).

The footnote with the above description reads: "from near Knoxville, Tenn., by Kearney, Bull. Torr. Club, XX. 253, who states that it flowers considerably later in the season than the typical form."

Kearney's plant was actually C. rubifolia. Kearney called the plant growing on the bluff of the Tennessee River, Cimicifuga racemosa var. cordifolia, until he began to make closer comparisons of these with C. americana and normal C. racemosa. After realizing that C. cordifolia Pursh is a biotype of C. americana, and Gray's C. racemosa var. cordifolia is just a C. racemosa with unusually large, deeply-cordate leaflets, Kearney (1897) described his plant and named it C. rubifolia.

Gattinger (1901) states: "Cimicifuga rubifolia Kearney seems to be identical with cordifolia Pursh." Gattinger saw neither Pursh's nor Kearney's specimens.

Kearney's Cimicifuga rubifolia seems to be a good species, and it is hoped that the above discussion in addition to those of the morphological descriptions, distribution, ecology, and the illustrations clarifies the confusion of the past. It should be recognized as a well defined species in our manuals.

6. CIMICIFUGA ARIZONICA WATS.

(Arizona Bugbane)

Cimicifuga arizonica Wats. Proc. Amer. Acad. 20:352 (1884-1885);

Robinson in Gray, Syn. Fl. N. Amer. 54 (1895); Tidestrom and Kittell, Fl. Ariz. and N.M. 25 (1941); Kearney and Peebles, Ariz. Fl. 305 (1951).

A relatively tall, long-lived perennial, with hard, knotted rhizomes and wand-like stems bearing three to seven biternate leaves, attached at the base and successively higher nodes. Rhizomes usually small, horizontal to almost erect, branched, attaining a maximum length of approx. 6-10 (mostly 7 or 8) cm. long, .5-1 cm. in diameter, bud scales and leaf bases persisting, less heavy than those of C. racemosa, bearing few to numerous fibrous roots on lateral and lower surface; stems 7-21 (mostly 12-15) dm. high, erect, stout at the base, diminishing in size towards summit, usually greenish or greenish-brown to purplish-brown at the base, angled to terete below, usually terete above, sometimes grooved below the nodes, bearing a wide shallow sulcus on the face, glabrous up to the inflorescence, there very sparsely to densely short pubescent; petioles 1-3.5 dm. long, straight or sometimes arcuate, rounded beneath, usually deeply and broadly sulcate on the upper face, especially towards the base, glabrous or glabrescent in the groove, usually not dilated at the apex, somewhat enlarged and with basal, membranaceous, wing-like margins clasping the stems, wing-like margins on base of upper leaves, often not completely enclosing the

stem; leaves ternate-biternate, the central division 3-15-(usually 9-) foliate; terminal leaflet larger than the others; the lateral divisions similar, usually at least 9-foliate, (thus leaves may contain as high as 45 leaflets); petiole of central division 6-17 cm. long, usually rounded below, narrowly to rather broadly and shallowly sulcate, glabrous and smooth to rarely sparsely pubescent at the apex and base; petioles of the lateral divisions 4-10 cm. long; petiolules of the lateral leaflets of the central divisions about 2-4 cm. long, shallowly sulcate on the upper face sparsely strigose; petiolules of leaflets of the lateral divisions usually somewhat shorter, otherwise similar; terminal leaflet of the central division 8-17.5 (mostly about 10) cm. long, 6-12.5 (mostly about 8) cm. wide between the apices of the two widest lobes, ovate or oblong-ovate in outline, equilateral, moderately incised or lobed, palmately three-lobed, usually subcordate, acuminate to attenuate (but occasionally almost truncate), serrate to dentate-serrate, tips of teeth glandular, green above, much paler beneath, from almost glabrous to short ciliate, especially on the veins below, 3 prominent veins arising at the base, then one less prominent on either side of these; other leaflets of the central division usually smaller and inequilateral, commonly 7-12 cm. long, 4-7 cm. wide; leaflets of the lateral divisions similar to those described; mean stomate length 42.76μ ; inflorescence a panicle (sometimes 2) of 2-8 virgate to lax racemes (which are sometimes branched) 1-4.5 dm. long; rachis and pedicels sparsely to occasionally rather densely pubescent with short, straight, lustrous hairs, pedicels (in flower) about 2-4 mm.

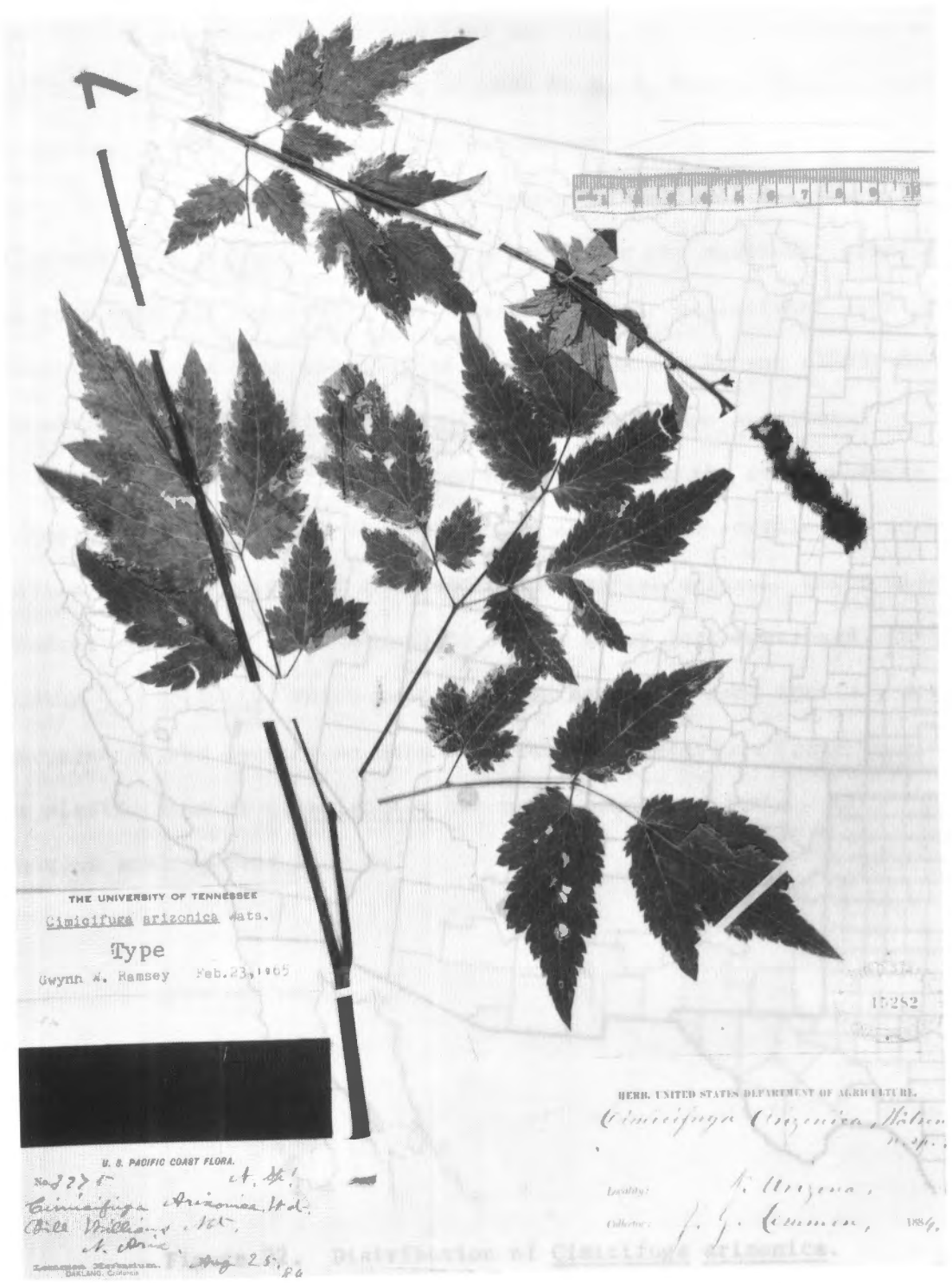
long, sometimes paired, stout, subtended by an elongate-subulate bract about 3-4 mm. long (usually about $\frac{1}{2}$ and occasionally equal to the pedicel length), flanked by two smaller, ovate-triangular, acute, bractlets, about 1-1.5 mm. long, pedicels (in fruit) 2-8 mm. long (but usually shorter than the stamens); sepals 5, fugacious, 4.5-5 mm. long, 4-5 mm. wide, obtuse at the apex, narrowed at the base, concave, petaloid, outer 2 greenish-yellow, inner 3 paler; petals none; staminodes rarely 1-2, whitish, ovate-obovate, long pedicellate, 3 mm. long, bifid, horns acute at the apex and curved; stamens 40 to 75 (mostly 60), about 7 mm. long, anthers rounded, definitely 4-lobed, 1 mm. long; filaments slender spatulate; pistils 1-3 (usually 2), approx. 4 mm. long, sessile, sparsely to densely glandular; style rather short, somewhat flattened laterally, uncinete stigma minute but occasionally slightly expanded; ovulary approx. 8 mm. in diameter; fruit a follicle; follicles 1-3 (mostly 2), 10-18 (mostly 12) mm. long, 5-7 (mostly 6) mm. wide; sessile, sparsely glandular, oblong, somewhat compressed laterally, base slightly tapered, apex rounded and laterally (almost 45° - 90°) beaked with the persisting uncinete style, light green, walls membranous, veins prominent and parallel-ascending; seeds 9-15 (mostly 10-12), 2.5-3 mm. long, 1-1.5 mm. wide, arranged in one row, lenticular, cylindrical in appearance, sides oblong in outline, rather loosely covered with whitish chaffy scales becoming pale brown upon drying, not reddish brown as in C. rubifolia, scales not equal as in C. rubifolia, rather irregular arrangement when viewed under magnification, scale not usually as wide as in C. rubifolia, rather spatulate.

Type locality: Bill Williams Mountain, North Arizona (Watson, 1884-1885). Type specimen: Bill Williams Mountain, North Arizona, Lemmon 3775, 25 August 1884 (GH). (Fig. 21).

Rich soil and deep shade in moist wooded ravines; from the northwest side of Bill Williams Mountain and upper Oak Creek Canyon (Coconino County), and abundant in loose talus and humus near the base of Workman Creek Falls in the Sierra Ancha Mountains (Gila County). Known only from Arizona. Fl. July-August. Ft. late July-August. (Fig. 22).

Specimens Examined:

ARIZONA: COCONINO CO: Bill Williams Mt., Rusby 510, Aug. 1883 (US, MICH, F, PH, PENN); Bill Williams Mt., Lemmon 3775, 25 Aug. 1884 (ARIZ. GH, US); Bill Williams Mt. 6,900 ft., Kearney & Peebles 14040, 16 July 1938 (GH, NY, US, ARIZ, F); Oak Creek Canyon, above Sterling Springs fish hatching ponds, Deaver 407 & 408, 5 Aug. 1941 (ASC); Oak Creek Canyon above trout rearing pond, Deaver 407, 18 Aug. 1945 (ARIZ); creek bottom, upper Oak Creek, Goodding 186-47, 22 Aug. 1947 (ARIZ. ORE); Canyon Bottom, Oak Creek, Goodding 6-48, 31 July 1948 (ARIZ). Upper Oak Creek Canyon, 500 yds. nw. of Pump House Wash Bridge on Hwy. 89-A, and above Sterling Springs fish hatching ponds, Ramsey & Rominger 33151, 27 July 1964 (TENN). GILA CO.: base of Workman Creek Falls in Sierra Ancha Mts., Gould & Hudson 3757, 31 Aug. 1946 (ARIZ, NY); nr. base of Workman Creek Falls in the Sierra Ancha Mts., Gould 4445, 20 Aug. 1947 (ARIZ, GH, MO); North slope at bottom of Workman Creek Falls in the Sierra Ancha Mts., Pase s.n., 10 Sept. 1964 (TENN).



THE UNIVERSITY OF TENNESSEE
Cimicifuga arizonica Wats.

Type

Gwynn W. Ramsey Feb. 23, 1905

10252

HERB. UNITED STATES DEPARTMENT OF AGRICULTURE.

Cimicifuga arizonica, Watson
 n. sp.

Locality: N. Arizona,

Collected by: J. G. Coulter, 1884.

U. S. PACIFIC COAST FLORA.

Nov 22 1884 et. 1884!
Cimicifuga arizonica, H. & A.
 Phil. Millard, 1884,
 et. 1884.
 Aug 25, 1884

DISTRIBUTION OF *Cimicifuga arizonica*.

Figure 21. Type specimen of Cimicifuga arizonica.

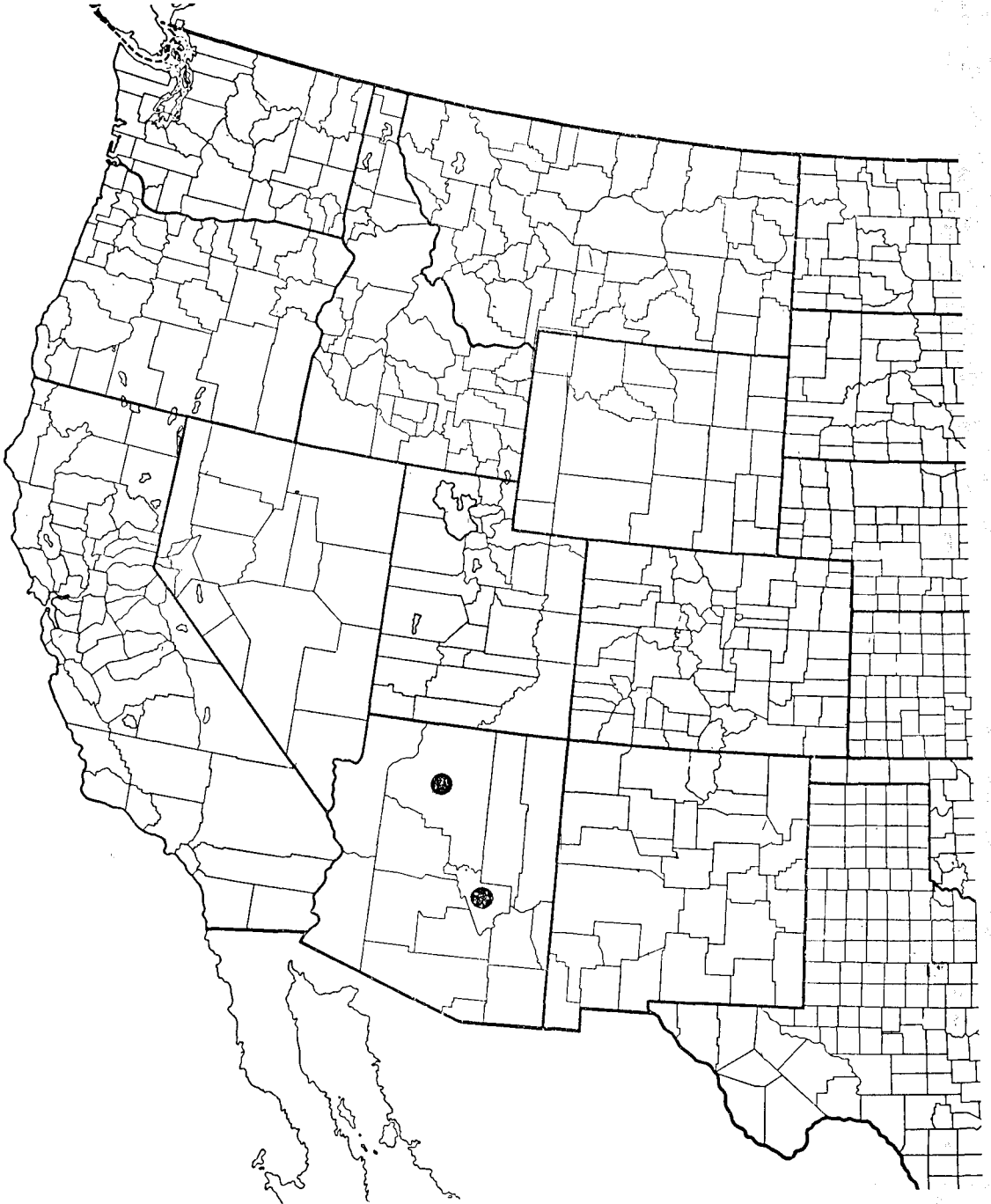


Figure 22. Distribution of Cimicifuga arizonica.

This interesting plant, which has many characteristics in common with the three eastern North American species, was first collected on Will Williams Mountain in August of 1883 by H. H. Rusby, who, according to Kearney and Peebles (1942), "collected extensively in Coconino County in 1883." Mr. and Mrs. J. G. Lemmon of Oakland, California also collected it on August 25, 1884, in a ravine on the northwest slope of the same mountain, near Williams, Arizona. Their collections were probably from the same location as Rusby's. Sereno Watson (1885) described and named Cimicifuga arizonica from the Lemmon specimen.

Watson (1885) differentiated his plant from the other members of the Eucimicifuga in North America and Asia by its sessile, or nearly sessile, oblong fruits and more attenuate leaflet apices. Other differences between it and the members of the group just mentioned, including C. rubifolia, which is recognized here as a good species, are discussed in the section on Morphological Considerations (page 27). The distinctness of C. arizonica has never been questioned. No synonyms are reported.

7. CIMICIFUGA AMERICANA MICHX.

(American Bugbane)

SYNONYMY

Cimicifuga americana Michx. Fl. Bor. Am. 1:316 (1803) Eaton, N. Am. Bot. ed. 8, (1840); Gray, Man. ed. 1, 16 (1848); Darby, Bot. Sou. Sta. 208 (1860) Wood, Cl. Bk. Bot. 205 (1866); Gray, Man. ed. 5, 48 (1863); Lloyd and Lloyd, Pharma. Rundsc. 4:32 (1886); Huth, in Engl. Bot. Jahrb, 16:319 (1892); Robinson in Gray, Syn. Fl. N. Am. 1:54 (1895); Gattinger, Fl. Tenn. 80 (1901); Robinson and Fernald, Gray's man. ed. 7, 407 (1908); Britton and Brown, Illus. Fl. 2:92, 1866 (1923); Bailey, Stand. Cyclo. Horti. 769 (1933); Small, Man. S.E. Fl. 513 (1933) Braun, Anno. Cat. Sperm, Ky. 56 (1943) Bailey, Man. Cult. Pl. (Rev. ed.) 407 (1949); Fernald, Gray's Man. ed. 8, 671 (1950); Gleason, Illus. Fl. 2:158 (1952); Strausbaugh and Core, Fl. W. Va. 2:398 (1953); Massey, Va. Fl. 97 (1961); Gleason and Cronquist, Man. Vasc. Pl. 306 (1963); Hoffman, Check List GSMNP, Castanea 29:16 (1964).

Cimicifuga americana Muhl. Cat. 53 (1813); ed. 2, 54 (1818).

Cimicifuga cordifolia Pursh, Fl. Bor. Amer. 2:373 (1814); Sims, Curtis Bot. Mag. 46:2069, Pl. 2069 (1819) pro parte; Elliott, Sk. Bot. S.C. and Ga. 2:17 (1824) pro parte; Torr. and Gray, Fl. N. Am. 1:36 (1838-1840) pro parte; Wood, Cl.-Bk. Bot. 205 (1866) pro parte; Chapman, Fl. Sou. U.S. ed. 2, 11 (1887) pro parte;

sensu Huth, in Engl. Bot. Jahrb. 16:319 (1892) pro parte; Robinson
in Gray, Syn. Fl. 1:55 (1895) pro parte.

Cimicifuga podocarpa Ell. Sk. Bot. S.C. and Ga. 2:16 (1824).

Macrotys cordifolia Eaton, Man. N. Am. Bot. ed. 5, 288 (1829).

Actaea podocarpa DC. Syst. 1:382 (1824-1846).

Thalictrodes americana O. Ktze. Rev. Gen. Pl. 1:4 (1891).

Actaea americana Prantl, Bot. Jahrb. 9:246 (1888).

A tall, long-lived perennial, with hard, knotted rhizomes and a solitary, slender stem usually bearing several large triternate leaves near the base. Rhizome horizontal, attaining a maximum length of about 12 cm. and width of 2 cm., bearing numerous fibrous roots which are usually matted, leaf buds curved upwards, terminated stems leaving deep radiate scars; roots approx. 6-20 cm. long, 1-5 mm. in diameter; wood in lunate clusters forming a circle in the center; stems 6-25 (mostly 11-15) dm. high, slender, usually relatively weak though enlarged at the base, diminishing in size toward the summit, with smaller leaves at successively higher nodes, greenish to brown, sulcate on the faces, smooth and glabrous or rarely with very scattered delicate short hairs up to the inflorescence, there densely short pubescent, sometimes almost granulose; petiole 1-5 dm. long, usually rather weak, arcuate or straight, flattened on the face, rounded below, rather widely and deeply sulcate, glabrous in the groove, occasionally with a few lax, lustrous, hairs, enlarged at the base with wing-like margins ensheathing the stem; leaves biternate to triternate (usually triternate), the divisions ultimately pinnately compounded, central and

lateral divisions containing numerous leaflets (20's - 40's), petiole of central division 8-18 cm. long, slightly flattened, sulcate, glabrous, petioles of lateral divisions 6-17 cm. long, nearly equal; petiolules of the lateral leaflets of the central division usually .5-6 cm. long, slightly sulcate, glabrous; petiolules of leaflets of the lateral divisions similar; terminal leaflet of the central division 6-15 (mostly 8-10) cm. long, 4-14 (mostly 6-9) cm. wide between apices of the two largest lobes, dark green above, pale beneath, ovate-oblong in outline, acute to acuminate, thin, glabrate, incisely 3-lobed, sometimes 2 lobes above center, dentate to serrate, cuneate to subcordate, 3 prominent veins arising at base, reticulate; other leaflets often inequilateral, commonly 3-15 cm. long, 3-10 cm. wide; mean stomate length 47.92 μ ; inflorescence a panicle of 3-10; rather lax, slender racemes which may themselves be branched; racemes 1-5 dm. long; rachis and pedicels usually granulose; pedicels (in flower) about .8-1.2 cm. long, stout, distal and largest in diameter, occasionally branched, subtended by a rather elongate, flattened bract; pedicels themselves bracteolate (in fruit) .8-1.5 cm. long basal bract commonly 3-5 mm. long, those upon pedicel shorter; sepals 5, fugacious, petaloid, 5-6 mm. long, 4-5 mm. wide, 2 inner ones yellowish-green, 3 outer whitish tinged with reddish-pink near the apex, often with a few stiff hairs at apex, ovate, concave; petals none; staminodes usually 2, bifid, ovate, concave, possessing a basal nectariferous area, yellowish with white lobes, sessile, approx. 2.5-3 mm. long; stamens 40-70 (mostly about 60); anthers .7-1 mm. long, ellipsoid in overall shape; filaments larger

at distil end, 6-10 mm. long; pistils 3-8, short-stipitate, about 4-5 mm. long; stigma minute, often curved; style subulate; ovulary about 1 mm. in diameter, glabrous to rather densely pubescent or granulose especially lower on the stipe; fruit a follicle; follicle obovate, on a long slender stipe, laterally compressed, 8-17 (mostly 10-12) mm. long, obliquely beaked apically by the hardened, persistent style, dark to yellowish-green in color, walls membranous, glabrous, seeds 5-8 (mostly 6-7), in a single row, flattened, covered with broad, whitish, lacerate scales, those scales around the median periphery longest, about 3.5 mm. long, 2-2.5 mm. wide, lenticular; body of seed pale brown.

Type locality: "in shady woods on high mountains of Carolina" (Michaux, 1803). Type specimen: is preserved in the Museum National d'Histoire Naturelle in Paris. (Fig. 23).

Rich, moist, rocky and boulder strewn, wooded slopes and coves, usually at higher elevations along the mountains from southern Pennsylvania, southward to Georgia and northwestern South Carolina. Fl. August-October. Ft. Mid-August-late September. (Fig. 24).

Specimens Examined:

GEORGIA: FANNIN CO.: ca. 1 mi. n. of Cowpen Mt., Duncan 7306, 20 Sept. 1946 (GA).

KENTUCKY: BELL CO.: along Cumberland River, Kearney 575, Sept. 1893 (F, GH, US); on Pine Mtn., Kearney s.n., Sept. 1893 (F, NY); nr. Wasiota, Kearney s.n., Sept. 1893 (MO). ELLIOTT CO.: locality not specified, Braun s.n., 6 April 1938 (GH). HARLAN CO.: top of Black

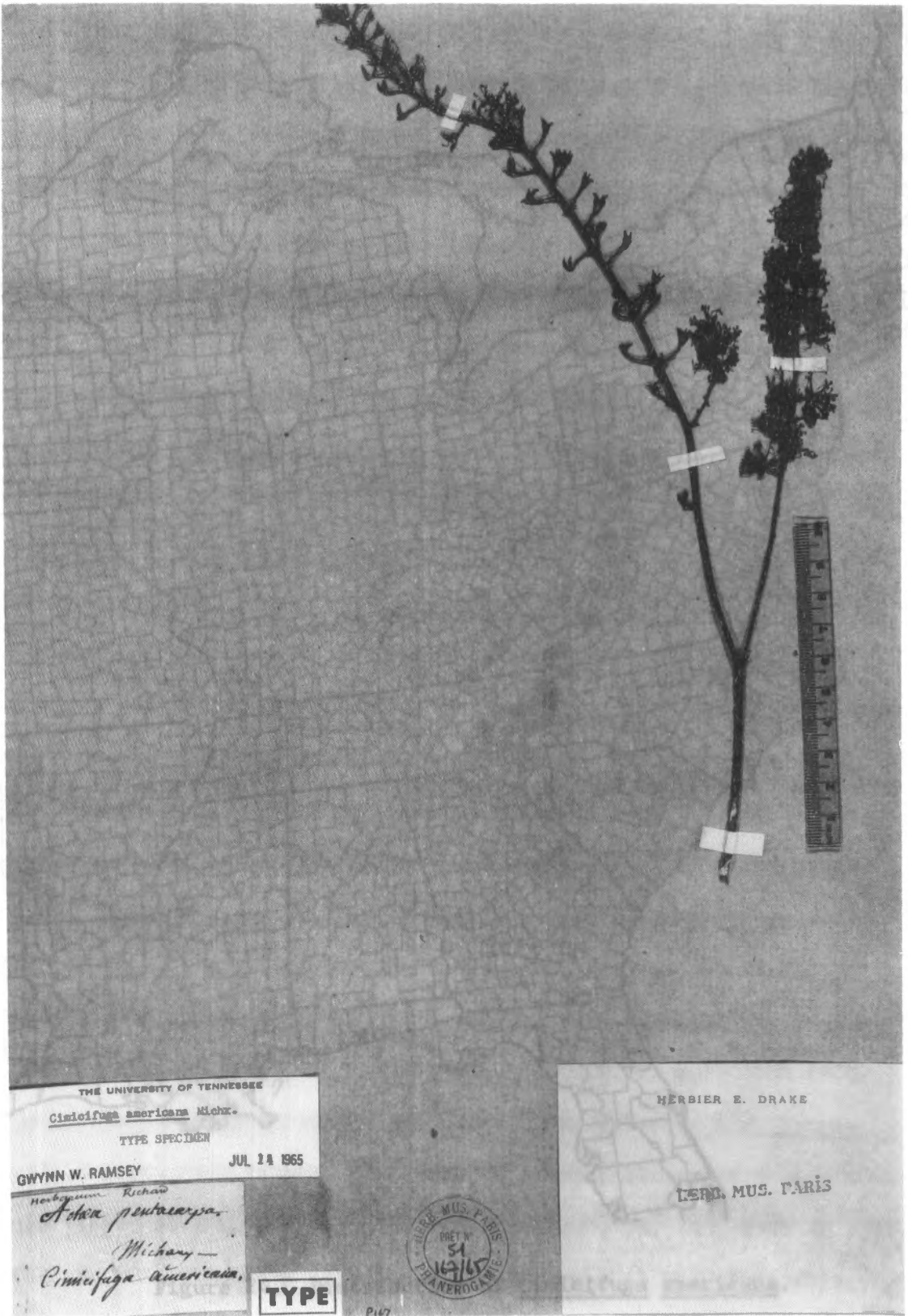


Figure 23. Type specimen of Cimicifuga americana.

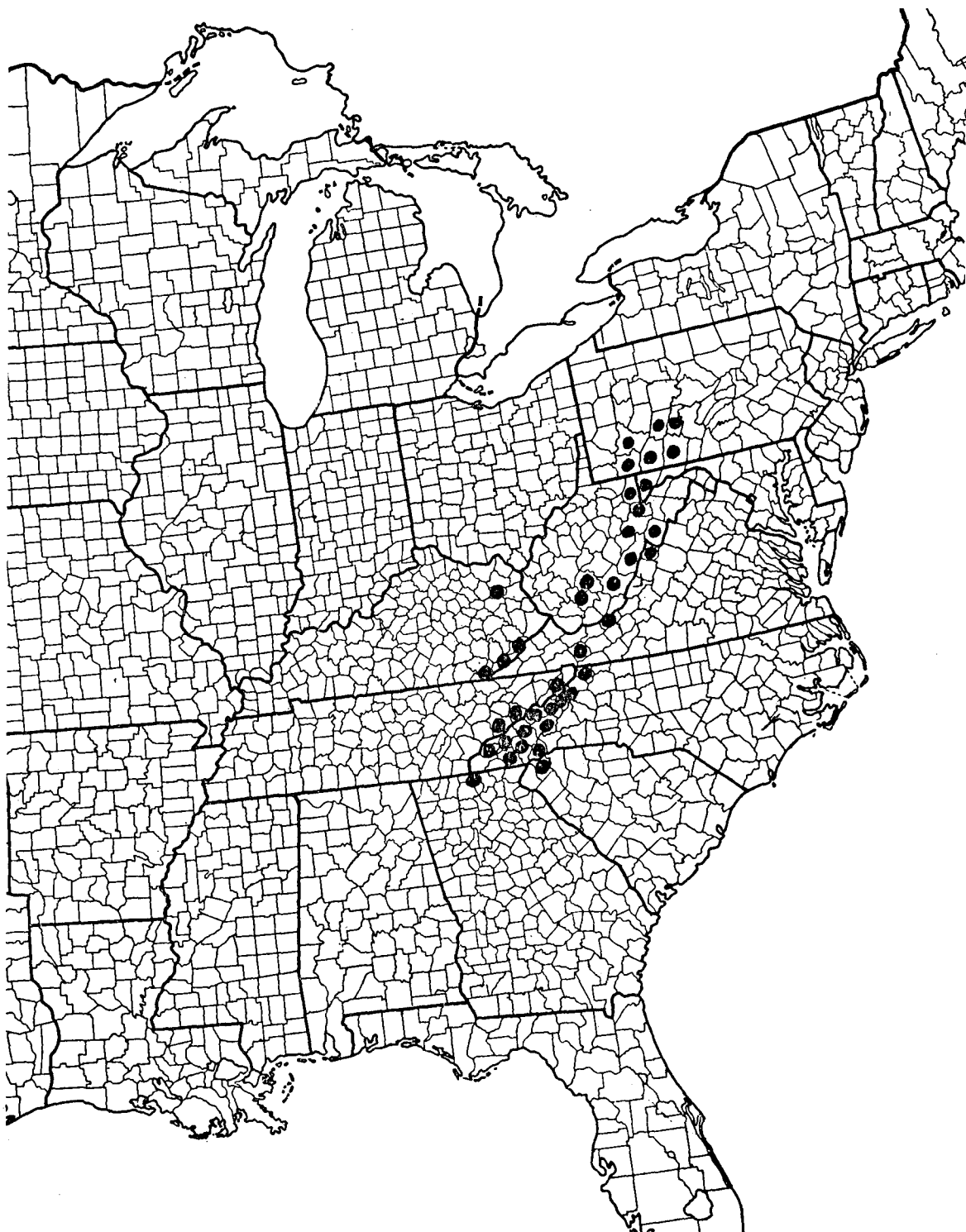


Figure 24. Distribution of Cimicifuga americana.

Mtn., Wharton 6318, 7 Aug. 1948 (KY); top of ridge at Black Mtn., McInteer 1313, 10 Sept. 1951 (KY). LETCHER CO.: Staggerweek Hollow, Braun 3770, 21 Oct. 1940 (GH).

MARYLAND: GARRETT CO.: nr. Oakland, Smith s.n., 21 Sept. 1882 (F, PH, US); ibid., Taylor s.n., (GH); nr. Kelso Gap, S & B s.n., 9 Oct. 1907 (ARIZ); vicinity of Jennings 4 mi. sw. of Grantsville, Stone s.n., 8-16 Aug. 1911 (PH); Castleman River 1 mi. s. of Grantsville, Stone 14103, 15 Aug. 1911 (PENN).

NORTH CAROLINA: ASHE CO.: Three Top Mtn., anon s.n., 3 Sept. 1891 (NCU); 2.3 mi. se. of Bina, Radford 41227, 28 Sept. 1958 (NCU); 2 mi. se. of Bina on New River, Sharp et al. 32521, 27 Oct. 1963 (TENN). AVERY CO.: Roan Mtn., Canby s.n., Sept. 1876 (US); flanks of Roan Mtn., Redfield 5522, 8 Sept. 1876 (MO); Roan Mtn., Canby s.n., 29 Sept. 1878 (NY); Grandfather Mtn., Curtis s.n., no date (NY); Roan Mtn., Chickering s.n., 20 July 1880 (F, GA, GH, DPU, MO, NCU, TENN, ORE, US, WIS); Roan Mtn., Smith s.n., 15 Sept. 1884 (US); ibid., Canby s.n., Sept. 1884 (F); Grandfather Mtn., anon s.n., no date (NY); ibid., Seymour s.n., 13 Aug. 1891 (WIS); ibid., Kelsey s.n., Aug. 1896 (US); w. flank of Grandfather Mtn., vicinity of Banner Elk, including Beech Mtn., Steele 116, 2 Sept. 1915 (CAN, LA); 0.7 mi. ne. of Linville on U.S. 221, Ahles 47499 & Duke, 24 July 1958 (NCU); 1 mi. from junction of 105 & 184 on 184 towards Banner Elk, Ramsey 31572, 2 Sept. 1963 (TENN). BUNCOMBE CO.: upper slopes of Craggy Mtn., anon 1966, 31 Aug. & 6 Oct. 1897 (ARIZ, BM, C, GH, ILL, MICH, MO, NY, PENN, PH, US, WIS, WTU); Black Mtn., anon s.n., 12 Aug. 1905 (US);

vicinity of Montreat, Standley & Bollman s.n., 31 Aug. 1913 (US).

GRAHAM CO.: 15 mi. nw. of Robbinsville, Wherry s.n., 7 Sept. 1948 (PENN).

HAYWOOD CO.: nr. summit of peak to e. of Luftee Knob, Ramseur 1759, 20 Aug. 1956 (NCU); nr. summit on n. slope of Cold Mtn., Ramseur 3427, 10 July 1957 (GH); at summit of Silvermine Bald, Ramseur 3595, 23 July 1957 (NCU); 6.3 mi. s. of Sunburst on road to Beech Gap, Ahles 50448 & Duke, 7 Oct. 1958 (NCU); summit of Caney Fork, Balsam Mtn., Smith s.n., 10 Aug. 1882 (US); deep coves of Caney Fork, Balsam Mtn., Smith s.n., 11 Aug. 1882 (US); Balsam Mtn., Williamson s.n., Aug. 1896 (PH); vicinity of Eagles Nest, nr. Waynesville, Standley s.n., 4 Sept. 1910 (US); ibid., Standley s.n., 8 Sept. 1910 (US).

JACKSON CO.: White Water River Falls nr. S.C. line, Radford 35116, 15 July 1948 (NCU); 12 mi. n. of Cherokee at Soco Gap on Hwy. 19, Ramsey & Ramsey 33172, 7 Sept. 1964 (TENN).

MACON CO.: bordering streams nr. Highlands, anon 1966a, 14 Sept. 1897 (GH, MO, NY, NCU, PENN, US); locality not specified, Harbison s.n., 9 Sept. 1928 (NCU).

MADISON CO.: 4.9 mi. se. of Sams Gap on U.S. 23, Ahles 50676 & Duke, 8 Oct. 1958 (NCU).

MITCHELL CO.: 0.6 mi. wsw. of Hughes Gap on road to Buladean, Ahles 49885 & Duke, 25 Sept. 1958 (NCU).

SWAIN CO.: just below to right of High Rock, Barksdale 1358, 2 Sept. 1935 (TENN); 5 mi. below Newfound Gap on Hwy. 421, Ramsey, Rogers, Chester, 33175, 11 Sept. 1964 (TENN); ibid., Ramsey & Ramsey 31553, 24 Aug. 1963 (TENN); ibid., Ramsey & Ramsey 529 & 531, 18 Aug. 1963 (TENN).

TRANSYLVANIA CO.: Mt. Pisgah, Gribbes, s.n., 1853 (NY); Gloucester, Memminger s.n., 20-30 Sept. 1895 (NCU); e. slope of Frying Pan Mtn., Freeman 57773, 29 Aug. 1957

(NCU). YANCEY CO.: Big Bald Mtn., anon s.n., 19 Aug. 1893 (NCU); on slope of Mitchell Mtn. road, Wiegand s.n., 10 Sept. 1931 (F); locality not stated, anon s.n., no date (NCU); w. slope of Celo Mtn., Ramseur 4135, 20 Aug. 1957 (NCU); 3.4 mi. nnw. of Swiss, Ahles 50701 & Duke, 9 Oct. 1958 (NCU).

PENNSYLVANIA: BEDFORD CO.: 3 3/4 mi. nw. of Pavia, Berkheimer 9341, 1 Sept. 1947 (PENN); 3 5/8 mi. nw. of Pavia, 15 Sept. 1948 (PENN). BLAIR CO.: Burgoon's Gap, Lowrie s.n., no date (NY, GH); ibid., Lowrie s.n., Sept. 1814 (F); Burgoon's Gap nr. Hollidaysburg, Porter s.n., Oct. 1850 (NY, WVA); ibid., Porter s.n., Oct. 1851 (WVA); ibid., Porter s.n., Sept. 1851 (GH); Burgoon's Gap & Kittaning Gap, Porter s.n., 4 Aug. 1858 (GH, ILL, MICH, PENN); Kittaning Point, Lowrie s.n., Sept. 1865 (MO, PH); ibid., Porter s.n., Aug. & Sept. 1865 (PENN); Burgoon's Gap, Lowrie s.n., Aug. 1865 (US); locality not specified, Lowrie s.n., 15 Aug. 1865 (PH); locality not specified, Porter s.n., 10 Sept. 1865 (US); Burgoon's Gap, Porter s.n., 10 Sept. 1868 (F, MO); locality not specified, Garber s.n., Sept. 1869 (NY); Burgoon's Gap, Porter s.n., 17 Sept. 1869 (NY, BM, PENN); ibid., Lowrie s.n., Sept. 1873 (F); Kittaning Point in Burgoon's Gap, Lowrie s.n., Oct. 1880 (GH). CAMBRIA CO.: Cresson, Boott s.n., 30 June 1875 (GH). GAYETTE CO.: in gorge below Cucumber Falls, Ohio Pyle, Bright 16532 & 16545, 17 July 1938 (PENN, WVA); Ohio Pyle, Jennings s.n., 13 Sept. 1942 (WVA). NORTHHAMPTON CO.: Easton, Garber s.n., July-Sept. 1868 (WIS). SOMERSET CO.: along Clear Run, 1 mi. s. of Reels Corners, Jennings s.n., 15 Oct. 1950 (WVA); above abandoned railroad, 1/4 mi. nw. of

Barronvale, Wherry s.n., 2 Aug. 1951 (PENN); ibid., Wherry s.n., 9 Sept. 1951 (PENN). WESTMORELAND CO.: locality not specified, Pierron s.n., 29 Aug. 1876 (ILL); locality not stated, Pierron s.n., 5 Sept. 1876 & 1877 (C); locality not stated, Pierron s.n., 10 Sept. 1876 (F); locality not specified, Block s.n., Aug. 1881 (C); Big Spring summit of Laurel Hill, Eggleston s.n., 3 Oct. 1928 (GH, NY, US); Alleghny Mtn., O.W.N. s.n., Sept. 1834 (BM).

SOUTH CAROLINA: PICKENS CO.: 3 mi. n. of Rocky Bottom nr. U.S. 178, Radford 16735, 22 Aug. 1956 (NCU).

TENNESSEE: CARTER CO.: Roan Mtn., nr. Roan Station, Sharp et al. 29369, 12 Sept. 1961 (TENN); slopes along Hwy. 143 above Roan Village 5,000 ft. Ramsey et al. 31610, 20 Sept. 1963 (TENN); ibid., 4,200 ft. Ramsey et al. 31609, 20 Sept. 1963 (TENN). COCKE CO.: nr. Lemon's Gap, Kearney s.n., 3 Sept. 1897 (NY, US); ibid., Kearney 604, 8 Sept. 1897 (NCU, US); Snake Den Ridge, Jennison 2857, 25 Aug. 1936 (TENN). SEVIER CO.: Newfound Gap, Alexander et al. s.n., 19 Sept. 1933 (NY); Woolly Tops Branch, Cain 1025, 24 Sept. 1934 (TENN); Cumberland Gap, Jennison 2834, 20 Aug. 1936 (TENN); upper Porter Creek, Raper & Jennison 3364, 31 Aug. 1936 (TENN); n. slope of w. ridge of Mt. LeConte, Ramseur 1653, 14 Aug. 1956 (NCU); the boulevard, ne. slope, Ramseur 4023, 16 Aug. 1957 (GA); Chimneys Camp Ground, GSMNP, Iltis 17125, 1 April 1961 (WIS); just above chimneys in GSMNP, Iltis et al. 20063, 21 April 1962 (WIS); below Chimneys just above chimney Camp Grounds, GSMNP, Iltis et al. 20060, 21 April 1962 (WIS); above Laurel Falls on the trail to Cove Mtn. fire tower, Drumke s.n., 7 Sept. 1962

(TENN); below Newfound Gap on U.S. 441 ca. 1 mi. beyond tunnel, Pittillo 2600, no date (KY); Fort Harry Cove, on Hwy. 441, GSMNP, Ramsey & Keaton 32448, 5 Oct. 1963; ibid., Ramsey & Norris 31603, 13 Sept. 1963 (TENN); $\frac{1}{2}$ mi. e. of Clingman's Dome parking area, Ramsey & Norris 31601, 13 Sept. 1963 (TENN); ibid., Ramsey et al. 33177, 11 Sept. 1964 (TENN); Big Locust Nature Trail, GSMNP, Ramsey & Ramsey 33101, 10 Oct. 1964 (TENN).

VIRGINIA: BEDFORD CO.: Hale's Fork, Apple Orchard Mt., Freer 258, 19 Aug. 1933 (LYN). GILES CO.: Cascades of Little Stony, Massey s.n., 8 Sept. 1935 (VPI). HIGHLAND CO.: nr. summit of Allegheny Mtns., nw. of Hightown, Wherry & Pennell s.n., 25 Aug. 1927 (PH). NELSON CO.: along road between Montebello and South River Lumber Co. railroad, Freer 259, 4 Sept. 1933 (LYN); grounds of State Fish Hatchery, Montebello, Freer s.n., 26 Aug. 1947 (GH, LYN). SMYTH CO.: road between Marion & White Top Mtn., Core s.n., 2 Sept. 1951 (NY); Mt. Rogers, Kral 11679, 21 Sept. 1960 (VPI).

WEST VIRGINIA: FAYETTE CO.: Locality not specified, Nuttall s.n., no date (WVA). GREENBRIER CO.: on Buckeye Mt. off Grass Mtn., McCutcheon s.n., 9 Sept. 1951 (WVA). PENDELTON CO.: Spruce Knob, Core s.n., 13 Aug. 1931 (GH); below and nw. of Panther Knob, Rosbach 1147, 21 Sept. 1957 (WVA). POCAHONTAS CO.: w. of Cheat Mtn., Wherry & Pennell s.n., 26 Aug. 1927 (PH); Bald Knob, WVA Bot. Expedition 1128, 20 July 1927 (WVA); Cheat Mtn., Western Maryland R.R., Core s.n., 4 Aug. 1931 (NY); se. slope back Allegheny Mtn. below Bald Knob, Rosbach 1025, 22 Sept. 1956 (MO). PRESTON CO.: Aurora and vicinity, Steele &

Steele, 30 Aug. 1898 (NY, US), nr. Albright, bank of Roaring Creek, anon s.n., 10 Sept. 1918 (WVA); Flag Creek, 2 mi. w. of Macomber, Pennell s.n., 10 Sept. 1940 (PH); along U.S. Rt. 219, nr. Tucker Lane, Davis 6218, 31 Aug. 1944 (WVA). RALEIGH CO.: at Slab Fork and Fritzpatrick, Tosh 440, 6 Sept. 1940 (WVA). RANDOLPH CO.: The Sinks, Osceola, Core s.n., 12 Aug. 1931 (NY); Cheat Mtn., Millspaugh s.n., 28 Aug. 1890 (NY, WVA). TUCKER CO.: Parsons, Greenman 364, 8 Sept. 1904 (F, GH); ibid., Moore 1982, 8 Sept. 1904 (GH, PENN). WEBSTER CO.: Camp Caesar ne. Gowen, Williams 489, 18 July 1936 (PENN).

Michaux (1803) first described this plant under the name of Cimicifuga americana. It is classified under his Polyandria Pentagyna and described as follows: "foliis decompositis; floribus pistillisque longiuscule pedicellatis; ovariis glabris."

According to Lloyd and Lloyd (1886), this native of eastern North America was first mentioned in Nomenclator Botanicus (Raevschel, 1797), in which it was recognized as "Actaea pentagyna of Carolina." Steudel (1840), in Nomenclator Botanicus, also listed Actaea pentagyna Walter as a synonym of the American species. Walter's (1788) diagnosis and binomial appeared in his Flora Caroliniana. Thus, his proposed name would receive priority over the accepted binomial of Michaux (1803), and the plant would be called Cimicifuga pentagyna. However, the author agrees with Huth (1892) who states, "It seems to me extremely doubtful that Walter meant Cimicifuga americana, since his description by no means fits the same."

Walter described three Actaea species in his Flora: (1) Actaea

monogyna, whose description fits Cimicifuga racemosa; (2) Actaea pentagyna, which was interpreted by Steudel as Cimicifuga americana Michx., but whose description does not fit that species; (3) Actaea dioica, whose description fits no American species of Cimicifuga.

Muhlenburg (1813) used the name proposed by Michaux, however, listing his own name as the author without explanation.

Much confusion has developed around C. cordifolia, a species described by Frederick Pursh (1814). Huth (1892) recognized Pursh's plant as a species separate from C. americana. Pursh's description reads, "foliis decomposito-biternatis, foliolis cordatis lobatis serrato-dentatis, racemis virgatim-paniculatis elongatis, floribus 2-5 gynis, germinibus glabris." Pursh's description and habitat note fits C. americana, and he even gives Michaux's name (i.e., C. americana) as a synonym. Thus, for these reasons and others discussed in the history of C. rubifolia Kearney, C. cordifolia Pursh is considered to be synonymous with Cimicifuga americana Michx. Several other authors (Kearney, 1897; Small, 1933; Merrill and Reeder, 1946) have taken this point of view. Other authors (see list of synonymy) have carried Pursh's binomial through the literature without actually understanding it; therefore, the name has been interpreted variously and incorrectly applied to several plants (e.g., forms of C. racemosa with subcordate leaflets, C. rubifolia).

De Candolle (1824) called this taxon Actaea podocarpa, using Linnaeus' old generic name, and a specific epithet that describes the stipitate fruits. Subsequently, Elliott (1824) designated it as

Cimicifuga podocarpa, putting De Candolle's species in the currently accepted genus.

Eaton (1829) designated it as Macrotys cordifolia, using the generic name coined by Rafinesque (1808), and Pursh's specific epithet. Prantl (1888) called it Actaea, and Kuntz (1891) shifted it to his proposed genus Thalictrodes, both using Michaux's specific epithet.

8. CIMICIFUGA LACINIATA WATS.

(Mount Hood Bugbane)

Cimicifuga laciniata Wats. Proc. Amer. Acad. 20:352 (1884-1885);

Robinson in Gray, Syn. Fl. N. Amer. 1:54 (1895); Peck, Man.

Higher Pl. Ore. 317 (1941); Abrams, Illus. Fl. Pac. Sta. 2:179

(1944); Hitchcock, et al., Vas. Fl. Pac. N.W. 2:337 (1964).

A relatively long-lived perennial of medium height, with small, woody rhizomes and solitary, wand-like stems bearing several rather large, ternately-compounded leaves. Rhizome vertically to obliquely oriented, attaining a maximum length of approx. 9 cm., 0.3 - 1.0 cm. in diameter, producing small, brownish, weak, fibrous roots on all sides; stems 9-16 (mostly 11-13) dm. high, erect, stout at the base, diminishing in diameter toward the summit, usually slightly grooved, commonly green, but occasionally brown at base and summit, angled at the base, glabrous to very sparsely pubescent up to the inflorescence, there tomentose; petioles 1 - 4.5 dm. long, slender, straight, at times compressed laterally, rather deeply but narrowly sulcate on the upper face, glabrous in the groove, not dilated at the apex, only slightly enlarged at the base with short, wing-like margins clasping the stem; leaves biternate-triternate, the central division 3-15-(usually 9-) foliate, terminal leaflets largest, lateral divisions 9-14-(usually 9-) foliate, leaves usually with 21-35 leaflets; petioles of central division 12-17 cm. long, sulcate like the main petiole, glabrous; petioles of lateral divisions 9-14 cm. long, equal or one as much as 2.5 cm.

longer than the other; petiolules of the lateral leaflets of the central division about 2-4 cm. long, narrowly sulcate on the upper face, sparsely long pubescent in the groove; petiolules of leaflets of the lateral divisions somewhat shorter, otherwise similar; terminal leaflet of the central division 7-12 (mostly about 10) cm. long, 7-12.5 (mostly 9-10) cm. wide between the apices of the two largest lobes, ovate to ovate-lanceolate in outline, equilateral, acuminate, acute to widely subcordate at the base, deeply cleft into three primary lobes, these incised and laciniately-toothed, the central lobe usually bearing 4-6 smaller lobes which are oppositely arranged, thin, green above, paler beneath, sparsely ciliate along margins, sparsely tomentose on the larger veins beneath, glabrous above, 3 prominent veins arising 5-9 mm. above the base of leaflet, reticulate; other leaflets smaller and inequilateral, otherwise similar; mean stomate length 60.59 μ ; inflorescence a panicle of 4-8 loosely flowered racemes, the racemes themselves often branched; rachis and pedicels tomentose; pedicels (in flower) about 3-13 (commonly 5-8) mm. long, slender, enlarged slightly at the base and apex, often branched, subtended by a solitary lance-subulate, often ciliate, bract approx. 3 mm. long (occasionally, the bract at base of raceme branches are much longer), pedicels in fruit same as in flower; sepals 4 or 5 (usually 5), fugacious, ovate-elliptic, 5 mm. long, 4-5 mm. wide, apex rounded, usually strongly ciliate, rounded to narrowed at base; petals or staminodia 1-5, 3-4 mm. long, bifid, ovate, concave, bearing a basal nectary, yellowish with white lobes, stipitate; stamens about 20-25, unequal; filaments 4-5 mm. long, slender; anthers

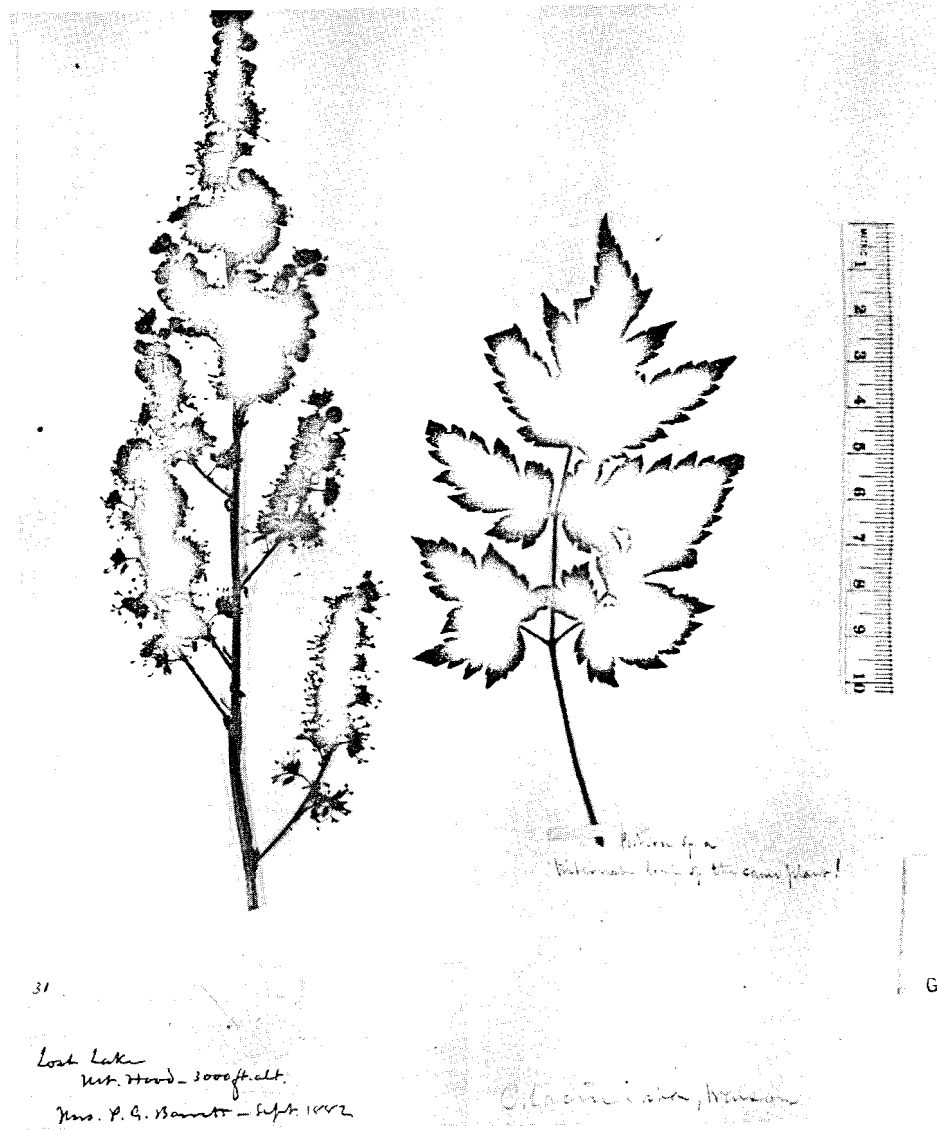
.6 mm. long, elliptical; pistils 2-5 (commonly 3-4), short stipitate, approx. 2 - 2.5 mm. long from base of ovulary to summit of the stigma; style subulate stigma minute ovulary about .8-1 mm. in diameter, granularly tomentose; fruit a follicle; follicles 2-5, 7-13 (mostly 9-11) mm. long, stipitate, glabrous to very slightly pubescent, compressed laterally, oblong-obovate in outline, apex rounded, base tapered, beaked just below the apex, beaked at a 45° angle but occasionally directed apically, greenish-brown to light brown, walls thin, veins not prominent; seeds 4-8 (commonly 8), arranged two rows, flattened, covered with elongate, narrow, white, lacerate scales, those on the disc shorter, those around the median periphery longest, disc smaller and scales longer than those of G. americana, about 2.5 - 3 mm. long, 2.5 mm. wide, lenticular, disc pale brown.

Type locality: Lost Lake, Hood River County, Oregon. Lectotype specimen: Lost Lake, Mount Hood, Barrett s.n., Sept. 1882 (GH). (Fig. 25).

Moist open woods, boggy flats, and damp borders of Lost Lake, at the western base of Mount Hood, in Hood River County, Oregon; also along cliffs near Mirrow Lake above Yocum Falls in Clackamas County, Oregon; Canadian Zone. Fl. August-September. Ft. September. (Fig. 26).

Specimens Examined:

OREGON: CLACKAMAS CO.: along cliffs near Mirrow Lake, above Yocum Falls on way to Mt. Hood, Thompson s.n., 10 Aug. 1926 (WTU); edge of cliffs nr. Mirrow Lake, Mt. Hood, Thompson 1637, 10 Aug.



Lectotype
 THE UNIVERSITY OF TENNESSEE
Cimicifuga laciniata Wats.
 GWYNN W. RAMSEY OCT 15, 1904
 SYN. FL. N. AME

Figure 25. Lectotype specimen of Cimicifuga laciniata.



Figure 26. Distribution of Cimicifuga laciniata.

1925 (MO); Lost Lake, Mt. Hood, Thompson 3648, 21 Aug. 1927 (WTU); Lost Lake, Mt. Hood, Thompson s.n., 31 July 1934 (MO, NY, US, WTU); Lost Lake, nr. Mt. Hood, Jones 6022, 18 Aug. 1934 (DAO, ILL, WIS); 1 mi. from western entrance to trail around Lost Lake, Mt. Hood, Ramsey 33157, 7 Aug. 1964 (TENN); ca. 1 mi. from western entrance to trail around Lost Lake, Mt. Hood, Barr 33173, 31 Aug. 1964 (TENN). HOOD RIVER CO.: Lost Lake, Mt. Hood, Barrett s.n., Sept. 1882 (GH); Lost Lake, Mt. Hood, Barrett s.n., 1884 (GH); Lost Lake, Mt. Hood, Henderson s.n., 26 Aug. 1884 (ORE); Lost Lake, Mt. Hood, Henderson s.n., 21 Aug. 1887 (GH); ibid., Henderson s.n., 1886 (GH). Lost Lake, Mt. Hood, Gonnan s.n., 5 July 1891 (WTU); n. side of Mt. Hood, Langille s.n., 1898 (US); Lost Lake, Mt. Hood, Henderson s.n., 6 Sept. 1924 (GH, ORE); Toney Creek, trail to Eden Park, Henderson s.n., 17 Sept. 1924 (MO).

This rare plant, which has many characteristics similar to Cimicifuga americana of Eastern North America, was first collected in September 1882 (GH) by Mrs. P. G. Barrett, of Hood River, and again in 1884 (GH), and also by Mr. L. F. Henderson (UO), of Portland, Oregon (Watson, 1885). The site of the collection was at Lost Lake, Mount Hood, Oregon. Subsequently, it was described and given its present name in 1885 by Sereno Watson who distinguished it from the other North American Cimicifuga by the leaflets which are coarsely-laciniate toothed, the persistent sepals and staminodia, and the 2-5 shortly stipitate, pubescent ovaries. Cimicifuga laciniata has been confused, at times, with C. elata, which does not have stipitate pistils or fruits, or staminodes.

9. CIMICIFUGA HERACLEIFOLIA KOM.

(Komarov's Bugbane) Nomen Nov.

Cimicifuga heracleifolia Kom., in Act. Hort. Petrop. 18:438 (1901).

Komarov, Fl. USSR. 7:82 (1937).

A rather short perennial, with hard, knotted rhizomes and solitary stems bearing biternate or triternate leaves at the base and successively higher nodes. Rhizomes woody, thick, horizontally oriented, short, attaining a maximum length of about 6 cm., .5-1.0 cm. wide, bearing numerous, elongate, fibrous roots; stems 5-14 (mostly 11) dm. high, erect, diminishing in size toward the summit, green to straw-colored, terete throughout, lightly furrowed to grooved in the lower portion, glabrous up to the inflorescence, there densely covered with short grey, simple and glandular hairs, occasionally almost granularly pubescent as in Cimicifuga americana; petioles .2-2.5 dm. long, straight, broadly and shallowly sulcate on the upper face, glabrous in the groove, enlarged at the base with wing-like margins clasping and sometimes ensheathing the stem, petiole margins of the upper leaves never completely ensheathing the stem; lower leaves biternate to triternate, the central division 3-7-(mostly 3-) foliate, the lateral divisions 3-9-(mostly 5-) foliate, (thus, the leaves may possess up to about 25 leaflets); upper leaves usually 3 foliate, glabrous, more delicate than the lower ones, nearly sessile (resembling the leaves of Heracleum); petiole of the central division 5-13 cm. long, narrowly sulcate, glabrous; petioles of the lateral divisions 4-12 cm. unequal;

petiolules of the lateral leaflets of the central division up to 2 cm. long; petiolules of the leaflets of the lateral division shorter; terminal leaflet of the central division 6-12 (mostly 8) cm. long, 4-9 (mostly 7) cm. wide between the apices of the two lateral lobes, broadly ovate, trilobed, lobe tips acuminate, base rounded to subcordate, often inequilateral, serrate-incised, 4 or 5 prominent veins arising at the base, teeth gland-tipped, green above and bright green below, glabrous above and below, coriaceous; other leaflets of the central division smaller and inequilateral, commonly 6-7.5 cm. long, 4.5-6.0 cm. wide; leaflets of the lateral divisions similar to those described; inflorescence a paniculate raceme with each branch being 9-23 cm. long, branches and pedicels densely covered with simple and glandular hairs; pedicels (in flower) 2 mm. long, stout, subtended by 3 lance-subulate bracts, one of which is long and flanked by two shorter ones; sepals 4-5, concave, fugacious, 2.5-3.5 mm. long, 2-3 mm. wide, obtuse apex and rounded base; apetalous; staminodia 2-3 (mostly 2), spatulate, concave, lobe whole and white, not antheroid, 2-2.5 mm. long, short stipitate, nectariferous area absent; stamens 14-23 (mostly 16-18); filaments 4-5 mm. long, filiform; anthers elliptical; pistils 3-6 (mostly 4), 1.5-2 mm. long, sessile or short stipitate, glabrous; style short, undifferentiated; stigma minute; ovary .5 mm. in diameter; fruit a follicle (not examined); seeds scaly (not examined).

Type locality: "Ussuriinsk, along the Suyifun River." Type Specimen: believed to be preserved at Leningrad (not seen). The original description is thought to be conclusive. Representative specimen shown in Figure 27.

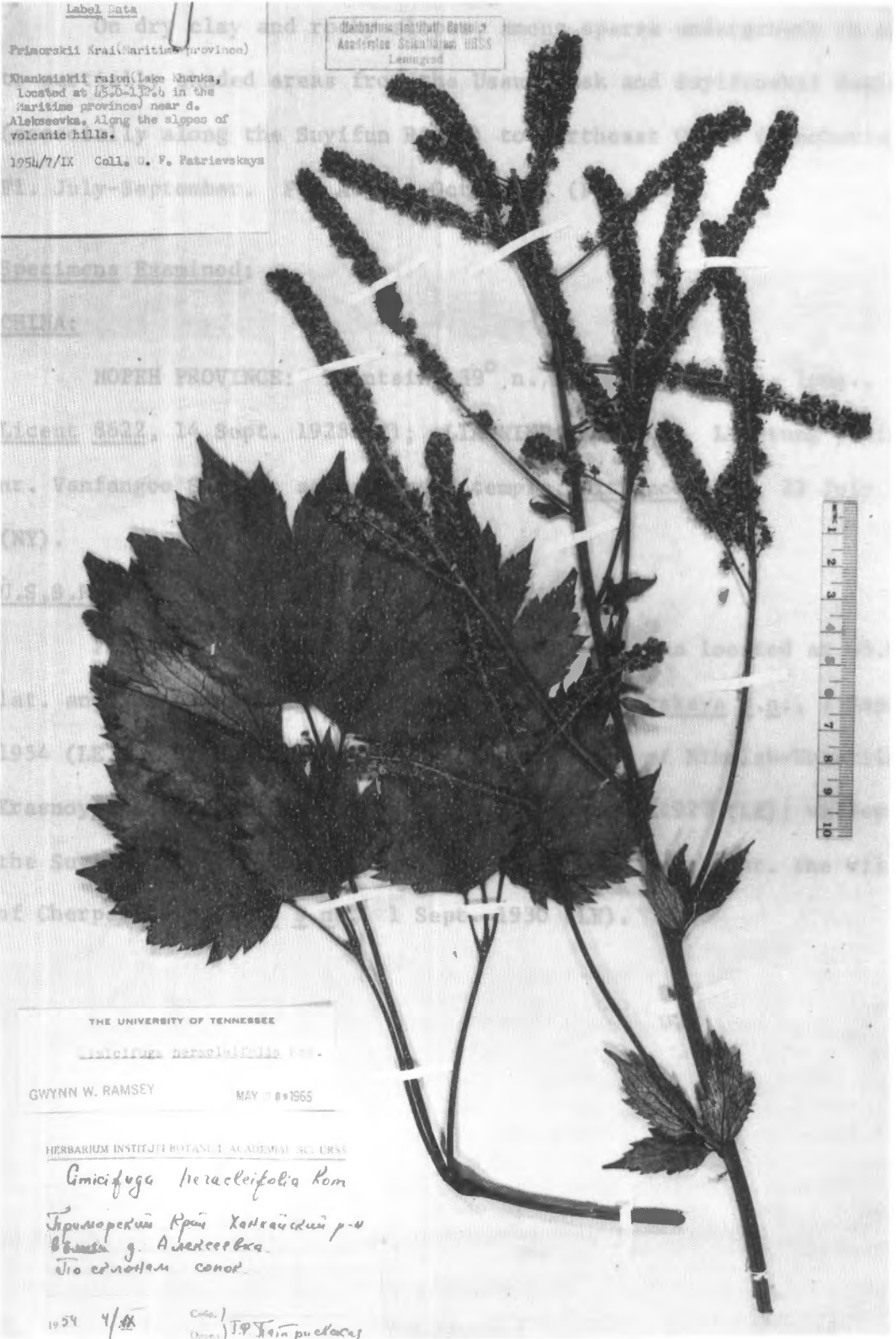


Figure 27. Representative specimen of Cimicifuga heracleifolia.

On dry clay and rocky slopes, among sparse undergrowth in open to partially shaded areas from the Ussuriinsk and Suyifunskii Regions (especially along the Suyifun River) to northeast China (Manchuria).

Fl. July-September. Ft. August-October. (Fig. 28).

Specimens Examined:

CHINA:

HOPEH PROVINCE: Tientsin, 39° n. Lat., $117^{\circ} 30'$ e. long.,

Licent 8622, 14 Sept. 1928 (K); LIAONING PROVINCE: Liaotung peninsula, nr. Vanfangoo Station at a Chinese temple, Litvinov 1790, 23 July 1902 (NY).

U.S.S.R.:

FAR EAST: KHANKAISKII REGION: (Lake Khanka located at 45.0° n. lat. and 132.4° e. long.) nr. Alekseevka, Patrievskaya s.n., 7 Sept. 1954 (LE). SUYIFUNSKII REGION: in the vicinity of Nikolsk-Ussuriiskii, Krasnoyarsk Volcanic Mt., Transhel s.n., 5 Sept. 1927 (LE); valley of the Suyifun River (43.3° n. lat. and 131.8° e. long.), nr. the village of Cherpetit, Komarov s.n., 1 Sept. 1930 (LE).



Figure 28. Distribution of Cimicifuga heracleifolia.

10. CIMICIFUGA DAHURICA (TURCZ.) MAXIM.

(Manchurian Bugbane) Nomen Nov.

SYNONYMY

Cimicifuga dahurica (Turcz.) Maxim., Prim. Fl. Amur. 28 (1859); Huth,
in Engler Bot. Jahrb. 16:316 (1892); Komarov, Fl. USSR 8:82 (1937).

Actinospora dahurica Turcz., in Fischer and Meyer, Ind. Sem. Hort.

Bot. Petrop. 1:21 (1835); Ledeb., Fl. Ross. 1:72 (1845). Torrey
and Gray, Fl. N. Am. 1:35 (1838-1840).

Actaea pterosperma (Turcz.) Fl. Baic. 1:21 (1842-1845).

Actaea davurica Franchet, Nouv. Arch. Mus. Hist. Nat. 8:28 (1872);

Nouv. Arch. M.P. (2) 5:175 (1883); Pl. David. 1:23 (1884).

Thalictrodes dahuricum O. Kuntz, Rev. Gen. Pl. 1:4 (1891).

A tall perennial, with hard, knotted rhizomes and solitary stems bearing biternate or triternate leaves at the base and successively higher nodes. Rhizomes small, thick, horizontal, sometimes branched, attaining a maximum length of 8 (mostly 6) cm., 0.5 - 1.5 cm. in diameter, bearing numerous fibrous roots; stems 7 - 18 (mostly 12 - 14) dm. high, erect, stout at the base, diminishing in size toward the summit, pale-green to brown especially at the base, terete throughout, lightly grooved, leafy, glabrous up to the inflorescence, there sparsely to densely covered with glandular and simple, grey hairs; petioles 0.5 - 2.5 dm. long, straight, broadly and very shallowly sulcate on the upper face, especially toward the base, glabrous in the groove, enlarged at the base with wing-like margins clasping and sometimes

enclosing the stem, margins of upper leaves not completely ensheathing the stem; leaves biternate to triternate, the central division 3-15 (usually 5-) foliate, the lateral divisions 3-15-(usually 9-) foliate (thus, the leaves may contain up to 45 leaflets) petiole of the central division 6-8 cm. long, sulcate, glabrous; petioles of lateral divisions 4-6 cm. long, about equal; petiolules of the lateral leaflets of the central division 1-2 cm. long, sulcate glabrous, or absent; petiolules of leaflets of lateral divisions shorter; terminal leaflet of the central division 4-16 (mostly 7-10) cm. long, 4-12 (mostly 6-8) cm. wide between the apices of the two largest lobes, broadly ovate, equilateral, tri-lobed, long acuminate, 3 prominent veins arising at the base, typically rounded at the base but frequently subcordate, serrate to dentate-serrate, incised, teeth gland-tipped, green above, paler below, glabrous to sparsely ciliate above, short ciliate in the sinuses and on the major veins below; other leaflets of the central division smaller and inequilateral, commonly 8-10 cm. long, 4-6 cm. wide; leaflets of the lateral divisions similar to those described; inflorescence is a simple or compound raceme (panicle of branched racemes) about 1-5 dm. long, branches and pedicels densely covered with simple and glandular, grey hairs, pedicels (in flower and fruit) about 8 mm. long, slender, subtended by a long-subulate bract about 2 mm. long, flanked by 2 smaller, lance-subulate, bractlets, about 1 mm. long; sepals 5-6, fugacious, 2.5 - 3.5 mm. long, 2.5 - 3.0 mm. wide, concave, with obtuse apex and truncate base; apetalous; staminodes 2-3, forked, branches twice as long as broad, cleft to near the middle

(frequently below), summit of the lobes dilated, antheroid, remote, 2.5 - 3.0 mm. forked, long stipitate, nectariferous glands absent; stamens 45-55 in male flowers; filaments about 5-6 mm. long, slender, filiform, slightly dilated to the summit; anthers elliptical to round, aborted in perfect flowers or entirely absent; pistils (in male flowers) 3-5, (in perfect flowers which occur more rarely than the other two forms), about 6-8 (in female flowers), about 3 mm. long, rarely sessile, usually very short stipitate, glabrous to finely hairy; style short; stigma minute, appressed to the style; ovary about 1 mm. in diameter; fruit a follicle; follicles about 3-5 (mostly 3), 6-13 (mostly 7) mm. long, 3-4 mm. wide, short stipitate, glabrous, oblong to slightly obovate, base slightly tapered, apical end rounded, beaked with the short, straight, persistent style, chartaceous, veins diagonally oriented; seeds 3-6 (mostly 5), 0.2 - 2.5 mm. long, 2 mm. wide, flattened, covered with thin, transparent, striated, unequal, lacerate scales.

Type locality: "Davuria, Mongolie." Type specimen: Preserved at Leningrad. Type specimen not examined but original description thought to be conclusive. Representative specimen shown in Figure 29.

Along forest margins, among scrubby undergrowth of deciduous woods, in drier open ground of valley meadows, along streams and wooded rocky slopes of eastern Siberia in the Transbaikal, Amur, and Ussurinsk regions, Korea, China, especially Manchuria. Fl. late July-September. Ft. late August-last of October. (Fig. 30).

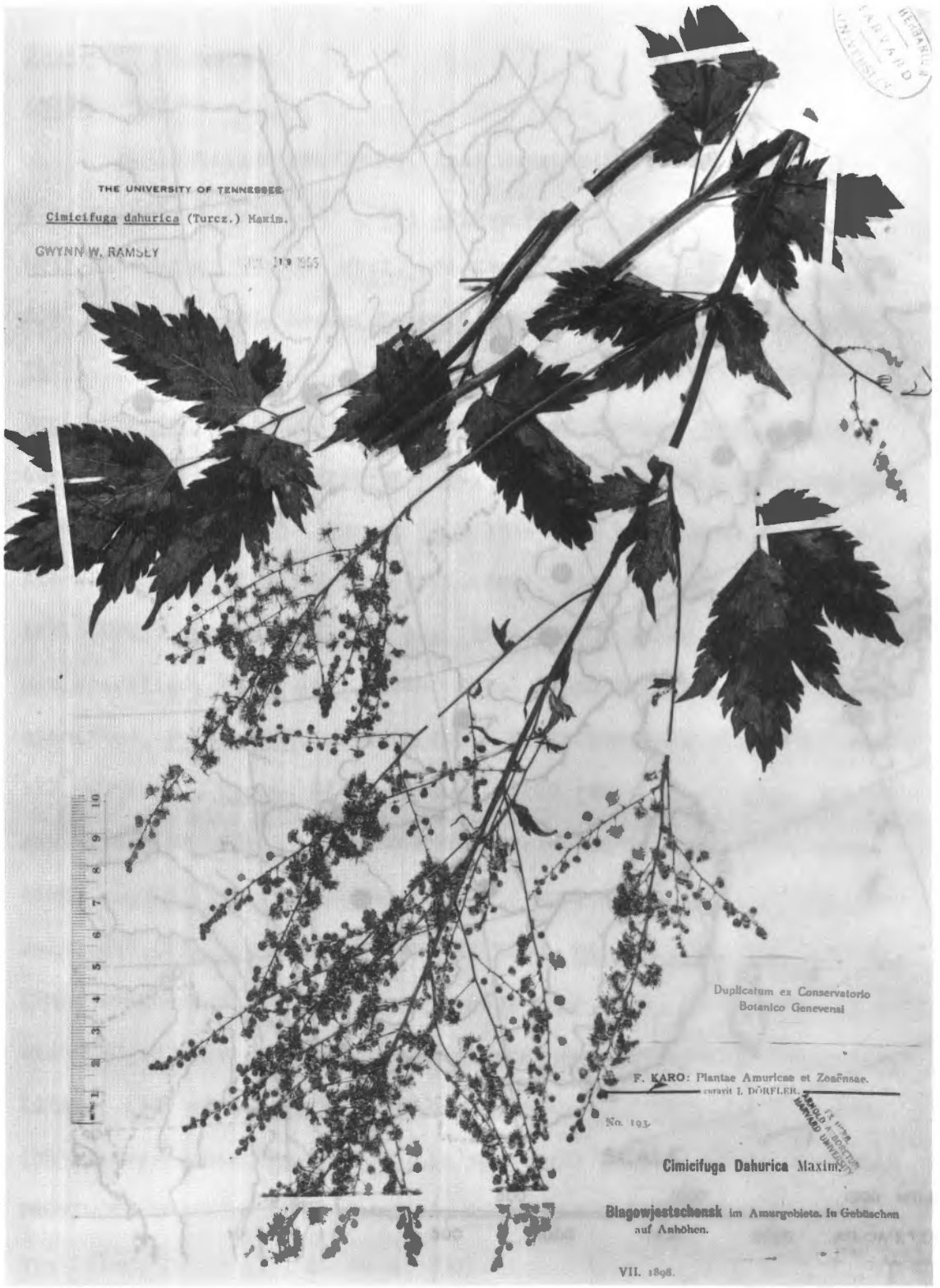


Figure 29. Representative specimen of Cimicifuga dahurica.

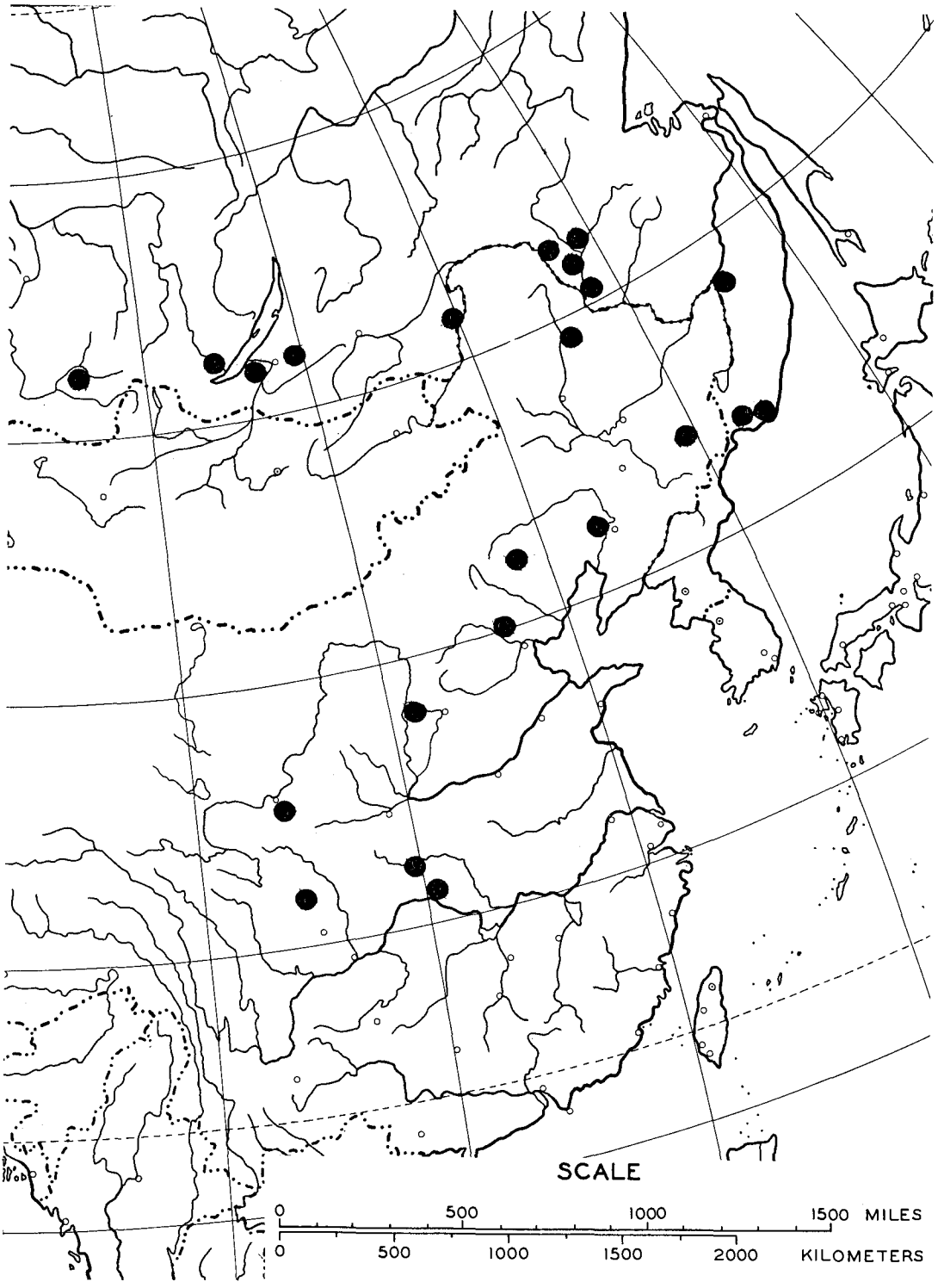


Figure 30. Distribution of Cimicifuga dahurica.

Specimens Examined:CHINA:

HEILUNGKIANG PROVINCE: East Manchuria, Southern Ussuriensis, Komarov 665, 5 July 1895 (BM); ibid., Komarov s.n., 16 August 1895; West Manchuria, Kihigan Mts., nr. Sta. Saltanovna, Litvinov 745, 16 Aug. 1902 (NY); St. Barim, Roerich Exp. 13111, 21 Aug. 1934 (US); ibid., Roerich Exp. 631, 22 Aug. 1934 (US). HOPEH PROVINCE: Peking, Brebschneider 2226, 1882 (BM); environs of Peking, Beaurais s.n., Aug. 1884 (P); ibid., Provost s.n., 4 Sept. 1896 (P); Weichang 42° n. lat. 118° e. long., Purdum 142, 1914 (K); Hsiowutaishan, Yang-Kia-Ping, Smith 276, 18 Aug. 1921 (UPS); ibid., Smith 159, 26 Aug. 1921 (UPS); ibid., Li 10677, Aug. 1929 (NY). HUPEH PROVINCE: locality not specified, Henry 2447, 1885 (GH). KANSU PROVINCE: locality not specified, Purdum 766, no date (K). KIRIN PROVINCE: Kirin 44° n. lat. 127° e. long., Licent 8622, 14 Sept. 1928 (BM); ibid., Chen 465, 29 Aug. 1931 (BM, GH). LIAONING PROVINCE: coast of Manchuria, lat. 44-45° n., Wilford s.n., 1859 (GH, S). Mergen, Chaffanjon 1616, 27 July 1896 (P). SHANSI PROVINCE: Ta Keou, Licent 6757, 9 July 1922 (BM); southern Yuan-chu-district, Shui-wang-ping, Smith 6662, 21 July 1924 (MO, S, UPS); Chiao-cheng district, Pashui-ko-shan, Smith 7125, 24 Aug. 1924 (GH, S, UPS); Fan-shan-hsien, Ling 9478, 31 July 1925 (US); Lu-yah-shan, Smith 8191, 16 July 1927 (BM, S, UPS). SZECHWAN PROVINCE: locality not specified, Henry 7261, 1885 (NY); locality not specified, Henry 145, no date. (MO).

KOREA:

CHIRISAN SCHULLA PROVINCE: Whang sai sung ma, Smith s.n., 13 Aug. 1934 (US).

MONGOLIA:

DISTRICT NOT SPECIFIED: central Mongolia, Licent 3413, 31 Aug. 1917 (BM); eastern Mongolia, David s.n., Aug. 1864 (P).

U.S.S.R.:

EASTERN SIBERIA: TRANSBAICAL REGION: Lake Baikal Region, Turczaninow s.n., no date (P); Yenisey, Lundstrom s.n., 6 Sept. 1875 (UPS); Nerchinskii, along the Urov and Argun Rivers, n. lat. 52° & 130° e. long., Stukov 525, 19 June 1896 (LE); Irkutsk, Enander s.n., 8 July 1913 (S). AMUR REGION: Sukhotino (upper course of the Amur River), Korzhinskii s.n., 21 July 1891 (US); upper and middle Amur, Korzhinskii s.n., 1891 (US); Blagowjestschensk in the Amur Region, Karo 193, July 1898 (BM, K, S, US); ibid., Karo s.n., 21 July 1904 (LE); ibid., Karo 665, July 1905 (NY); ibid., Karo 34159, 1906 (S, WIS); Amur Region, Khabarowsk, Enander s.n., 19 Aug. 1918 (S); Bassein River 53.0° n. lat. and 128.0° e. long., Krasnorvtskaya 328, 2 Aug. 1926 (LE); 52.5° n. lat. and 127.0° e. long. to the nw. of Aktai, Isachenko et al. s.n., 26 July 1958 (LE). USSURIISKII REGION: village nr. Vladimiro, Ussuriiskii Krai, Aibvlavkina 591, 11 July 1913 (LE); on the Ussurisk River, Moak s.n., no date (K); around Vladivostok, Enander s.n., 3 Aug. 1913 (S); Vladivostok and vicinity, Topping 2397, May-Oct. 1919 (US). Vladivostok, Palczewsky s.n., 12 July (NY).

This plant was first described by Turczaninow in Fischer and Meyer (1835) under the name Actinospora dahurica. Maximowicz (1859) transferred it to the correct genus, Cimicifuga. Franchet (1872) placed it in another genus calling it Actaea davurica, and Kuntz (1891) referred it to his genus, Thalictrodes.

11. CIMICIFUGA SIMPLEX WORMSK.

(Kamchatkan Bugbane)

SYNONYMY

Cimicifuga simplex Wormsk. ex DC. Prodro. 1:64 (1824); Turczaninow, Bull. Soc. Nat. Mose. 15:87 (1842); Turczaninow, Fl. Baic. & Dahur. 1:87 (1842-1845); Maximowics, Prim. Fl. Amur. 29 (1859); Hulten, Fl. Kam. 2:102 (1903); Komarov, Fl. Kam. Penin. 2:119 (1929); Komarov, Fl. USSR. 8:84 (1937).

Actaea Cimicifuga simplex DC. Prodro. 1:64 (1824).

Cimicifuga foetida var. simplex Regel, Pl. Radd. Bai.-Dahr. & Amur. 122 (1861); Huth, in Engler Bot. Jahrb. 16:316 (1892).

Cimicifuga foetida var. Tschonoskii Huth, in Engler Bot. Jahrb. 16:316 (1892).

Cimicifuga yezoensis (Nakai) Kudo, in Jour. Col. Agrie. Sapporo 12:36 (1923).

A tall perennial, with hard, knotted rhizomes and solitary aerial stems bearing basal and cauline, biternate or triternate leaves. Rhizomes woody, thick, horizontally or diagonally oriented, sometimes branched, short, attaining a maximum length of 6 (mostly about 5) cm., 0.5 - 1.0 cm. wide, bearing numerous, stout, fibrous roots; stems 6-17 (mostly about 12) dm. high, erect to arcuate, especially near the tip, diminishing in size toward the summit, green to brownish-green or straw-colored, terete throughout, lightly furrowed at the base, leafy,

glabrous up to the inflorescence, there densely covered with short grey, simple and glandular hairs; petioles 0.5 - 2.7 dm. long, straight, narrowly and shallowly sulcate on the upper face, glabrous in the groove, enlarged at the base with wing-like margins clasping and sometimes enclosing the stem, petiole margins of the upper leaves not completely ensheathing the stem; leaves biternate to triternate, the central division 5-23-(mostly about 17-) foliate, the lateral divisions 5-27-(mostly about 15-) foliate (thus, the leaves may possess up to about 80 leaflets); petiole of the central division 6-15 cm. long, narrowly sulcate with scattered, lax, lustrous hairs in the groove; petioles of the lateral divisions 5-9 cm. long, nearly equal, although occasionally noticeably unequal; petiolules of the lateral leaflets of the central division up to 1.5 cm. long; petiolules of leaflets of lateral divisions usually shorter; terminal leaflet of the central division 3-14 (mostly about 5-8) cm. long, 2-10 (mostly 3-4) cm. wide between the apices of the two largest lobes, oval to long-elliptical or ovate, frequently broadly ovate and tri-lobed, apex acute to acuminate, base rounded to cuneate, sometimes inequilateral, serrate-incised, 3 prominent veins arising at the base, teeth gland-tipped, green above, paler below, glabrous to sparsely ciliate on major veins above and below and in the sinuses; other leaflets of the central division smaller and inequilateral, commonly 5-6 cm. long, 2-3 cm. wide; leaflets of the lateral divisions similar to those described; inflorescence usually a dense, simple, terminal raceme which is rarely branched, about .6 - 3.0 dm. long, branches and pedicels densely covered with simple and glandular,

grey hairs; pedicels (in flower and fruit) about 6 mm. long, slender, subtended by two very short (0.5 mm.), wedge-shaped or oval and obtuse, unequal bracts, a smaller bract may be present upon the pedicel; sepals 5, concave, fugacious, 3.5 - 4.0 mm. long, 3-4 mm. wide, obtuse apex and rounded base; apetalous; staminodia 1-3 (mostly 2), oval, concave, bifid, depth of notch about 1/3 the length of the staminode, lobes narrow, parallel and obtuse or slightly attenuate, not strongly antheroid, 3.0 - 3.5 mm. long, short stipitate, large circular nectariferous gland present; stamens 28-42 (mostly 32-34), sometimes all sterile and changed into ligulate staminodes; filaments about 6-7 mm. long, strongly dilated to the summit, accrescent; anthers elliptical; pistils 2-6 (usually 3-4), absent in staminate flowers, about 2.5 - 3.0 mm. long, rarely sessile, usually long-stipitate, villous to tomentose, rarely glabrous, stipes accrescent and equal to the ovary at maturity; style elongate; stigma minute, uncinata; ovary about 1 mm. in diameter; fruit a follicle; follicles about 3-5 (mostly 3), 4-8 (mostly 7) mm. long, 3-4 mm. wide, stipitate, follicle stipe significantly elongate and abruptly bent at its base, glabrous, obovate, a rather long beak which is oriented apically, walls chartaceous, veins diagonally oriented; seeds 4-8 (mostly 5-6), 3.5 - 4 mm. long, 3 mm. wide, flattened, covered with thin, transparent, striated, unequal, lacerate scales.

Type locality: "Kamchatka." Type specimen: Lost according to Komarov (1938). Original description thought to be conclusive. Lectotype specimen is shown in Figure 31.

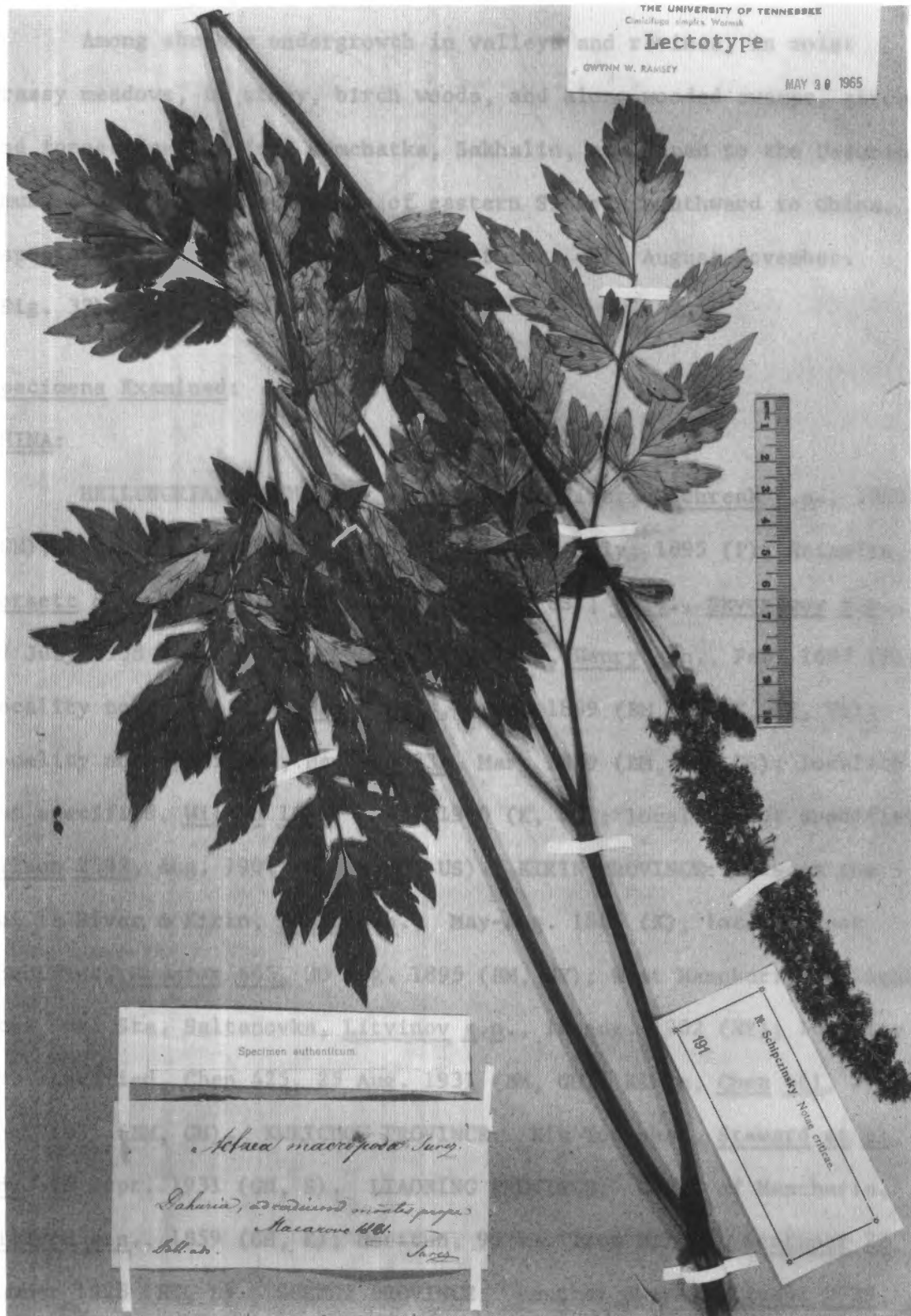


Figure 31. Lectotype specimen of Cimicifuga simplex.

Among shrubby undergrowth in valleys and ravines, in moist grassy meadows, in stony, birch woods, and along wooded swamps, streams, and forest margins from Kamchatka, Sakhalin, and Japan to the Ussurinsk, Amur, and Transbaikal regions of eastern Siberia southward to China, especially in Manchuria. Fl. July-October. Ft. August-November. (Fig. 32).

Specimens Examined:

CHINA:

HEILUNGKIANG PROVINCE: on the Amur River, Schrenk s.n., 1850 (GH); Southern Ussuriensis, Komarov 666, 31 July, 1895 (P); Hsiaolin, Dorsett & Dorsett 4075, 28 Aug. 1925 (NY, US); ibid., Skvortzov s.n., 27 July 1938 (GH). HUPEH PROVINCE: Ichang, Henry s.n., Feb. 1887 (P); locality not specified, Henry 6073, Mar. 1889 (BM, GH, K, NY, US); locality not specified, Henry 6073B, Mar. 1889 (BM, GH, US); locality not specified, Wilson 1629, Aug. 1900 (K, NY); locality not specified, Wilson 2592, Aug. 1901 (K, NY, P, US). KIRIN PROVINCE: between the Hui fa River & Kirin, James s.n., May-Aug. 1886 (K); locality not specified, Komarov 666, 30 Aug. 1895 (BM, NY); West Manchuria, Khingan Mts., nr. Sta. Saltanovka, Litvinov s.n., 16 Aug. 1902 (NY); locality not specified, Chen 425, 25 Aug. 1931 (BM, GH); Kirin, Chen 461, 29 Aug. 1931 (BM, GH). KWEICHOW PROVINCE: Niu Tou shan, Steward et al. 589, 15 Sept. 1931 (GH, S). LIAONING PROVINCE: Coast of Manchuria, Wilford s.n., 1859 (GH, K); Haritun, 90 km. from Mergen, Stotzner 22, summer 1928 (NY, S). SHENSI PROVINCE: central Shensi, Licent 2739,

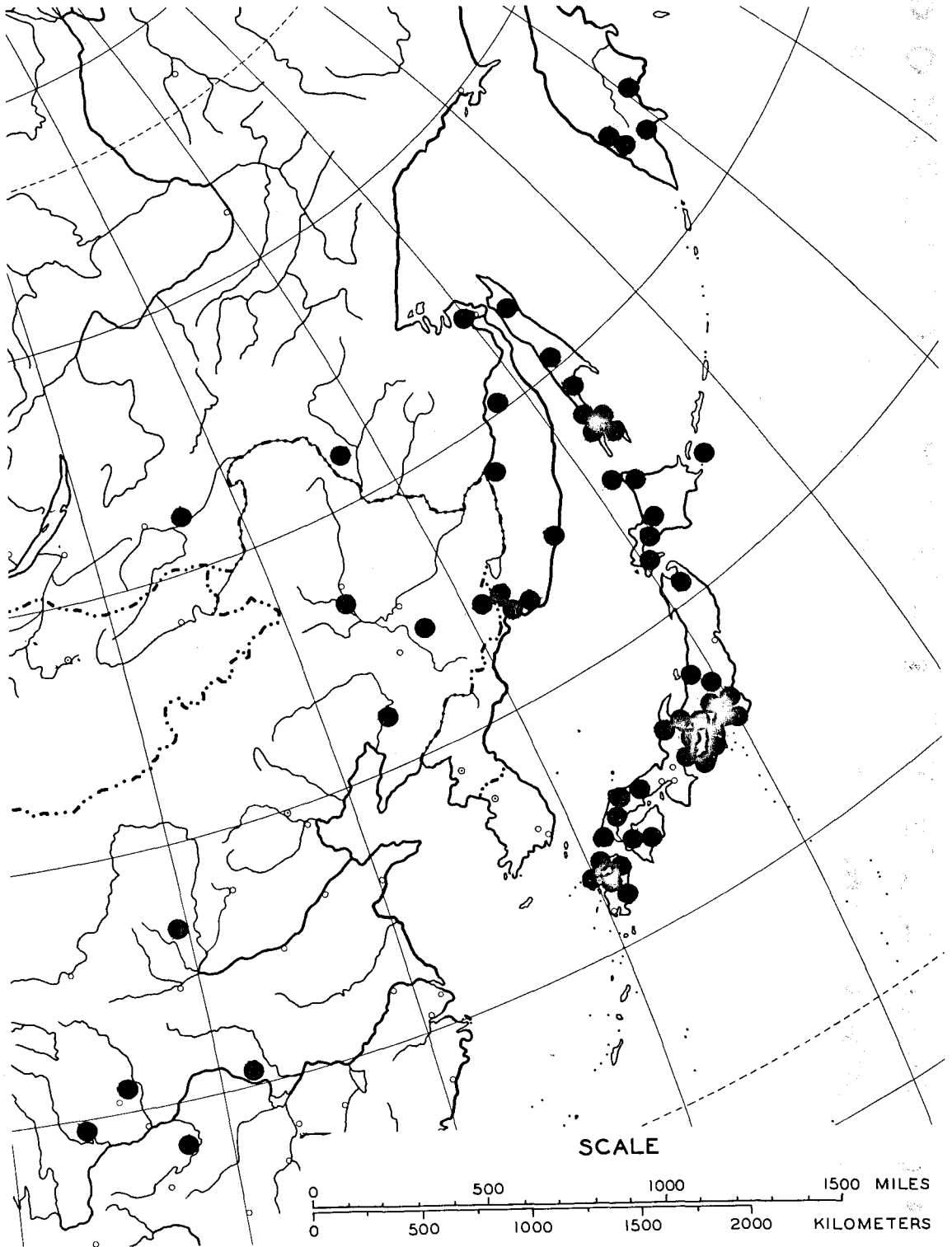


Figure 32. Distribution of Cimicifuga simplex.

22 Aug. 1916 (EM). SZECHWAN PROVINCE: Omei Hsien, Mt. Omei, Fang 2782, 11 Aug. 1928 (GH, NY, US); ibid., Fang 3069, 16 Aug. 1928 (GH, US); ibid., Lee 3266, 11 Aug. 1940 (US); southern Su-tchuen, district of de tchen-keou-tin, Farges 212, no date (K, P); Mt. Omi, Wilson 4713, no date (AA, K). PROVINCE NOT SPECIFIED: Manchuria, Turczaninow s.n., 1831 (P); Maearove s.n., no date (LE); ibid., Fischer s.n., 1836 (P); southeastern Manchuria, Anon. s.n., 1860 (EM); Manchuria, Chaffanjon 1691, 1895 (P); Manchuria, Bohnhof 292, 1898-99 (NY); ibid., Radde s.n., no date (GH, P).

JAPAN:

HOKKAIDO: HOKKAIDO PREFECTURE: around Hakodate, Albrecht s.n., 1861 (F, GH, K, NY); ibid., anon. s.n., 1861 (US); se. coast, Maries s.n., Aug. 1880 (GH); Mori, Faurie 938, 19 Aug. 1889 (P); Sapporo, Kubuchi s.n., 13 Sept. 1889 (MO); ibid., Tokubuchi s.n., Aug. 1890 (K); ibid., Tokubuchi s.n., Oct. 1890 (K); ibid., Arimoto s.n., July 1903 (MO); ibid., Arimoto s.n., 3 Sept. 1903 (GH); Mororan, Faurie 6211, Sept. 1904 (BM); Rusutu, Sakamura s.n., Aug. 1912 (TAI); Ishikarikuni, Kudo 220, 21 June 1913 (TAI); Muroran, Kudo 298, 28 July 1914 (TAI); Toshiri Mt., Kudo 1626 & 1972-73, 19 July 1915 (TAI); Yapuro Nat. Forest, Kudo 1179, 25 June 1916 (TAI); Mt. Rishiri, Kudo 1974, 21 July 1916 (TAI); locality not specified, Kudo 93, July 1917 (TAI); Wakkanai, Ishidova 63, Aug. 1916 (TAI); Muroran, Kudo 3944, 29 Aug. 1917 (TAI); Hakodate-yama, Yamamoto 784, 28 Oct. 1924 (TAI); forest reservation nr. Sapporo, Dorsett & Dorsett 1041, 5 Sept. 1929 (NY, US); Wakkanai, Amiva & Waseda s.n., 25 July, 1962 (KAG).

HONSHU: AICHI PREFECTURE: Orimoto-tooge, Kita-shitara-gun, Furuse s.n., 28 Sept. 1855 (S). AOMORI PREFECTURE: in mts. of Amori, Faurie s.n., Sept. 1902 (BM). CHIBA PREFECTURE: on s. side of Mt. Kiyosumi, Furuse s.n., 1 Nov. 1958 (AA). GIFU PREFECTURE: Hokuno Village, Shiota 539, 20 Sept. 1921 (GH); Yamada Village, Shiota 5461, Oct. 1931 (GH); locality not specified, Kurumada 9182, no date (GH). HIROSHIMA PREFECTURE: Mt. Hibasan, Morimoto 114, no date (KAG). IBARAKI PREFECTURE: Mt. Tsukuba, Kobayashi 13641, 7 Oct. 1952 (S). ISHIKAWA PREFECTURE: Mt. Hakusan, Fujita 1013, 20 Aug. 1912 (KAG). Setoishi Forest, Kudo 89, 27 Aug. (TAI). KANAGAWA PREFECTURE: Yokohama, anon. s.n., Oct. 1862 (BM, GH, NY, S); around Yokosuka, Savatier s.n., 1866-74 (US, P); Fujayama, Faurie 6567-70, Oct. 1890 (P); Kamarura, anon. s.n., 1 Sept. 1910 (US); Mt. Takatoriyama, Miura-pen, Sakuma E264, 10 Oct. 1947 (AA); Mt. Tamzawa, Yamazaki 2898, 24 Aug. 1950 (S); NAGANO PREFECTURE: locality not specified, Tschonoski s.n., 1864 (GH, NY); Mt. Yatsugadake, Naito s.n., 13 Aug. 1925 (KAG); foot of Mt. Asama, Nagano-ken, Beattie & Kurihara 10111, 12 Sept. 1927 (US); Kirigamuni, n. of Suwa, Murata s.n., 30 July 1952 (WIS); Sugadaira, Chiuisagata-gun, Mizushima s.n., 29 Aug. 1954 (S); foot of Mt. Kurohime-yama, Kami-minochi-gun, Furuse s.n., 17 Sept. 1956 (S); side of Matsubara Lake, Minami-saku-gun, Furuse s.n., 25 Sept. 1958 (AA, S). NIIGATA PREFECTURE: at the foot of Mt. Myojo, Nishikubiki-gun, Shimizu 12865, 28 Sept. 1961 (S). SAITAMA PREFECTURE: locality not specified, Kamelama 538, 1 Aug. 1905 (GH); Jumoji-toge to Mt. Akasawa, Chichiby-gun, Shimizu 13591, 4 Oct. 1962 (S). SHIGA PREFECTURE: Mt. Ibukiyama, Umemura 1011, no date (KAG).

- SHIMANE PREFECTURE: Mt. Funamichiyama, Naito s.n., 25 Aug. 1927 (KAG).
- SHIZUOKA PREFECTURE: Iwashina-mura, Kamo-gun, Furuse 2537, 31 Oct. 1954 (S); Nakko Kami-kano-mura, Tagata-gun, Furuse s.n., 4 Nov. 1955 (S); Numanokawa, foot of Mt. Amagi, Izu peninsula, Noguchi 5273, 23 Oct. 1957 (KAG).
- TOCHIGI PREFECTURE: Nikko, Millspaugh 2636, 1 Oct. 1911 (F).
- TOKYO PREFECTURE: Dokan-zan, Watanabe s.n., 18 Oct. 1893 (K, US); Tokyo, Terasaki s.n., Oct. 1906 (K); ibid., anon s.n., 2 Nov. 1911 (S); Tohyo-to, Mt. Takawa-san, asakawa-machi, Furuse s.n., 17 Oct. 1958 (AA, S).
- TOTTORI PREFECTURE: slopes of Mt. Daisen, 25 mi. se. of Yonago City, Que 27, 29 August 1956 (US).
- TOYAMA PREFECTURE: Tateyama town along Hachiro Hill Trail, 40 mi. se. of Toyama City, Charette 2082, 25 Aug. 1954 (MO).
- YAMAGUCHI PREFECTURE: Tokusa-mura, abu-gun, anon s.n., 5 Aug. (KAG).
- YAMANASHI PREFECTURE: Mt. Mitsutooge, Nishi-katsura-mura, Minamu-tsuru-gun, Furuse s.n., 3 Sept. 1954 (S); Mt. Fuji, Yosida side, Hulten s.n., 5 Oct. 1961 (S).
- KYUSHU: FUKUOKA PREFECTURE: Chikuzen, Wakasugi-yama, Nagarro s.n., 19 Oct. 1894 (TAI); ibid., Takenouchi s.n., Oct. 1929 (S).
- KUMAMOTO PREFECTURE: Mt. Kunimidake, Sako 896, 2 Sept. 1957 (KAG); Momiki, Gokanosyo, Sako 1034, 3 Sept. 1957 (KAG); ibid., Sako 1188, 4 Sept. 1957 (KAG); ibid., Hatusima & Sako 27128, 20-23 Aug. 1962 (KAG).
- MIYAZAKI PREFECTURE: Mt. Dodake, Hinokagecho, Hatusima et al. 22521, 8 Oct. 1958 (KAG); between Gobasyo and the summit of Mt. Sobo, Hatusima et al. 22643, 9 Oct. 1958 (KAG); Takachihokyo, Hatusima et al. 22382, 10 Oct. 1958 (KAG).
- NAGASAKI PREFECTURE: Nagasaki, anon. s.n., 1863 (GH, K).
- OOTA PREFECTURE: Mt. Haneyama, Kusu-cho, Kusu-gun, Sato 5037, 3 Oct. 1964 (KAG).

SHIKOKU: EHOME PREFECTURE: Mt. Higashiakaishi, Ishikawa s.n.,
 30 Aug. 1934 (KAG). KOCHI PREFECTURE: Nanokawa, Tosa, anon. s.n.,
 30 Sept. 1889 (GH); Mujiri Islands, Aonae, Kudo 2554, 8 Aug. 1915 (TAI).
U.S.S.R.

EASTERN SIBERIA: CHITA REGION: along the Itakend River between
 Shavernaya and Ayanom, nr. Nerchinski, Kuznetsov 1201, 14 July 1909
 (LE); Nerchinski Zavod, nr. the Uryumkan River, Krashennikov 1055,
 14 Aug. 1909 (NY); ibid., Krashennikov 861, 14 Aug. 1909 (S); Sentry
 Station on the Shilka River nr. Nerchinshi, Sukachev & Popavskaya 1300,
 14 Aug. 1910 (LE); nr. Nerchinski, on Bass and Kengi River, Abolin 786,
 26 July 1911 (LE). AMUR REGION: upper and middle Amur, Korshinsky s.n.,
 1891 (US); Zeya at 53.0 n. lat. & 128 e. long., Prokhorov & Kuzeneva
577, 20 July 1908 (LE); Zejskaya Pristan, Karo 427, 7 Aug. 1899 (BM,
 GH, K, P, S, US); nr. Zeya, Sokolov 724, 1909 (S). Khabarovsk REGION:
 Nikolayevsk, Shestunov s.n., 6 Aug. 1906 (LE); ibid., Georgievskaya
s.n., 14 Aug. 1912 (LE); valley of the M. Uianga River nr. Chernyayevo,
 52.8 n. lat. and 126.0 e. long., Balt's 150, 25 July 1914 (LE); Bassein
 River nr. Zeya, Kuzeneva 416, 6 Aug. 1926 (LE); $\frac{1}{2}$ Klm. ne. of Chenk,
Savich 882, 6 Sept. 1930 (LE); Nikolayevsk, Tsinger s.n., 20 Aug. 1934
 (LE); valley of the Amur nr. n. Chernyayevo, Sochava & Lipatova s.n.,
 27 July 1956 (LE); vicinity of Khabarovsk, Plyusin s.n., 14 Aug. 1912
 (LE); valley of the Mongugai River in the vicinity of Bogoslavka,
Dyukin s.n., 19 Aug. 1913 (LE); northern Sikhota-Alin Mts., Botcha
 River Valley, Shishkin 552, 15 Aug. 1924 (LE). USSURISKII REGION:
 Sudangaya River nr. Ussuriisk, Malinovo 137, 12 Sept. 1926 (LE);

Vladivostok and vicinity, Topping 2425, May-Oct. 1919 (US); Ternei, 45.0 n. lat. & 136.6 e. long., Sitsa River, Tomininov 197, 8 Sept. 1936 (LE); Suchan River, Frolovka Village, valley of Pensai, nr. Suchan, Aivulavkipa 1396, 2 Aug. 1913 (LE). SAKHALIN: Korsakov, Faurie 448, Sept. 1908 (BM); village nr. Aleksandrovsk, Shyushmeeova 27, 10 Aug. 1910 (LE); on the flanks of Taskhara Mts., Kholmsk, Vasil'ev s.n., 6 July 1912 (LE); locality not specified, Kudo & Ishida 7644, 12 Sept. 1923 (TAI); locality not specified, Kudo 7680, 12 Sept. 1923 (TAI); locality not specified, Ortomari 136, Aug. 1928 (TAI); nr. Yuzhno-Sakhalinsk (Toyohara), Naito s.n., 5 Aug. 1931 (KAG); Tomari on the sw. coast of the Island, Motorishya s.n., 5 Sept. 1951 (LE); vicinity of Kholmsk, Vasil'ev & Forelkina s.n., 5 Sept. 1952 (LE); se. slope of the Behb-ukakat-yama River nr. Vakrushevo, Shukobagskii 125, 1 Aug. 1955 (LE); northern Sakhalin, Murayama s.n., no date (KAG). KURILE ISLANDS: Tokohan, Bergmen 503, 5 Aug. 1930 (S); Shilotan, Ohwi 1113, 31 Aug. 1931 (UPS); ibid., Gizenko s.n., 27 Aug. 1948 (LE). KAMCHATKA: locality not specified, Raftargiveff s.n., 1831 (MO); Paratum, Stubendorf s.n., 26 July 1849 (LE); locality not specified, Khympfer s.n., 1865-66 (GH); Petropavlovsk, Macoun s.n., 8 Sept. 1891 (GH); along Mt. between the Polovinnaya and Gavanskaya Rivers, Komarov s.n., 23 July 1908 (LE); on Mt. between the Polovinnaya and Tsvanskaya Rivers, Komarov s.n., 23 July 1908 (LE); locality not specified, Komarov s.n., 29 Aug. 1908 (P); in the valley of the Kuzhenenk River, nr. the village of Tolgino, Rubinskii 181, 7 July 1909 (LE); along slope of Petrovsk Mt., Perfilev 27, 28 Aug. 1910 (LE); Petropavlovsk, Hulten 878, 16 Aug.

1920 (GH, LE, S); ibid., Hulten 941, 18 Aug. 1920 (S); southern Kamtchatka, Nikolajevsk, Malaise 2618, 1928 (S); southern Kamtchatka, Savoiko, Malaise 3018, 1928 (S); Petropavlovsk, Everdam s.n., 10 Aug. 1928 (MO); ibid., Everdam s.n., 20 July 1928 (S, US); ibid., Everdam s.n., 23 July 1928 (F, GH, NY); Ust-Bolsheretsk, Kovalenko 64, vicinity of Nachika, along edge of valley of the Uzback River between the Kalzan and Komarova Mts., Slirshiva 272, 29 July 1939 (LE); on the right bank of the Kikhchit River, Krasyuk & Komarov s.n., no date (LE); locality not specified, Stewart s.n., no date (P, UPS).

This plant is listed as Actaea Cimicifuga simplex in de Candolle's Prodrumus (1824). In the same publication there is reference to the presently accepted botanical name, Cimicifuga simplex, the authority of which is Wormskijord. Regel (1861) and Huth (1892) treated this species as a variety of Cimicifuga foetida. Cimicifuga yezoensis (Nakai) Kudo is interpreted, by the author, as synonymous with Cimicifuga simplex.

The flowers of Cimicifuga simplex are usually perfect; rarely, however, flowers contain only sterile stamens, or rarely, flowers possess fertile stamens and rudimentary pistils. Because of these unusual forms Huth (1892) gave formal recognition to a sequence of forma as follows: (a) mascula, (b) femina, and (c) hermaphrodita. The present work does not formally recognize these forms.

12. CIMICIFUGA FOETIDA L.

(foetida bugbane)

SYNONYMY

Cimicifuga foetida L. Syst. Nat. 12 ed. 645, 659 (1767); Linnaeus, Amoe. Acad. 8:193; Linnaeus, Sex. Syst. 6:402 (1798); Hooker and Thomson, Fl. Indi. 1:59 (1855); Hooker and Thomson, Fl. Brit. Indi. 1:30 (1872); Franchet, B.S.B.F. 33:382 (1886); Huth, in Engler Bot. Jahrb. 16:317 (1892); Robinson in Gray, Syn. Fl. N. Am. 1:54 (1895); Takeda, Jour. Bot. Brit. & For. 48:268 (1910); Munesada, Journ. Pharm. Soc. Japan 51:86 (1931); Bailey, Stand. Cyclo. Horti. 1:796 (1933); Datta, Sci. and Cult. 10 (12); 519 (1945); Polunin, Pl. Geog. 191 (1960).

Actaea cimicifuga L. Amoe. Acad. 2:354 (1751); Linnaeus, Sp. Pl. 1:722 (1764); Linnaeus, Gen. Pl. 2:261 (1767); DC. Prodro. 1:64 (1824).

Actaea racemosa Genersich, Fl. Scipus. El. 39 (1798) non. L.

Actinospora frigida Fisch. et Meyer, Ind. Sem. Hort. Petrop. 1:21 (1825).

Actaea frigida Wallich, Cat. No. 4725 (1828).

Actinospora wallichii Meissn. Gen. Comm. 4 (1837).

Actaea frigida Royle, Illus. Bot. Himal. 57 T. 14 (1839).

Thalictrodes cimicifuga Ktze., Rev. Gen. Pl. 1:4 (1891).

Cimicifuga foetida L. var. racemosa Regel, Pl. Radd. 1:121 (1892).

Cimicifuga foetida L. var. intermedia Regel, Pl. Radd. 1:121 (1892).

Cimicifuga foetida var. velutina Franchet in Finet et Gagnepain, Bull. Soc. Bot. France 51:521 (1904).

Cimicifuga ussuriensis Oettingen, in Act. Hort. Furjev. 6:138 (1906).

Cimicifuga foetida L. var. Leiogyna Mihi., Takeda, in Jour. Bot. Brit. & For. 48:268 (1910).

Cimicifuga taquetii Levl., Feddes Repert. Spec. Nov. Regni. Veget. 9:448 (1911).

Cimicifuga mairei Levl., Bull. Geo. Bot. 25:42 (1915).

Cimicifuga cimicifuga Aschers-Graebn. Syn. V. 2:631 (1926).

Cimicifuga europaea Schipez., in Komarov. Fl. USSR. 7:85, 720 (1937).

A tall perennial, with hard, knotted rhizomes and solitary stems bearing biternate or triternate leaves at the base and higher nodes. Rhizomes woody, thick, horizontally oriented, sometimes branched, attaining a maximum length of 12 (mostly about 8) cm., 1.0 - 2.5 cm. wide, bearing numerous thick fibrous roots; stems 4.0 - 20 (mostly about 14) dm. high, erect, stout at the base, diminishing in size toward the summit, green to brownish-green or straw-colored, terete or angled at the base, terete above, lightly grooved at the base, leafy, glabrous to sparsely hairy up to the inflorescence, there lightly to densely covered with short, grey, simple and glandular hairs; petioles 0.3 - 2.5 dm. long, straight, narrowly and shallowly sulcate on the upper face, glabrous in the groove, enlarged at the base with wing-like margins clasping and sometimes almost completely ensheathing the stem, glabrous to sparsely pubescent; leaves biternate to triternate, the central division 5-31-(mostly about 21-) foliate,

the lateral divisions similar, occasionally leaflets are more numerous, (thus, leaves may possess up to about 100 leaflets); petiole of the central division 4-13 cm. long, narrowly sulcate with scattered, lax, lustrous hairs in the groove, petioles of the lateral divisions 3.5 - 8.0 cm. long, nearly equal, occasionally noticeably unequal; petiolules of the lateral leaflets of the central division up to 3 cm. long, those of the leaflets of the lateral division shorter; terminal leaflet of the central division 2-17 (mostly 6-9) cm. long, 1.0 - 15 (mostly 4-7) cm. wide between the apices of the two lateral lobes, equilateral, oval to long-elliptic or broadly ovate, trilobed, apex acute to acuminate, base rounded, occasionally sub-cordate, serrate-incised, 3 prominent veins arising at the base, teeth gland-tipped, green above, paler below, glabrous to rarely hirsute or villous on the lower surface; other leaflets of the central division smaller and inequilateral, commonly 5-7 cm. long, 2-4 cm. wide; leaflets of the lateral divisions similar to those described; inflorescence usually a paniculate raceme with branches 10-12 cm. long, but occasionally a simple raceme as in Cimicifuga simplex, branches and pedicels sparsely to densely covered with grey, simple and glandular hairs, branches sometimes elongate and distant; pedicels 1-2 mm. (in flower) and 4-6 mm. long (in fruit), slender, subtended by 1-3 (usually 2) unequal, acute, subulate to lanceolate bracts, the longer being generally shorter than but frequently exceeding the length of the pedicel (e.g. specimens from the Himalayan Range); sepals 3-5 (mostly 4), fugacious, 3.5 - 4.5 mm. long, 3-4 mm. wide, concave, oblong to ovoid, bright, green; apetalous;

staminodia 3-5 (mostly 4), urceolate, emarginate with overlapping lobes or bifid and rather deeply notched as in specimens from the Himalayan Range, in these the branches are about as broad as long, not narrow as in Cimicifuga simplex, lobe tips strongly antheroid, overlapping or distant, sometimes fleshy, 3 mm. long, shortly stipitate, large circular nectariferous gland at the base; stamens 14-25 (mostly about 18), sometimes all sterile and developed into ligulate staminodes; filaments 5-7 mm. long, not strongly dilated toward the summit, mostly filiform, accrescent; anthers elliptic or orbiculate; pistils 1-8 (mostly 4), 3.5 mm. long, sessile or short stipitate, sparsely glandularly pubescent to villous, stipe accrescent and shorter than the ovary at maturity; style short, persistent; stigma minute, slightly uncinatate; ovary about 1.0 mm. in diameter; fruit a follicle; follicles 2-5 (mostly 3), 9-19 (mostly 13) mm. long, 4-6 mm. wide, short stipitate, stipes usually twisted about one another, glabrous to sparsely glandularly pubescent, long-obovate, short beak diagonally oriented, walls coriaceous to chartaceous, veins prominent and diagonally oriented; seeds 5-8 (mostly 7), 3.5 - 4 mm. long, 3 mm. wide, reddish-brown, flattened, covered with thin, transparent, striated, unequal, lacerate scales as in Cimicifuga simplex.

Type locality: "Habitat in Siberia." Type specimen: No. 698.1 preserved in the Linnaean Herbarium in London. The actual type specimen was not examined but a photograph of it was obtained from the Canadian Department of Agriculture, Ottawa, Canada. (Fig. 33).

On humus soils in closed to partially shaded deciduous forests,



Figure 33. Type specimen of Cimicifuga foetida.

and also in mixed-gymnospermous forests and their openings, high temperate mountain woods, open thickets, stream banks, mountain meadows and steep slopes of ravines from central Europe in eastern Germany, Poland, Czechoslovakia, Hungary, and Romania eastward to the Ukraine Region, Siberia (as far as the Yakutsk Region), Altay, the Himalayan countries, China, and Mongolia. Fl. Late July-September. Ft. August-October. (Fig. 34)

Specimens Examined:

BHUTAN:

Niuook La, Durzeboo 1, 31 July 1884 (K); Zado La Limper, Cooper 2421, 29 July 1914 (BM); Ohra Purnthang, Cooper 4735, 28 Aug. 1915 (BM); Bela La Pare, Ludlow et al. 19629, 22 Aug. 1949 (BM); Baeshong, Thimbu Chu, 27° n. lat. & 62° e. long., Ludlow et al. 17523, 15 Nov. 1949 (BM).

BURMA:

Adung Valley, $28^{\circ} 20'$ n. lat. & $97^{\circ} 45'$ e. long., Ward 9906, 5 Aug. 1931 (BM, GH); Taron Valley, $28^{\circ} 10'$ n. lat. & $98^{\circ} 10'$ e. long., Kaulback 137, 19 Oct. 1938 (BM); North Triangle, Tama Bum, Ward 21454, 12 Oct. 1953 (AA, GH).

CHINA:

HUPEH PROVINCE: Locality not specified, Henry 6073A, 1885-88 (GH); Patung District, Ichang, 31° n. lat. & $111^{\circ} 50'$ e. long., Henry 4867, May 1888 (K); Locality not specified, Henry 6812, 1885-88 (K, US); locality not specified, Wilson 553, Aug. 1900 (K, NY, US); Zancan-scian, Silvestri 3723, May 1912 (AA). KANSU PROVINCE: Kanse, Tal

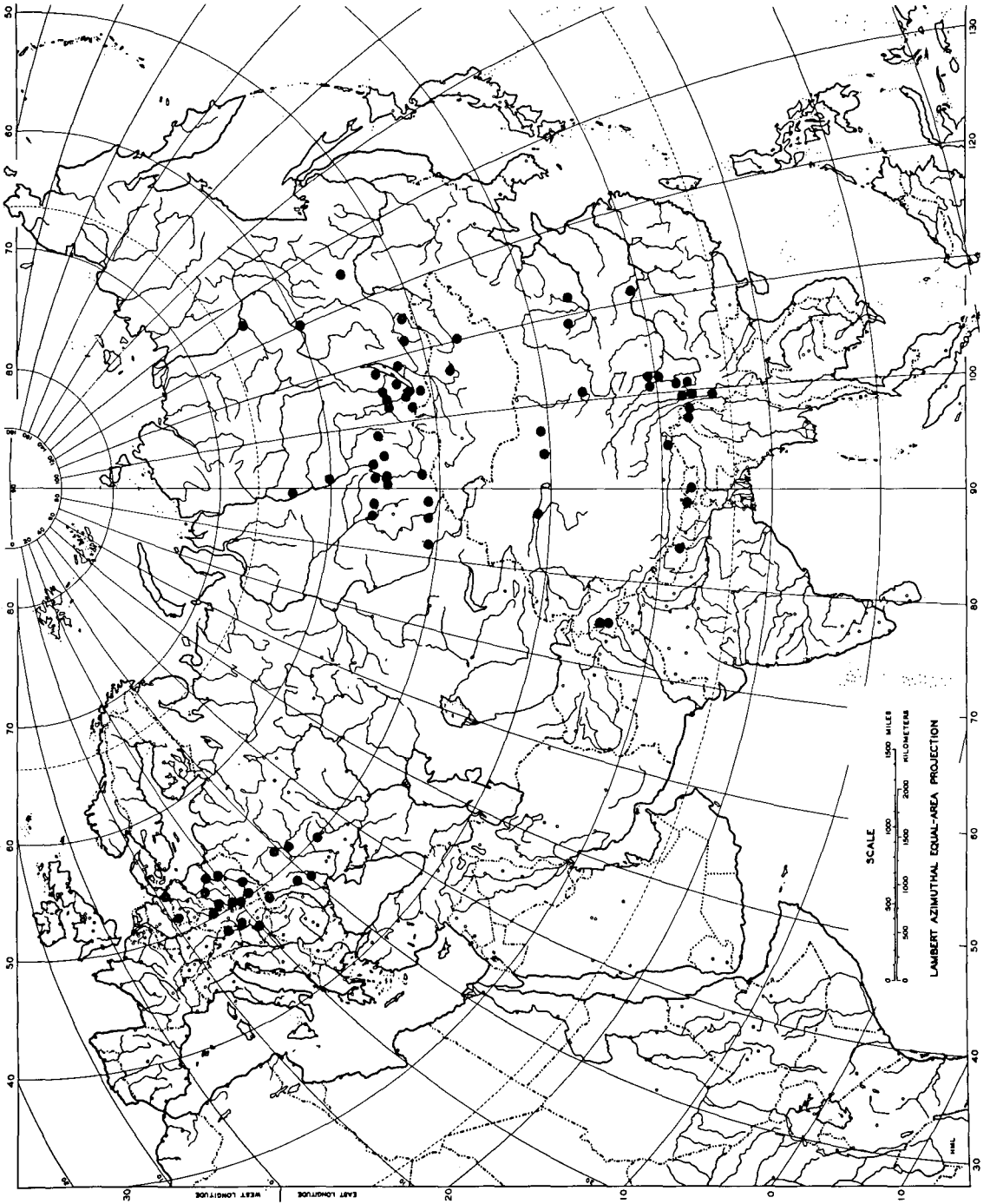


Figure 34. Distribution of *Cimicifuga foetida*.

von Tsv Is Kn, Linpribl 2065, 27 July 1914 (S); La Che Tze Shan Mts.,
 s. of Sining, Ching 711, 3 Aug. 1923 (GH, US); Tow River District, west
 Kansu, Purdom 755, no date (K). SHANSI PROVINCE: locality not specified,
Licent 2208, 6 July 1916 (BM); Chiao-Cheng District, Yun-ting-shan,
Smith 7015, 19 Aug. 1924 (BM, GH, MO, S, UPS); Chieh-hsiu district,
 Cho-mei-shan, Smith 7769, 22 Sept. 1924 (UPS). SHENSI PROVINCE:
 locality not specified, Licent 2356, 26 July 1916 (BM); Koan Tinn miao,
Licent 2796, 24 Aug. 1916 (BM, P). SZECHWAN PROVINCE: Between Taining
 (Ngata) and Taofu (Dawo) 31° n. lat. & 101° e. long., Smith 12167, 14
 Sept. 1934 (AA, BM, UPS); locality not specified, Potanin s.n., 1885
 (P); nr. Tachienlu, Pratt 661, Dec. 1890 (BM, K, P); Dara-tha-phong,
Soulie 18, July-Aug. 1891 (P); Tongolo, Soulie 257, 20 Aug. 1893 (P);
 Ta-tsien-lou, Soulie 538, 1893 (P); ibid., Soulie 2280, July 1894 (P);
 Pao-ki-meao, Hugh 22, Aug. 1897 (BM); Mt. Thae-pei-san, Hugh s.n.,
 Oct. 1898 (BM, GH); Mt. Ki-fong-san, Hugh s.n., 1899 (BM); 33° n. lat.
 & $103^{\circ} 30'$ e. long., Sung-pan, Smith 2729, 14 July 1922 (UPS);
 Dongrergo, Smith 3507, 8 Aug. 1922 (UPS); Sung-pan, Smith 4081, 14 Aug.
 1922 (UPS); Narlong, Smith 4220, 27 Aug. 1922 (UPS); Wenchuan Hsien,
Fang 1469, 23 July 1928 (GH, K, NY, US); Sung-pan Hsien, Fang 6040,
 15 Aug. 1928 (GH); ibid., Fang 4311, 21 Aug. 1928 (GH, K, NY, US);
 Kangting Hsien, 30° n. lat. & 102° e. long., Tachienlu, Fang 3562,
 25 Sept. 1928 (GH, US); Tachienlu to Sachou, via. Mouping, Stevens
120, Aug.-Sept. 1929 (F); n. of Wen-chuan, Hsien, Wang 21777, 20 July
 1930 (GH); Tchen-keou-tin, Farges 212, Sept. (P); locality not speci-
 fied, Bock & Rosthorn 2551, no date (UPS). TIBET: west Tibet,

Falconer 76, 27 June 1838 (BR, GH, K); Tsela Dzong, 29° n. lat. & 94° e. long., Ward 12041, 24 July 1935 (BM); Tsanang La. nr. Paka. (se. Tibet) $29^{\circ} 15'$ n. lat. & $94^{\circ} 23'$ e. long., Ludlow et al. 5834, 15 July 1938 (BM, UPS); Deyang, Tamnyen, $29^{\circ} 27'$ n. lat. & $94^{\circ} 38'$ e. long., Ludlow et al. 5454, 28 July 1938 (BM, UPS); valley above Tse, $29^{\circ} 23'$ n. lat. & $94^{\circ} 22'$ e. long., Ludlow et al. 7130, 25 Sept. 1938 (BM).

YUNNAN PROVINCE: Houang-li-fui, Delavay s.n., 22 Sept. 1882 (P); Lan Kong, Delavay s.n., 23 Aug. 1884 (P); locality not specified, Delavay s.n., 15 Oct. 1886 (P); Yentzekay, Delavay s.n., 19 July 1887 (K); Hse-chou-men, Delavay s.n., 12 July 1889 (P); Yunnan-sen, Ducloux 2240, 28 Aug. 1903 (P); pass between Chung Tien and Tang Tui, 27° n. lat. & $99^{\circ} 30'$ e. long., Forrest 514, Sept. 1904 (K); Len Chong Chan, Ducloux 3895, 18 Aug. 1905 (P); Tien-Tsin, Ducloux 4801, 18 Aug. 1905 (P); w. side of Isan Phan Range nr. head of Yang pi Valley, lat. $25^{\circ} 40'$ n. lat. & $99^{\circ} 30'$ e. long., Forest 982, Sept. 1905 (K); locality not specified, Ducloux 4800, 6 Aug. 1906 (P); Yo-lin-chan, Duclarin s.n., 1910 (S); Rochers de Mea Hong, Maire 168, Aug. 1910 (NY); e. flank of the Lichiang Range, $27^{\circ} 25'$ n. lat., Forrest 6334, Aug. 1910 (BM); locality not specified, Maire 149, 26 July 1913 (BM); locality not specified, Maire s.n., 15 April 1914 (P); prope Lichiang, Schneider 2044, 29 July (GH); ibid., Schneider 2825, 1914 (GH); Rochers de Kiao-me-ti, Maire s.n., 10 Aug. 1921 (P); Mt. Wuaha, Yung-ning territory, Rock 24201, May 1922 (GH); Yantze watershed, Prefectural district of Likiang, e. slopes of Likiang Snow Range, Rock 5968A, May-Oct. 1922 (US); ibid., Rock 5802, May-Oct. 1922 (US); ibid., Mt. Alete, Rock 4637, June

1922 (GH, US); trakten au Yunnanfu, Cavaleria s.n., Dec. 1922 (UPS); Mt. Wuaha, Yung-ning territory, Rock 24598, Oct.-Nov. 1932 (GH); western Yunnan, Anon, Mc/L/B.243, Mar. 1933 (K); Ta-li-Hsien, Tsai 53841, 27 July 1933 (AA); Che-tse-lo, top of Pi-lo-shan, Tsai 58131, 23 Aug. 1934 (GH); Wei-se Hsien, Tsai 59844, 17 Oct. 1934 (AA); Likiang Snow Range, Ching 30387, 17 July 1935 (AA); A-tun-tze, Wang 64777, July-Aug. 1935 (AA, GH, TAI); ibid., Wang 64865, July-Aug. 1935 (AA, GH, TAI); Wei-si Haien, Yeh-chih, $27^{\circ} 40'$ n. lat. & $99^{\circ} 30'$ e. long., Wang 68539, Aug. 1935 (AA, UPS); Huann-fu-ping, A-tun-tze, Wang 69119, Aug. 1935 (AA); Soo-roo-la, Cham-pu-tung, Wang 66723, Sept. 1935 (AA, TAI); Atun-tze, Wang 70131, Sept. 1935 (AA); Bai-mar-shan, A-tun-tzw, Wang 69505, Sept. 1935 (AA); Shi-gi-tung, Champutung, Wang 67203, Oct. 1935 (AA); ibid., Wang 67149, Oct. 1935 (AA); ibid., Wang 67480, Oct. 1935 (AA); Muli, Kulu, 28° n. lat. & 101° e. long., Yu 14244, 12 Sept. 1937 (AA, BM); Chungtien, Gouzah, Yu 13480, 23 Sept. 1937 (AA); A-tun-tze, Mt. Miyetzimu, Yu 10553, 14 Oct. 1937 (AA, BM); Muli, Wachin, Jin-chang, Yu 14682, 30 Oct. 1937 (AA); Taron-taru Divide, valley of Bucah-wang, Yu 20088, 3 Sept. 1938 (AA); Salwin-Kiukiang Divide, e. of Tehahtu, Yu 20287, 15 Sept. 1938 (AA); ibid., Newanglung, Yu 20754, 18 Oct. (AA); locality not specified, Yu 7402, 1938 (GH); Chungtien plateau, Feng 1710, 19 July 1939 (AA); ne. Likiang, Tzai-koo Snow Mt., Ching 21181, 1 Aug. 1939 (AA); Ganhaitze, sw. Likiang Snow Range, Ching 21111, 6 Aug. 1939 (AA); Likiang Snow Range, Ching 30486, 21 Aug. 1939 (AA); n. flank of Haba Snow Range, Feng 2128, 22 Aug. 1939 (AA); nw. Likiang, Chu-po-kou, Ching 22114,

16 Oct. 1939 (AA); nw. Likiang, Laschiba, Ching 21866, 30 Oct. 1939 (AA); Tsekou, Manberg s.n., no date (K); Menpze, Ta-hec-shan, Henry 11158, 21 Oct. (K, MO, NY); locality not specified, Yu 10267, no date (AA); locality not specified, Yu 10031, no date (AA); locality not specified, Yu 6999, no date (AA); locality not specified, Yu 6908, no date (AA).

INDIA:

KASHMIR: locality not specified, Wallich 4725, no date (P); Kishtvar to the Pir Patsaski or Kishtvar Pass, anon. s.n., 1-4 Aug. 1856 (BM); Srinagar, 34° n. lat. & 75° e. long., Clark 31328, 15 Sept. 1876 (BM); between Kaarsali and Bari, Duthie 727, 1 Sept. 1883 (BM); Liddar Valley, Duthie 25449, 19 Aug. 1901 (K); Gulmarg, Rich 1227, 7 Aug. 1919 (K); ibid., Stewart 10352, July 1929 (NY); Lahul, Koetz 686, 25 July 1930 (NY); locality not specified, Barbour s.n., Aug. 1922 (BM); locality not specified, Barbour s.n., Sept. 1922 (BM); Baramula, 34° n. lat. & 75° e. long., Rich s.n., no date (K); Khelanmarg, Polunin 56/141, 10 Aug. 1956 (BM); ibid., Polunin 56/799, 13 Sept. 1956 (BM, F).

MONGOLIA:

Si Mantze in central Mongolia, Licent 3413, 31 Aug. 1917 (P); vicinity of Ulan-Bator-Khoto (Urga), 47° n. lat. & 105° e. long., Galitzky 284, 5 Aug. 1927 (S); Mts. e. of Kentei, upper reaches of the Hereleng (Kerulen) and Chon Rivers, $44^{\circ} 50'$ n. lat. & 110° e. long., Ikonnikovy 1157, 17 Aug. 1928 (NY).

NEPAL:

Locality not specified, Wallich 4725 (Cat.). 1830 (BR, K);
 Laruni Chiang, Dhaj 34, 17 June 1914 (K); Lamrak, Dhevoj 197, 1929
 (BM); Terra Bence, Dhevoj 0426, 1930 (BM). Schwarzwasserthal der
 Ostlichen Kalkalpen, Tatra Mts., Konigshutte s.n., July 1887 (K, NY);
 Lublin, $50^{\circ} 15' \text{ n. lat. } \& \text{ } 22^{\circ} 40' \text{ e. long.}$, Karo s.n., July 1889 (C);
 Bydgoszcz (Bromberg), Krebs & Wien s.n., 8 July 1895 (S); Kielce,
Drymmer 404, 1895 (S); Bodzentinskoe, $50^{\circ} 55' \text{ n. lat. } \& \text{ } 20^{\circ} 55' \text{ e.}$
 long. , Puring s.n., 5 May 1897 (LE); ibid., Roshler s.n., no date (BR);
 Lubichowo, $53^{\circ} 45' \text{ n. lat. } \& \text{ } 18^{\circ} 25' \text{ e. long.}$, Gross s.n., 1 Aug. 1904
 (US); Pisihnikra, Gross s.n., 4 Aug. 1905 (S); Olsztyn (Allensteiner),
 $53^{\circ} 50' \text{ n. lat. } \& \text{ } 20^{\circ} 30' \text{ e. long.}$, anon. s.n., 3 Aug. 1913 (F);
 Olesno, $50^{\circ} 45' \text{ n. lat. } \& \text{ } 18^{\circ} 20' \text{ e. long.}$, Kuhners s.n., no date (US);
 locality not specified, Steffen s.n., 20 Aug. 1924 (C); locality not
 specified, Huffun s.n., 14 Sept. 1924 (C).

ROMANIA:

Jobsdorf Transsilvania, Bartle s.n., 3 Aug. 1877 (S);
 Transsilvania, $46^{\circ} 30' \text{ n. lat. } \& \text{ } 24^{\circ} \text{ e. long.}$, Barth s.n., 10 July
 1881 (UPS); ibid., Orlahns s.n., July (S).

U.S.S.R.:

UKRAINE REGION: MINSK PROVINCE: In the vicinity of Penki Mt.
 nr. Mozyr, $52^{\circ} \text{ n. lat. } \& \text{ } 29^{\circ} 20' \text{ e. long.}$, Abramovich s.n., 3 Aug.
 1898 (LE). KIYEV PROVINCE: Kiev, anon. s.n., 4 Sept. 1839 (LE); ibid.,
anon. s.n., 26 July 1850 (LE); ibid., $48^{\circ} 33' \text{ n. lat. } \& \text{ } 28^{\circ} 35' \text{ e.}$
 long. , anon. s.n., 27 July 1855 (LE); ibid., anon s.n., 27 July 1856

(LE); Mar'yanovsk, nr. the n. of Koshev, $47^{\circ} 25'$ n. lat. & $30^{\circ} 10'$ e. long., Litvinov s.n., 9 July 1916 (LE). TARNOPOL'SK PROVINCE: Ternopol'sk, Maksimovka Station, $49^{\circ} 32'$ n. lat. & $25^{\circ} 40'$ e. long., Michelson 404, 20 Aug. 1915 (LE).

KRASNOYARSK REGION: TOMSK PROVINCE: in the vicinity of Tomsk, $56^{\circ} 30'$ n. lat. & 85.0° e. long., nr. Basandaika, Krylovyn s.n., 11 Aug. 1885 (LE); nr. Uppid, Krylovyn s.n., 2 July 1888 (NY); nr. Tomsk, anon. s.n., 1909 (S); Mariinskii area, in the vicinity of Krasnorechenskago, $56^{\circ} 10'$ n. lat. & $87^{\circ} 50'$ e. long., Kucherovskaya & Nekrasova s.n., 16 July 1912 (LE); nr. Basandaika, Krylovyn s.n., no date (NY); nr. Tomsk, Klopptov 31, 3 July 1914 (LE). YENISEI PROVINCE: Yeniseysk, $60^{\circ} 10'$ n. lat. & 92° e. long., Marks s.n., 1876 (S, UPS); banks of the Obi, Wyjins s.n., 1877 (K); Yatsouskoi nr. Yeniseysk, Enander s.n., 10 Aug. 1894 (S); Maklakovskaya, 55° n. lat. & 92° e. long., Kuznetsov 116, 20 July 1913 (S); about 20 Km. to the s. of Yeniseysk, in the valley of the Yenisei River, Igoshina s.n., 15 July 1947 (LE); Yenisei, Navo Sjalouskoji, Brenner s.n., no date (S); Central Sayan, Kan River, right tributary of the Yenisei, Krasnoyarsk, $56^{\circ} 30'$ n. lat. & $93^{\circ} 50'$ e. long., Fedorov et al. s.n., 2 Aug. (LE); MINUSINSK PROVINCE: Koibar Mt. 64 Km. of Minusinsk, Krylov s.n., 22 July 1892 (LE); vicinity of Ust'Abaianskogo, Izynch Mt., Smirov s.n., 20 July 1909 (LE); Achinsk to Minusinsk, $56^{\circ} 30'$ n. lat. & 91° e. long., Kuznetsov 454, 12 July 1912 (LE); Achinskii nr. Nikol'skii, $52^{\circ} 30'$ n. lat. & 92° e. long., Turkevich 512, 23 June 1913 (LE); Oirotica nr. Shebalina, 51° n. lat. & 86° e. long.,

Juzesczuk 78, 7 Aug. 1936 (LE); Kansk, $56^{\circ} 15'$ n. lat. & $95^{\circ} 50'$ e. long., Verkhovskaya & Mishin 467, 12 July 1911 (LE); Turukhansk, lower Tunguska River and right bank of the Tutanshana River, $65^{\circ} 50'$ n. lat. & 88° e. long., Rubin & Maskil' 369, 14 July 1932 (LE); ibid., nr. the mouth of the Khurkakit River, Rubin & Maskil' 32, 18 Aug. 1932 (LE).

ALTAY REGION: ALTAY PROVINCE: Altai Mts. Teletsloe Lake, $51^{\circ} 35'$ n. lat. & $87^{\circ} 48'$ e. long., Klopotov 271, 2 Aug. 1908 (LE); Lower Chimon, Vereshchagin s.n., 25 June 1909 (LE); Valley of the Pikhtovka River, Zmeinogorsk, $51^{\circ} 10'$ n. lat. & $82^{\circ} 10'$ e. long., Tomin s.n., 27 July 1910 (LE); locality not specified, Ludwig s.n., no date (GH, K).

IRKUTSK REGION: IRKUTSK PROVINCE: Angara above Tunguska, 52° n. lat. 104° e. long., Czekanowski s.n., 1867 (BM); Sayansk Mts., Tunkinskii, $51^{\circ} 50'$ n. lat. & 102° e. long., Komarov s.n., 26 Aug. 1902 (LE); vicinity of the City of Shcherbakovoi, Balagansk, 54° n. lat. & 103° e. long., Naltsev s.n., 22 July 1907 & 5 Aug. 1907 (LE); nr. Balaganskii, in the valley of the Korda River nr. the Angara River, Ganeshin s.n., 7 July 1909 (LE); Verkholsenskii, 53° n. lat. & 106° e. long., along the Len and Kireng Rivers, Tomin 245, 17 July 1909 (LE); Lietvennichnoe Village on Lake Baikal, Dyachkova s.n., June 1910 (LE); nr. the city of Gromov, Oka-Angarskii area, 54° n. lat. & 102° e. long., anon. s.n., 27 July 1910 (LE); Tutura Village, Aleksandrov 1676, 5 Aug. 1910 (LE); valley of the Chikan River, $54^{\circ} 40'$ n. lat. & 106° e. long., nr. the mouth of the lower Berei, Kuznetsov 1413, 4 Aug. 1910 (LE); Lake Baikal, Kulterev Village, along

the Tunkinskii Mts., $51^{\circ} 50'$ n. lat. & 102° e. long., Sukochev & Poplavskaya 2268a, 17 July 1915 (LE); Vydrino, $55^{\circ} 25'$ n. lat. & 97° e. long., 16 July 1913 (S); Lake Baikal, western shore between 53° n. lat. & 115° e. long., Sukachev & Bryzzhev 1265, 19 July 1928 (LE); ne. shore of Lake Baikal, 53° n. lat. & 108° e. long., at the mouth of the Tarkushok, Tyvlina & Skryabin s.n., 1 Sept. 1956 (LE); Irkutsk, Frisht s.n., no date (NY); Lake Baikal, Irkutsk, anon. s.n., no date (P).

CHITA REGION: AKSHINSKII' PROVINCE: along the Chikoy, 51° n. lat. & $116^{\circ} 35'$ e. long., Stukov 333, 28 July 1903 (LE); along the Chikoy River nr. the mouth of the Burecho, Smirnov 503, 2 July (LE).

YAKUTSK REGION: ALDANSKOYE PROVINCE: valley of the Aldan River, $57^{\circ} 30'$ n. lat. & 125° e. long., vicinity of Petropavlovskie Village at the mouth of the Matskii River, Karavaya s.n., 9 Aug. 1957 (LE).

OLEKMINSKII PROVINCE: Olekminskii, $60^{\circ} 20'$ n. lat. & $120^{\circ} 20'$ e. long., nr. the mouth of the Cherepanikha River, Kyaravyal' s.n., 2 Aug. 1947 (LE); Lena River, 65° n. lat. & 125° e. long., Augwcz s.n., no date (K).

This plant was the first Asian species to be collected and described. It was first discovered in Siberia by Messerschmid near the end of the 17th century. Amman (1739) listed this plant as "Thalictrodes foetissimum Christophoriana facia." Linnaeus (1750) was the first to precisely describe it as Cimicifuga (not the genus at this time) but did not utilize a specific name. This first description was reprinted in Amoenitates Academicae (1751) in an article entitled "Planta Cimicifuga." Linnaeus (1753) assigned this plant to the genus Actaea, calling his plant Actaea Cimicifuga. In 1767 he made Cimicifuga

a genus, giving the plant its presently accepted binomial of Cimicifuga foetida. This is considered to be the type species for the genus.

Genersich (1798) referred to this species as Actaea racemosa, which was Linnaeus' binomial for the North American Cimicifuga racemosa.

Fischer and Meyer (1835) assigned this species to the genus Actinospora (because of its scaly seeds), and Kuntz (1891) assigned it to Thalictrodes.

IX. DISTRIBUTION AND ECOLOGY

Members of the genus Cimicifuga occur in the northern temperate zone of Europe, Asia, and North America. Some species, such as the American C. laciniata, C. arizonica and the Asian C. heracleifolia and C. biternata, are narrowly endemic, while the eastern North American C. racemosa and Eurasian C. foetida have very wide geographical distributions. Even though all these plants seem to grow in rather mesophytic habitats the world over, the distribution of the various species is doubtless determined by variations in tolerances to light intensity, soil pH, temperature, mineral availability, biotic associates, and a host of other environmental factors.

Ecologic information for the North American species comes from the author's field studies, personal communications with other collectors, specimen label data, and the published literature. Less complete information for the Eurasian species comes from the published literature in addition to specimen label data. Soil pH at the different locations visited by the author were determined with a Beckman Model 72 pH meter after 4 grams of soil were mixed with 50 ml. of doubly-distilled water.

In the following discussion the North American taxa are arranged in two groups: (1) Eastern, and (2) Western, and then alphabetically according to species. The ecology and geography of the Eurasian species are discussed last.

The symbols on the distribution maps (Section VIII) are not intended to indicate concentration or frequency of occurrence, and many more would likely be added if many counties and districts were surveyed.

EASTERN NORTH AMERICAN SPECIES

Cimicifuga americana Michx.

This plant has the second widest distribution of the Eastern North American species. It is found from east-central (Northampton County) and southwestern Pennsylvania, southward through Garret County, Maryland, West Virginia, western Virginia and eastern Kentucky, eastern Tennessee, and western North Carolina, to northwestern South Carolina and north central Georgia (Fig. 24, p. 162). In this range it occurs primarily at the higher elevations, extending from about 900 feet along the Cumberland River in Bell County, Kentucky, to about 6400 feet near Clingmans Dome in the Great Smoky Mountains National Park.

The station in Northampton County, Pennsylvania, doubtfully exists today, since it was collected there only once in 1868. Sight records for C. americana have been reported for locations in Kentucky (Braun, 1943). These are not indicated on the distribution map.

This plant is found most abundantly on steep north-facing talus slopes in soil with a high humus content. The slopes are often boulder-strewn. At higher elevations (ca. 6300 ft.) in the Smokies it is found in, and adjacent to, the hardwood gaps in the spruce-fir forests, and at lower elevations it occurs in the dense to partial

shade of the cove hardwoods forest type. All of the sites are rather moist.

Some of the plants associated with C. americana at the higher elevations are: Overstory: Abies fraseri, Picea rubens, Betula alleghaniensis, and Acer spicatum; Ground Cover: Aconitum uncinatum, Clintonia borealis, Oxalis montana, Rubus canadensis, Trillium luteum, Senecio rugelii, and Laportea canadensis.

At the lower elevations some of the common associates are:

Overstory: Tsuga canadensis, Liriodendron tulipifera, Aesulus octandra, Betula alleghaniensis, Quercus borealis, Tilia heterophylla, Halesia carolina, and Fraxinus americana; Ground Cover: Trillium erectum, Trillium grandiflorum, Euonymus americana, Euonymus obovatus, Viola canadensis, Podophyllum peltatum, Caulophyllum thalictroides, Smilacina racemosa, Erythronium americanum, Mitella diphylla, Stellaria pubera, Sedum ternatum, Cimicifuga racemosa, Actaea pachypoda, Allium tricoccum, Uvularia sessilifolia, Rhus radicans, Lycopodium lucidulum, and Polystichum acrosticoides.

The soils along the Appalachians, where this species is most heavily concentrated, are primarily grey-brown podzolic soils with some lithosols. Tests of soil pH (in the Great Smoky National Park) gave 3.8 in the spruce-fir area and 4.8 - 5.1 in the cove hardwood areas.

Cimicifuga racemosa (L.) Nutt.

This was the first North American member of the genus to be

discovered and transported to Europe (Lloyd and Lloyd, 1888). It has the greatest range of the American species. Its range extends from the four eastern most counties of the Niagara Peninsula of southern Ontario, New York, and Massachusetts, southward to South Carolina and central Georgia, and southwestward to southern Illinois, Missouri, and Arkansas. The heaviest concentration appears to be along the Appalachians from Pennsylvania to northern Georgia.

Many sight records have been reported, but only actual specimens examined have been mapped (Fig. 9, p. 62). Deam (1941), concerning the Indiana distribution, states, "Coulter reported it from Kosciusko, Shelby, and Tippecanoe Counties, Higley and Raddin reported it from Pine and Lake Counties, and Schneck reported it from the lower Wabash Valley." Braun (1943) lists it for several Kentucky counties. Soper (1962) reported sight records from Elgin, Waterloo, and Wentworth Counties in southern Ontario and states, "this species is now extremely rare and may possibly be confined to one or two localities in the Niagara Peninsula."

Cimicifuga racemosa has been collected in cultivation in a number of states, two of which will be mentioned. J. C. Parlin collected it in 1899 in an orchard in North Berwick, York County, Maine (GH, NEBC). Perkins collected it in the same county and city near Bauneg Beg Pond in 1953, and she states, "perhaps originally planted (NEBC)." Moldenke collected it in cultivation in 1937 at Jamaica, Windham County, Vermont (BM, BR, ILL, MO, NY). These cultivated or possibly cultivated plants have not been mapped.

One specimen with the following label data was examined:

Florida, Archibald Mettner, 1829. Specific location data were not given. This specimen is preserved in the United States National Herbarium. Cimicifuga racemosa is not known in Florida today.

Many manuals give Michigan and Wisconsin as being within the range of this species, but no specimens from those states have been encountered in this study, and it is doubtful that it grows there today.

Although C. racemosa occupies many kinds of sites it is found most abundantly on north-facing slopes throughout its range. However, it is not unusual to find it in more open and drier situations than those of the other two eastern species.

Cimicifuga racemosa is always associated with C. rubifolia. It is associated also with C. americana, except at elevations above 5000 feet. Plants growing with C. racemosa are very similar to those associated with the other two eastern American species (C. americana at lower elevations).

This species is found on soils produced from a great number of rock types, including limestone, sandstone, conglomerates, shale, shists, gneisses, and granite. It grows in soils ranging from sandy to those having a high clay or humus content. Soil pH ranges from 4.8 to 6.7.

Cimicifuga rubifolia Kearney

Upon the initiation of this study in 1962, Cimicifuga rubifolia was known only from Anderson, Hamblen, and Knox Counties in Tennessee.

During the past three years it has been found in ten additional counties, namely: Claiborne, Grainger, Hancock, Hawkins, Jefferson, Loudon, Meigs, Montgomery, Roan, and Sullivan Counties. It is found in a total of 37 locations in Tennessee. It was found in Scott County, Virginia, in June of 1963 (Ramsey, 1964). In Virginia, it is rather abundant from the Tennessee-Virginia State Line along the Clinch River as far north as Clinchport, and also on the north fork of the Holston River south of Gate City. All of the counties named, with the exception of Montgomery County, are in the Ridge and Valley Province (Fenneman, 1938).

In 1951 Bailey and Swayne reported it from Pope County, in southern Illinois, under the name of Cimicifuga racemosa var. cordifolia (No. 1135, at ILL. and SIU.). This collection in addition to several others from southern Illinois, with the same name or the name Cimicifuga cordifolia, have been studied and identified as C. rubifolia Kearney. Since 1951 it has been collected in Johnson County (Fern Clyffe, Mohlenbrock et al. 2832, 15 June 1954, SIU) and Gallatin County (Grindstaff Hollow, Mohlenbrock 4367, 27 July 1954, SIU). Thus, Cimicifuga rubifolia is found in the Ridge and Valley Province in Tennessee and Virginia and has disjunct populations in southern Illinois and Montgomery County, Tennessee (Fig. 19, p. 140).

This interesting plant is found on north-facing, limestone talus slopes along the Clinch, Holston, Powell, and Tennessee Rivers in Tennessee, and the Clinch and North Fork of the Holston in Virginia. In only three locations has it been found away from river slopes along

rivers in Tennessee, and then on calcareous shale. In southern Illinois it grows on sandstone-limestone in rather deep ravines. The elevations for these locations range from about 950 feet along the Clinch River in Tennessee and at Belle Smith Springs in Illinois, to 1600 feet on Clinch Mountain, in Hawkins County, Tennessee.

Some of the common plant associates of C. rubifolia are:

Overstory: Tilia heterophylla, Liriodendron tulipifera, Dirca palustris, Acer saccharum, Acer rubrum, Geltis occidentalis, Liquidambar styraciflua; Ground Cover: Impatiens capensis, Actaea pachypoda, Astilbe biternata, Lactuca canadensis, Ptilimnium capillaceum, Cimicifuga racemosa (never C. americana), Polygonatum biflorum, Heuchera americana, Sedum ternatum, Tiarella cordifolia, Stellaria pubera, Anemone canadensis, Lindera benzoin, Sanguinaria canadensis, Phacelia bipinnatifida, Trautvetteria carolinensis, Hepatica acutiloba, Erythronium americanum, and Camptosorus rhizophyllus.

Cimicifuga rubifolia may have a relatively high calcium requirement for it is found only on limestone and calcareous shale. The soils in which it grows generally have a high humus and boulder content. Soil tests show a pH range of 6.2 to 6.7.

WESTERN NORTH AMERICAN SPECIES

Cimicifuga arizonica Wats.

This species is endemic to Coconino and Gila Counties of Arizona (Fig. 22, p. 155). It is known only from three locations, two of which are in Coconino County (Bill Williams Mountain and

upper Oak Creek Canyon) and the third in Gila County (Workman Creek Falls in the Sierra Ancha Mountains). The first two locations are separated by approximately 40 air miles, these being approximately 130 air miles north of the population in the Sierra Ancha. The more northern Arizona populations are separated from the nearest northwestern United States populations of Cimicifuga elata by approximately 750 air miles.

Cimicifuga arizonica is found at elevations between 5500 feet and 7000 feet. All sites are in rather deep shade with moist, rich, sandy soils with varying humus and boulder content.

The author's collections were made on July 27, 1964, at the upper Oak Creek Canyon location, and were apparently the first collections of the plant in sixteen years. The elevation for this population is about 5800 feet. The habitat is riparian, at the base of a northwest facing slope. On the basis of the number of leaves and flower stalks observed, an estimated 35 to 40 rhizomes were present. Nine complete plants were collected, and these along with plants sent to the author, herbarium specimens, and his own field observations served as the basis for his description and comments on this entity. Tests of soil samples indicate a pH of 6.7 to 7.0.

Some plants associated with Cimicifuga arizonica in this rather closed mesophytic woods of upper Oak Creek Canyon are: Overstory: Acer negundo var. interius, Alnus oblongifolia, Alnus tenuifolia, Juglans major var. arizonica, Platanus wrightii, Pseudotsuga menziesii; Ground Cover: Aquilegia chrysantha, Galium sp., Monarda menthaefolia,

Osmorhiza nuda, Parthenocissus vitacea, Pteridium aquilinum, Rhus radicans, and Thalictrum fendleri. The visible vegetation on the drier slopes above this wooded canyon bottom includes various scrub species of Quercus, Pinus ponderosa, Cercocarpus sp., scattered Agave parryi, and other desert and chaparral species.

Charles P. Pase, Research Forester at the Forest Hydrology Laboratory of Arizona State University, Tempe, collected specimens of C. arizonica for the author from the Workman Creek Falls area on September 10, 1964. He reports (personal communication, 1964):

The plants were quite large, up to four feet tall. Only a few flowering racemes were observed, and these were collected. The only colony of Cimicifuga arizonica known in the Sierra Ancha is at the foot of Workman Creek Falls, S32, T6NR14E, Gila and Salt River Meridian. They make up a pure stand about one acre in extent, on deep rich soil on a 50% north slope at the bottom of Workman Creek Canyon. The elevation is about 6,500 feet.

The overstory vegetation in the area is Acer grandidentatum, with the surrounding forest of Abies concolor, with Alnus oblongifolia also common along the stream.

The associated understory vegetation, mostly surrounding the colony, consists of the following species: Agrimonia striata, Smilacina racemosa, Thalictrum fendleri, and Woodsia mexicana. Glyceria striata, Glyceria sp., Equisetum arvense, Viola canadensis, and Ranunculus sp. are common along the water's edge.

Cimicifuga elata Nutt.

This rather tall plant has a more extensive range than the other western North American species. It occurs from the Chilliwack River in southern New Westminster County, British Columbia, which is its northernmost known station, southward through Clallam and King

Counties, Washington, to Douglas County in southwestern Oregon. It occupies a variety of habitats from the western Cascades westward. However, it is found primarily in the Coast Ranges (Fig. 13, p. 110). The author has not seen it reported from British Columbia (CAN, UBC) nor Douglas County (OSC) previously. Thus, its distribution has been extended north and south of its previously published range.

Habitats (where Cimicifuga elata may occur) other than those listed on page 108 are: open rocky creek bottoms, coniferous woods, moist clay banks, and brushy logged-off lands, in the humid transition and Canadian zones (Abrams, 1940). Its range in elevation is from 200 feet at Satsop, Washington, to 3000 feet in Westminister County, British Columbia.

At Cape Horn, in Skamania County, Washington, it is found in a Douglas-Fir Forest Formation associated with Pseudotsuga taxifolia, Acer macrophylla, Acer circinatum, Alnus rubra, and Rubus parviflorus, on a south exposure in rather shady and rocky soil at an elevation of 600 feet (from herbarium labels).

On the McKenzie River, at Coburg Bridge, in Lane County, Oregon, it is also found in a Douglas-Fir Forest Formation (lower Montane) associated with Pseudotsuga taxifolia, Osmaronia cerasiformis, and Lupinus rivularia, on an eastern exposure in partial shade at the forest margin in loamy soil, at an elevation of 420 feet (from herbarium labels).

The author's own collections were made on August 6, 1964, on a partially shaded roadside bank and moist wooded slope between Corbett

and Corbett Station, Oregon, and also on a moist roadside forest margin 2.8 miles east of Bridal Veil, Oregon. Both locations are on the south side of the Columbia River Gorge, of Multnomah County. At the latter location, the stems and racemes were protruding out over the bank from dense bushy roadside growth.

Some plants associated with Cimicifuga elata at these locations are: Overstory: Acer macrophyllum, Alnus rubra, Cornus nuttallii, Salix sp., and Sambucus glauca; Ground Cover: Achillea millefolium, Actaea sp., Disporum sp., Equisetum arvense, Galium sp., Heracleum lanatum, Holodiscus discolor, Montia siberica, Phacelia heterophylla, Polypodium vulgare, Polystichum munitum, Pteridium aquilinum, Rubus parviflorus and Symphoricarpos alba.

The rocks of this area are basaltic. The soils in the range of Cimicifuga elata would generally be classed as grey-brown and red and yellow podzols. The soil samples which were obtained in the Columbia River Gorge had a pH of 5.9.

Cimicifuga laciniata Wats.

This rare plant was known only from Lost Lake, Mount Hood, in the Cascade Range, Hood River County, Oregon, until J. William Thompson (WTU), collected it near Mirror Lake in the more western and adjacent Clackamas County. More recently, Carl S. English (1929), reported it from Multnomah County. English writes:

This rare plant, otherwise known only from Lost Lake, Mount Hood, was found along a stream bank of Larch Mountain three miles from the Columbia River Highway above Multnomah Falls.

The date of English's collection is reported as August 25, 1929, number 1587. This collection has not been observed even though the author has visited or borrowed material from the larger western herbaria. Therefore, the distribution map (Fig. 26, p. 175) of Cimicifuga laciniata will not show Multnomah County as being within its range, even though this possibility strongly exists.

The author's collections of Cimicifuga laciniata were made at the original type locality, Lost Lake, Mount Hood, on August 8, 1964. Lost Lake is located at the northwestern base of Mount Hood at an elevation of 3140 feet. The vegetational types, in general, would be included in the Canadian Zone of Merriam (1894).

The plants collected were growing in moist soil, rich in humus and leaf mold in open to rather shaded Tsuga-Pseudotsuga-Abies woods. Several species of broadleaf shrubs and trees grew in the more lighted forest areas and along the lake margin. Cimicifuga grew six feet and further back of the shoreline. A portion of the area is a boggy, sub-wooded flat, behind which is a north facing wooded slope. Soil samples had a pH of 5.0.

Some plants associated with Cimicifuga laciniata in this location are: Overstory: Abies sp., Pseudotsuga taxifolia, Tsuga heterophylla, Alnus tenuifolia. Ground Cover: Achlys triphylla, Cornus canadensis, Heracleum lanatum, Mimulus sp., Mitella caulescens, Ribes sp., Rubus parviflorus and Smilacina racemosa.

Lost Lake and Mirror Lake are separated by approximately 15 air miles, the latter being near the southwest base of Mount Hood.

Herbarium labels indicate that this plant is found along moist cliffs near Mirror Lake, and on the edge of a Sphagnum bog on the Toney Creek Trail to Eden Park, in Clackamas County. The elevations for these two locations are 4000 and 5000 feet respectively.

EURASIAN SPECIES

Cimicifuga biternata (Sieb. et Zucc.) Miq.

This species is endemic to Japan and Cheju (Quelpart) Island off the southern coast of South Korea (Fig. 17, p. 130). Specimens only from Honshu Island in Japan have been examined, although, it has been reported from Shikoku and Kyushu. On Honshu it is found from Chiba, Tokyo, and Kanagawa Prefectures westward through Shizuoka, Yamanashi, Aichi, Gifu, and Kyoto Prefectures to Okayama. All of these prefectures, or locations within them, are on the Pacific climatic side of the island. The range of this species conforms to the Distribution Type II-A of Hara (1959). A specific locality for the specimen collected on Cheju Island of Korea by Smith in 1934 is not given.

Cimicifuga biternata is found in a great number of habitats throughout its range, some of them being: along streams, in grassy woods, in deciduous, needle-leaved, and mixed forest types, and even rather dry, open fields and mountain slopes. It is concentrated primarily in the Kanto and western Japan Floral Regions of Hara (1959). This species grows at elevations usually between 720 and 1700 feet.

Cimicifuga dahurica (Turcz.) Maxim.

The range of Cimicifuga dahurica (Fig. 30, p. 186) extends from

Heilungkiang, Kirin, and Liaoning Provinces of northeastern China (Manchuria) southward through Hopeh, Hupeh, and Shansi Provinces to Szechwan and also westward to Kansu Province. In eastern Siberia this plant is found from the Transbaikal region eastward to the Amur and Khabarovsk Regions then southward throughout the maritime provinces to Vladivostok. This species was collected by David in 1864 and again by Licent in 1917 in central and eastern Mongolia. Neither gave a specific locality for their collections. It has also been reported from Japan, but no specimens of this species collected there have been examined.

Cimicifuga dahurica grows along forest margins, in undergrowths along streams, in woods and drier habitats of valley meadows. It is often associated with pine-Rhododendron and birch forests. River terraces and moist open-grounds are also places in which to search for species. This Cimicifuga grows at elevations ranging from 1500 feet in Kirin Province to about 7000 feet in Shansi Province of China.

Cimicifuga foetida L.

This plant has the most extensive range of all the species of Cimicifuga, being found from Germany to the Yakutsk Region of eastern Siberia and into south China, a total distance of about 4500 miles (Fig. 34, p. 208). This is truly a remarkable range for a species. In Europe this plant is also found in Poland, Czechoslovakia, Hungary, Romania, and the Ukraine Region of the Soviet Union. In Siberia it is found from the vicinity of the Ob and Yenisei Rivers and the Altay Region of the west to the Amur and Yakutsk Regions in the east. From central Mongolia it extends to the Shansi and Shensi Provinces of

eastern China southward into Yunnan and Szechwan Provinces and Tibet. It is also found in the Adung Valley of northern Burma, the Kashmir Province of northern India, and along the Himalayas of Bhutan, Sikkim, and Nepal.

Within the great range of this species one would expect to find great variation in ecological conditions. Besides being found in very moist situations, such as in swamps, on wet meadows and stream-banks, and in deep shade of deciduous forests, it is found on well drained gravel soils, rocky or grassy mountain slopes, and on open shrubby hillsides. Cimicifuga foetida is often located in pine, spruce-cedar-fir, and birch forests. Some herbaceous genera frequently associated with C. foetida are: Actaea, Aruncus, Astilbe, Caltha, Rodgersia, Spiraea, and other species of Cimicifuga.

This plant grows at elevations ranging from about 2000 feet in Czechoslovakia to about 15,000 feet in the Himalayas of Nepal.

Cimicifuga foetida is similar to C. americana and C. laciniata of North America in that it is frequently found in moist acid soils of gymnospermous forests at higher elevations.

Cimicifuga heracleifolia Kom.

This is a rather narrowly endemic species, being distributed in northeastern China and in the Suyifunskii and Khankaiskii Regions of the eastern maritime province of the Soviet Union (Fig. 28, p. 181). These locations are found within a radius of about 500 miles. In China, the range of the species extends from Tientsin in Hopeh Province to the Liaotung peninsular in the Liaoning Province. Both locations

are near the Gulf of Chihli. In the maritime provinces of Russia, it is found near Lake Kaanka and also in the valley of the Suyifun River. It is reported from Japan and Korea but no specimens from these areas have been examined.

Cimicifuga heracleifolia is commonly found in drier habitats, such as on rocky slopes and often in completely open places or among sparse undergrowths of Corylus and Lespedeza.

Cimicifuga japonica (Thunb.) Sprengel

Cimicifuga japonica is restricted to southeastern Asia being found in Japan, Cheju (Quelpart) Island of Korea, and China (Fig. 15, p. 120). In Japan this species is found from Aomori Prefecture, the extreme northern prefecture of Honshu, southward primarily along the Pacific side of the island through Iwate to Kanagawa Prefecture then westward through Gifu to Hiroshima and Shimane Prefectures. On Shikoku, it is found in Kochi Prefecture, and on Kyushu it has been collected in all prefectures. Thus, its range in Japan conforms to the Distribution Type I of Hara (1959), but the species is not found in Hokkaido. Specific location data are not given for the specimen collected by Faurie on Cheju Island in Korea. In China Cimicifuga japonica ranges from Shansi Province southward through Hupeh to Szechwan, Kweichow, and Yunnan Provinces.

This plant is found in the shade of moist, deciduous forests, in ravines, on mountain slopes, cliffs, and may also grow in the partially shaded areas of forest margins, openings, and even in loam

soil of Miscanthus grasslands. It is commonly associated with soils produced from limestone, and grows between elevations of 800 and 6300 feet.

Some genera which grow with Cimicifuga japonica in the Fagus zone (800-1200 m.) of the mountain districts in the Kanto Floral District of Hara (1959) are: overstory: Fagus, Quercus, Carpinus, Betula, Ulmus, Acer, Fraxinus, Juglans, Corylus, Rhamnus, and Euonymus; groundcover: Thalictrum, Caulophyllum, Asarum, Smilicina, Trillium, Dryopteris, and Rodgersia.

Cimicifuga simplex Wormsk.

The range of this Cimicifuga is second greatest of the Asian species (Fig. 32, p. 195). It was first collected in the 1830's on the peninsula of Kamchatka and since has been collected in Japan, China, Korea, Siberia, and on the Island of Sakhalin. In Japan, it is found from Kitami Province on Hokkaido southward throughout Honshu to Ehime and Kochi Prefectures on Shikoku and to Miyazaki Prefecture in southeastern Kyushu. In China, C. simplex extends from Heilungkiang, Kirin, and Liaoling Provinces of the northeast (Manchuria) southwestward through Hupeh and Shensi to Szechwan and Kweichow Provinces. In eastern Siberia this plant is found from Lake Baikal eastward through the Amur and Khabarovsk Regions southward throughout the maritime provinces to Ussuriskii and Vladivostok and into Korea. Specimens that were collected from locations throughout the Island of Sakhalin and from Shikotan Island in the Kurils also have been examined.

This plant grows primarily in very moist habitats. Some of the

habitats are: valley meadows along streams, moist slopes, grassy marshes, marshy meadows, mixed forests of narrow stream valleys, hummocks on peat-bog soil, wooded swamps, deep shade of deciduous forests, and partial shade of mixed forests. In more northern latitudes it is often found in spruce-fir type forests and also in birch forests. Komarov (1929) states,¹ concerning the habitat of Cimicifuga simplex on Kamchatka,

adapted almost exclusively to woods of stony birches (Betula ermani), where it grows everywhere. It was seen only once outside of birch woods. This area corresponds to a region of sub-alpine woods.

Cimicifuga simplex grows at elevations ranging from about 1800 feet in the Niigata Prefecture of west central Honshu in Japan to about 6500 feet in Szechwan Province of China.

Cimicifuga simplex appears to be best adapted to wet habitats similar to those of C. laciniata of northwestern North America, which grows only in swampy, boggy, sub-wooded flats, of the Canadian or lower sub-alpine zone.

¹Translated by Mr. Earl Keel, student in the Department of Germanic and Slavic Languages, The University of Tennessee.

X. DISCUSSION

Huth's study (1892) is the only world-wide revision of Cimicifuga. His revision recognizes eight species, seven varieties, and three formae. Included is Cimicifuga cordifolia Pursh, which in the present work is treated as synonymous with C. americana Michx. Pursh's description of C. cordifolia fits that of C. americana and Michaux's binomial is given as a synonym. Huth also treated C. simplex as a variety of C. foetida with three forms based on the presence of perfect or imperfect flowers. In the present work C. simplex is regarded as a distinct species and the formae have been discarded because of their apparent insignificance. All species possessing one pistil and non-scaly seeds were placed by Huth in the section Eucimicifuga. Placed in this section are the Japanese species with cordate leaflets, C. biternata and C. japonica, the latter including the varieties, acerina and obtusiloba. These varieties, as well as other varieties treated by Huth, have been reduced to synonymy in the present study.

Finet and Gagnepain (1904) listed Cimicifuga foetida var. velutina in their treatment of Cimicifuga. This taxon was described as having leaflets which were tomentose on the lower surface. Several specimens which fit this description have been examined. However, the type of pubescence observed in these few specimens is believed to be within the normal range of variation for the species, and not significant enough to give these plants varietal status. In the same work

C. dahurica Huth and C. calthaeifolia Maxim. were recognized. The first binomial was given the wrong authorship, which should have been (Turczaninow) Maximowicz, and the latter species is now assigned to the genus Beesia. Cimicifuga simplex was treated as a variety of Cimicifuga foetida, but because of its distinctive characteristics is treated here as a separate species.

Koidzumi (1930) recognized C. chinensis, C. macrophylla, C. acerina, C. peltata, and C. japonica. Hara (1943) reduced C. macrophylla and C. peltata to varieties of C. acerina. C. chinensis is considered here to be synonymous with C. japonica since specimens from both China and Japan have leaflets which are glabrous on the upper surface with the exception of a narrow zone of pubescence near their margins, as well as having other characteristics which always accompany this pubescence pattern as pointed out in the Systematic Treatment (Section VIII).

Komarov (1937) split C. europaea out of C. foetida, primarily on the basis of difference in pubescence on the inflorescence axis and bract shape. No consistent differences in these characteristics between the European and Asian specimens can be noted; thus, C. europaea is considered here to be synonymous with C. foetida. With the exception of this one interpretation the taxonomic treatment of other Asian species in this paper is in agreement with that of Komarov.

Hara's study (1943) is the only intensive treatment of the Japanese Cimicifuga with cordate leaflets. He recognized two species which are composed of six varieties. C. biternata (Sieb. et Zucc.)

Miq. is treated as synonymous with C. japonica (Thunb.) Spreng., and he follows Koidzumi (1930) by recognizing C. acerina as a good species. Observations in the present study indicate that Hara's interpretations of C. acerina and C. japonica may be incorrect (see discussions in the Systematic Treatments of Section VIII).

Leaflet-size and-shape in C. japonica and C. biternata are highly variable. Hara (1943) may be correct in assigning varietal status to several leaflet forms, however, observations in this study suggest that it may be sufficient to discuss these variations without assigning them to a subspecific taxon, since the boundaries for the "varieties" are not clear.

Makino's Illustrated Flora of Japan, which was rewritten by H. Hara, F. Maekawa, and T. Tuyama (1963), lists only C. biternata, C. japonica, and C. simplex, as members of the genus now growing in Japan, and does not recognize the varieties and forms as listed in earlier works.

In the present study, morphological, ecological, and distributional comparisons between the species of the genus Cimicifuga make certain close affinities evident. C. racemosa and C. elata of North America are closely related to C. biternata and C. japonica of east Asia by having scaleless seeds and single pistils. However, the Asian species are easily distinguished from the North American species by having sessile flowers and efoliate aerial stems. C. rubifolia also seems to be closely allied to C. biternata and C. japonica since it possesses a single pistil with broad stigma, ternate-biternate leaves,

leaf variations, cordate leaflets, and three bracts subtending the pedicels. It can be distinguished from the Japanese species of Cimicifuga by its scaly, cylindrical seeds, absence of staminodes, longer fruits, and lack of the definite pubescence pattern on the upper surface of the leaflets.

The Japanese Cimicifuga with cordate leaflets can be separated by consistent combinations of characteristics. C. biternata is distinguished by the arrangement of strigose hairs along the veins of the upper surface of the leaflets; short stipitate pistils with a short style; leaflets with acute tips; and leaves which are usually biternate. C. japonica, on the other hand, possesses a striking, narrow zone of marginal pubescence on the upper surface of the leaflets with the remaining surface area glabrous; acuminate-caudate leaflet lobes; long-stipitate pistils with a long style; and leaves which are usually ternate. The sessile flowers, efoliate stems, definite pattern of pubescence on the leaflets, differently shaped staminodia and fruits, and smaller, lunate, smooth seeds, make these two species distinct from each other as well as from all other members of the genus.

It appears that the species of Cimicifuga in eastern North America have counterparts in the west. C. laciniata of Oregon seems to be very closely allied to C. americana of the Appalachians since it possesses similarly shaped leaflets; stipitate pistils with minute stigmas; obovate fruits; flattened, scaly seeds; and similar staminodes. However, C. laciniata is distinguished from the eastern species by the absence of bracts upon the pedicels; tomentose ovaries (glabrous in C.

americana), more open inflorescence; leaflets which are more laciniately cleft; and persistent staminodes.

Presumably Cimicifuga laciniata is also closely related to C. foetida and C. simplex of eastern Asia since it possesses three to five pubescent, stipitate pistils with minute stigmas, and flattened, scaly seeds. Its staminodes, fruits, and seeds, are almost identical to those of C. simplex; however, its bracts are different in number and shape, the inflorescence is more open, and the terminal leaflets larger, subcuneate, and laciniately cleft.

Cimicifuga elata of the northwest is similar to C. rubifolia of the east in having deeply cordate terminal leaflets and biternate leaves, oblong fruits, sessile pistils, no staminodes, and foliate stems. The western species is sufficiently distinguished from the eastern by its verrucose or wrinkled instead of scaly seeds, and the common occurrence of two pistils per flower on the lower portion of the raceme.

Cimicifuga arizonica most closely resembles C. racemosa in habit, but has scaly, cylindrical seeds; oblong, sessile fruits; and biternate leaves similar to those of C. rubifolia. The flower of C. arizonica can be distinguished from that of C. racemosa and rubifolia by its two pistils, uncinat styles, minute stigmas, differently shaped staminodes, and number and shape of bracts subtending the pedicel.

Cimicifuga heracleifolia resembles C. foetida in having similar habit, number of pistils, and stipes. It is different from C. foetida

in having glabrous pistils with short styles, and spatulate, whole staminodes which do not possess nectariferous areas. The terminal leaflets of C. heracleifolia are completely glabrous and possess four to five prominent veins arising basally, while in C. foetida the terminal leaflets have only three prominent veins.

In habit, seed type, fruit, and shape of terminal leaflet, C. dahurica appears to be very closely related to C. foetida but is distinct from it by having smaller, deeply bifid staminodes which do not possess nectariferous areas, and a more branching inflorescence. There are always three bracts subtending the pedicel and the pistils are nearly glabrous. The seeds and fruits while always smaller than those of C. foetida, are otherwise similar. C. dahurica is different from all other species in having perfect flowers with a high degree of sterility. If fertile stamens are present the pistil is rudimentary. On the other hand, if fertile pistils exist the stamens are absent or possess aborted anthers. This may represent a tendency toward reduction, thus, specialization.

Cimicifuga simplex is also closely allied to C. foetida in possessing pubescent, stipitate pistils with minute stigmas, and foliage which is in many cases nearly indistinguishable. However, C. simplex is clearly differentiated from C. foetida, by having longer stipes, two short, rounded bracts subtending the pedicel, strongly spatulate filaments, bifid staminodes, the lobes of which are not strongly antheroid, and an inflorescence that is usually a simple or scarcely branching raceme.

Cimicifuga foetida is highly polymorphic, however, it is distinct from the other species on the basis of a consistent combination of characteristics. Even though the staminodes are usually urceolate with large antheroid lobes, they may occasionally resemble those of C. dahurica by being deeply cleft. This is true especially for many specimens collected in the Himalayas, and moreover, leaflets of some specimens from the Himalayas are frequently small and "Actaea-like." Fruits of this species collected in Kashmir are extremely enlarged and stems have been reported to reach ten to twelve feet in height. Specimens with these atypical characteristics should be studied further.

Even with a very good understanding of geographical and morphological relationships, it is extremely difficult to postulate centers of origin and distribution, and phylogenetic relationships.

Cain (1943) in discussing the Tertiary character of the cove hardwoods forest of the Great Smoky Mountains, includes Cimicifuga as a genus whose migration occurred mainly in pre-pleistocene times. Since members of the genus are associated with and primarily adapted as groundcover elements in the mesophytic forest on three continents, and inasmuch as they are also associated with some of the oldest known genera in unglaciated and otherwise undisturbed areas, it is assumed that Cimicifuga became widespread in the "Arcto-Tertiary" forest of the northern hemisphere. Li (1952) states,

Geological changes, including mountain elevations, submergence, climatic variations, glaciation, etc., have destroyed and changed the floras of many lands so that this mesophytic forest of the Tertiary in the northern hemisphere survives mainly in eastern Asia and eastern North America

with only scattered relics in southeastern Europe, western Asia, and western North America.

The presence of Cimicifuga simplex on Kamchatka and C. elata in southern British Columbia probably represent the remainder, or at least the descendants of Cimicifuga types which may have been found in the mesophytic forests which once existed in the Bering Sea area and across the northern hemisphere.

Both C. biternata and C. japonica are found on Cheju Island in Korea as well as in Japan. The range of the latter extends into China. Hara (1959) indicates that many species show the close relationship between the floras of western Japan and those of Korea, Manchuria or China. It is assumed that these species were spread to western Japan from Korea in the late Pliocene, when this region was connected with Korea through a land bridge including Tsushima Island. This theory could be used to explain the present distribution of C. biternata and C. japonica.

Several species of Cimicifuga are never found in areas which were once glaciated, C. rubifolia and C. arizonica being examples. C. racemosa, C. foetida, and C. simplex have evidently reinvaded several glaciated areas after the recession of glaciers. C. foetida has not been collected in the expanse from the Ob to the Dnieper Rivers. According to Komarov (1937) such a wide disjunction may be explained only by the occupation of an ice sheet, which destroyed for a long period of time the wooded vegetation and its associates.

Karyotype investigations have not been extensive enough to help

resolve the phylogenetic relationships within the genus. Cytotaxonomic relationships between the eastern Asian species are being studied presently by a Japanese student of Hiroshi Hara. Investigations on karyotype analyses and studies of phylogenetic relationships for the North American species of Cimicifuga are planned for the future.

Cimicifuga racemosa is nearly always found growing with C. rubifolia and C. americana, except at higher elevations. C. racemosa flowers during the summer while the other two species mentioned flower in the fall. Even though the latter two are fall flowering they are not sympatric. Thus, C. rubifolia is reproductively isolated from the other two eastern North American species either by difference in flowering time or geography. Observations suggest that similar circumstances exist between species in Asia.

XI. SUMMARY

A biosystematic study of the genus Cimicifuga has been made on a world-wide basis. Herbarium specimens of all species and field populations of all North American species have been studied in an attempt to distinguish the biotypes within the genus. Comparisons between the North American and Eurasian species have been made by using several techniques which utilize taxonomic, phytogeographic, ecologic, biometric, and gross morphologic data.

The results of the study indicate that this genus is composed of thirteen taxonomic entities. In North America there are seven taxa including six species and one forma. These are distributed into three western (C. arizonica, C. elata, and C. laciniata) and three eastern species (C. americana, C. racemosa, and C. rubifolia). C. rubifolia stands apart from the other eastern North American species by having three to nine (rarely more) leaflets; deeply cordate terminal leaflets which possess five to nine prominent, basally arising veins; three bracts subtending the pedicel; oblong fruits; scaly seeds which are cylindrical in outline; and no staminodes.

Cimicifuga cordifolia Pursh is treated as synonymous with C. americana Michx. C. racemosa (L.) Nutt. var. cordifolia (Pursh) Gray is treated as an unusually robust form of C. racemosa, which has no taxonomic significance. Cimicifuga racemosa (L.) Nutt. forma dissecta (Gray) Fernald is probably of little taxonomic significance.

In Eurasia there are six species (C. biternata, C. dahurica, C. foetida, C. heracleifolia, C. japonica, and C. simplex), only one of which, C. foetida, extends to eastern Europe.

Geographic distributions for the biotypes are quite distinct. Cimicifuga arizonica, C. laciniata, C. rubifolia, and C. heracleifolia are narrowly endemic while C. racemosa and C. foetida have the most extensive ranges. Even though Cimicifuga species, in general, occupy many habitats, several species appear to be restricted to certain substrates or moisture regimes. C. laciniata grows only in swampy, boggy, low-ground and C. rubifolia is found only on soils over calcareous rock. Species of the genus are found within the north temperate zone of Europe, Asia, and North America between elevations of 420 and 15,000 feet. C. foetida has been collected from about 25° to 65° north latitude.

The known ranges of several species have been greatly extended. C. elata is found in southern British Columbia and also in Lane and Douglas Counties in Oregon. C. rubifolia is now known from twelve counties of Tennessee instead of three, one county in Virginia, and three counties of southern Illinois.

A two-factorial analysis of variance on twelve hundred observations of anatomical, terminal leaflet characteristics, coupled with a Duncan's Multiple Range Test indicate a significant difference between several North American species for mean stomatal lengths and mean numbers of stomata per 0.1 mm.² The stomatal apparatus of C. laciniata is significantly longer than that of other species. Stomates of C.

americana and C. elata are not significantly different from each other but are distinguishable from the remaining species. C. rubifolia can be distinguished from C. americana but not from C. racemosa on the basis of this analysis.

Cimicifuga rubifolia has the greatest number of stomata per 0.1 mm.² of all North American species but the number is not significantly different from C. arizonica. Cimicifuga elata and C. racemosa show no significant differences in number of stomata as is true, also, for C. laciniata and C. americana. On the basis of this analysis C. rubifolia can be distinguished from both C. americana and C. racemosa with which it is often confused.

Results of linear measurements suggest that C. rubifolia can be distinguished from C. americana and C. racemosa on the basis of basal sinus depth and size of terminal leaflet, which is in direct correlation with its shape.

Initial measurements indicate that the North American Cimicifuga possess pollen grains measuring 19.0 - 28.6 μ in diameter. C. rubifolia has consistently smaller grains averaging 21 μ or less. Those of the remaining species most commonly measure 25 - 27 μ .

The occurrence of differences in xylem patterns in root X-sections of the eastern species of North American Cimicifuga suggest the possibility of distinguishing several species on the basis of anatomical characteristics.

All entities which have been studied cytologically have a chromosome count of $2n = 16$, and are always diploid, there being no

evidence of polyploidy in the group. Chromosomal counts for C. elata and C. rubifolia are reported for the first time.

Because Cimicifuga is frequently confused with Actaea, Aruncus, and Astilbe, when only vegetative structures are present, a table comparing and contrasting the subtle morphological features existing between these genera has been prepared.

Illustrations of morphological characteristics which are most useful in distinguishing the species of Cimicifuga have been drawn and serve as reference points for discussions and comparisons made between the Eurasian and North American species.

A key to the taxa has been devised on the basis of morphological relationships. In several places future research has been proposed.

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APPENDIX

TABLE V.

LENGTHS OF STOMATAL APPARATUS FOR THE NORTH AMERICAN CIMICIFUGA^a

Peel											
<u>Cimicifuga americana</u>											
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	
1	57.0	43.2	46.2	45.0	49.8	57.0	54.0	38.4	43.2	48.0	
2	55.2	54.0	48.0	39.0	45.0	43.2	46.8	52.2	48.0	42.0	
3	63.0	56.8	45.0	48.0	46.2	42.0	45.0	46.2	40.2	46.8	
4	51.0	45.0	45.6	46.8	58.8	44.4	46.2	42.0	46.2	48.0	
5	39.6	46.2	49.8	45.0	46.2	56.4	49.2	45.6	36.0	51.6	
6	48.0	55.2	46.8	49.2	45.0	52.2	43.2	44.4	45.0	53.4	
7	46.8	54.0	51.0	43.2	36.0	45.0	49.8	52.8	46.8	48.0	
8	38.4	45.0	48.0	52.8	47.4	48.0	51.0	48.6	48.6	45.6	
9	45.0	48.6	49.2	50.4	48.0	60.6	48.0	46.2	48.0	52.2	
10	50.4	52.8	51.6	51.6	49.2	52.2	48.6	48.0	41.4	54.0	
$\bar{X} = 47.92$ (A)											
Stomate	<u>Cimicifuga arizonica</u>										
	1	31.2	37.2	49.2	42.0	45.6	45.0	50.4	46.2	43.2	48.0
	2	40.8	42.0	38.4	36.6	45.0	43.8	43.2	44.4	37.2	39.6
	3	45.0	58.2	37.8	45.0	42.0	42.0	43.2	45.0	36.0	45.6
	4	34.2	40.2	39.6	42.6	46.8	45.6	43.8	42.0	44.4	46.8
	5	36.0	40.8	40.8	45.6	48.0	42.0	45.0	42.0	46.2	40.2
	6	45.6	39.0	45.0	41.2	44.4	40.2	46.8	36.0	40.2	48.6
	7	36.6	42.6	40.2	46.8	45.0	44.4	40.2	42.0	42.0	45.0
	8	43.2	43.2	43.8	41.2	46.2	45.0	42.0	40.3	44.4	48.0
	9	39.0	40.2	45.8	38.4	43.2	44.4	48.0	42.0	40.2	40.2
	10	40.2	51.6	40.2	36.0	45.6	43.2	42.6	43.2	42.6	39.0
$\bar{X} = 42.76$ (B)											
<u>Cimicifuga elata</u>											
1	48.0	42.0	45.6	37.2	45.0	54.0	45.0	54.0	51.0	45.0	
2	46.8	45.6	46.8	39.6	46.2	49.2	46.8	49.8	37.2	54.0	
3	40.2	41.4	49.2	42.0	52.2	49.2	39.6	45.6	43.2	48.0	

TABLE V. (continued)

Peel										
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
4	42.6	42.6	49.8	42.0	48.0	60.0	46.2	46.8	38.4	49.2
5	43.2	45.0	43.2	41.4	57.0	60.0	42.0	49.2	37.2	48.0
6	39.0	43.2	42.0	42.6	46.8	54.0	48.6	51.0	51.0	54.6
7	45.0	51.0	42.0	42.0	45.0	51.6	46.8	60.0	38.4	57.0
8	45.0	48.0	42.6	40.2	54.0	52.8	45.0	45.6	45.0	57.0
9	46.8	36.6	40.2	46.8	49.8	60.6	37.2	46.2	46.8	46.8
10	46.8	42.6	43.2	42.0	47.4	48.6	44.4	39.6	48.0	48.6

$$\bar{X} = 46.50 \text{ (C)}$$

Cimicifuga laciniata

Stomate	1	54.0	60.0	57.6	57.0	66.0	55.2	60.6	57.6	60.0	62.4
	2	55.2	60.0	56.4	66.0	69.0	60.0	61.2	56.4	58.8	66.0
	3	51.6	58.8	52.8	61.2	63.0	64.2	58.8	62.4	63.0	72.0
	4	54.0	57.6	60.6	60.0	72.6	60.6	57.0	57.6	61.2	66.0
	5	61.2	60.6	60.0	60.6	64.8	60.0	60.0	60.6	64.8	67.2
	6	60.6	61.8	58.8	61.2	66.0	54.0	61.8	60.0	60.0	64.8
	7	60.0	57.0	57.6	66.0	74.4	60.0	59.4	63.0	57.6	61.2
	8	52.8	58.2	57.0	57.6	60.0	57.6	60.0	60.0	59.4	61.8
	9	60.0	61.8	60.0	58.8	66.0	60.0	61.8	60.0	60.6	63.6
	10	51.6	66.0	62.4	61.8	62.4	60.6	60.6	56.4	60.6	60.6

$$\bar{X} = 60.59 \text{ (D)}$$

Cimicifuga racemosa

1	49.8	45.0	42.0	36.0	42.0	42.0	38.4	48.0	46.8	55.2
2	45.0	43.2	42.6	30.0	43.8	38.4	39.6	45.0	40.2	48.0
3	42.0	48.6	41.4	39.0	37.8	36.6	38.4	51.6	37.2	40.8
4	42.0	45.0	51.0	39.0	39.6	46.2	40.2	45.6	48.0	45.6
5	48.0	49.2	39.6	37.8	42.0	39.6	46.2	45.6	46.2	45.0
6	43.2	45.0	42.0	36.0	38.4	37.8	48.0	46.8	40.2	39.0
7	45.0	44.4	43.3	39.0	34.8	39.0	45.6	49.8	48.0	48.0
8	48.0	42.0	45.6	38.4	38.4	43.8	36.0	42.0	45.0	39.0
9	42.0	43.2	45.0	46.2	42.0	39.0	45.6	43.2	51.0	46.8

TABLE V. (continued)

		Peel									
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
10		54.0	43.2	44.4	42.6	39.6	40.8	42.0	48.0	45.6	45.0
		$\bar{X} = 43.16$ (E)									
		<u>Cimicifuga rubifolia</u>									
Stomate	1	48.0	48.6	45.0	42.0	43.2	37.2	48.6	40.6	40.2	45.0
	2	48.0	44.4	46.2	45.0	40.8	40.8	45.0	39.0	48.0	43.8
	3	42.0	46.8	42.0	39.0	45.0	45.0	44.4	42.0	42.0	40.8
	4	42.0	42.0	43.2	42.0	43.2	45.0	45.0	42.0	48.0	40.2
	5	40.2	57.6	39.6	48.0	41.4	37.2	43.2	43.2	46.8	42.0
	6	37.2	41.4	43.8	51.6	45.0	40.2	41.4	48.0	38.4	36.0
	7	43.2	45.6	46.2	51.0	40.2	43.2	45.6	36.0	46.2	44.4
	8	39.0	42.0	39.0	40.8	48.0	40.8	48.0	46.2	40.8	46.8
	9	48.0	42.0	42.0	44.4	38.4	36.0	46.2	44.4	39.0	39.0
	10	42.0	43.2	43.2	41.4	42.0	39.0	42.0	48.6	39.6	42.0
		$\bar{X} = 43.21$ (F)									

^aAll measurements in microns at 1350X magnification

TABLE VI.

NUMBER OF STOMATES PER .1 mm.² FOR THE NORTH AMERICAN CIMICIFUGA^a

		Peel																				
		<u>Cimicifuga americana</u>					<u>Cimicifuga arizonica</u>															
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	
	1	1	3	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	2	2	
	2	0	0	0	0	0	1	1	1	1	2	1	3	2	1	2	0	2	1	3	1	
	3	1	1	0	0	0	1	0	1	0	1	2	3	2	2	1	1	1	1	1	1	
	4	1	1	0	1	1	0	0	0	1	0	1	2	3	1	2	1	1	1	1	2	
	5	1	1	1	0	1	2	1	1	0	2	2	3	3	1	2	2	2	2	3	1	
	6	0	1	0	1	1	2	0	1	1	1	1	2	1	2	2	1	2	2	3	2	
	7	1	1	1	2	1	2	1	0	1	1	2	3	1	1	1	1	1	2	1	2	
	8	2	1	0	0	0	3	0	0	1	1	3	3	1	1	1	2	1	2	2	2	
	9	1	2	0	2	2	1	0	2	0	1	3	2	1	2	1	1	3	2	2	2	
	10	1	1	2	1	3	1	1	1	2	1	2	3	1	2	1	1	1	2	3	2	
		$\bar{X} = 0.90$										$\bar{X} = 1.71$										
Field		<u>Cimicifuga elata</u>					<u>Cimicifuga laciniata</u>															
	1	1	1	1	1	2	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	
	2	1	1	2	1	2	1	2	1	1	2	1	1	0	2	2	1	1	0	0	0	1
	3	1	1	1	1	0	1	2	1	2	1	1	1	0	1	1	1	1	1	1	1	1
	4	1	2	1	1	2	1	1	2	1	1	1	2	0	1	1	0	1	0	1	1	1
	5	2	1	1	1	1	2	2	1	1	1	1	2	1	1	1	1	0	0	0	0	1
	6	1	1	2	0	1	1	3	1	2	1	1	1	2	1	1	0	0	1	0	1	1
	7	0	3	1	1	1	1	2	0	1	0	1	1	1	0	0	1	1	1	2	1	0
	8	1	1	2	1	1	0	1	1	2	0	1	1	1	2	0	1	1	0	1	2	1
	9	1	3	1	1	1	0	1	1	1	1	1	3	1	1	1	1	2	1	1	1	1
10	1	1	1	2	0	1	1	1	1	2	1	1	1	1	1	2	1	1	1	0	1	
		$\bar{X} = 1.17$										$\bar{X} = 0.89$										
		<u>Cimicifuga racemosa</u>					<u>Cimicifuga rubifolia</u>															
	1	1	1	2	2	1	2	2	2	2	1	2	2	1	2	1	3	2	1	3	3	
	2	2	2	1	1	0	3	1	1	2	2	1	2	2	4	1	1	3	2	1	2	

TABLE VI. (continued)

		Peel																			
		<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Field	3	1	2	1	3	2	2	1	1	0	1	0	1	2	2	1	0	1	1	3	2
	4	1	2	1	2	1	2	1	1	1	0	1	0	2	1	2	2	3	0	2	2
	5	1	1	2	2	1	2	1	1	2	1	1	1	0	3	2	2	2	1	1	2
	6	2	1	0	1	2	0	2	1	1	1	2	2	2	2	2	1	1	2	1	1
	7	2	1	1	1	0	2	2	1	1	2	1	2	1	2	1	2	1	2	2	2
	8	2	0	0	1	1	0	0	0	1	2	2	3	1	1	2	1	1	2	2	1
	9	0	1	1	3	1	2	2	1	1	1	1	1	2	3	3	2	1	1	2	2
	10	3	1	1	2	2	1	1	1	2	1	3	3	4	3	2	1	2	3	3	1
	$\bar{X} = 1.30$											$\bar{X} = 1.72$									

^aAll counts made at 675X magnification

TABLE VII.

MEASUREMENTS OF TERMINAL LEAFLET LENGTHS, WIDTHS, AND SINUS DEPTHS FOR
THE THREE EASTERN NORTH AMERICAN SPECIES OF CIMICIFUGA^a

Length	Width	Depth	Length	Width	Depth	Length	Width	Depth
<u>Cimicifuga americana</u>			10.5	6.5	0	9.5	7.5	0
			9.5	9.5	0	10.0	7.5	0
10.0	7.5	0	10.0	6.0	0	11.0	7.5	0
15.0	8.5	0	7.0	4.5	0	8.5	8.0	0
8.5	6.5	0	11.5	8.0	0	11.0	8.0	.2
13.5	12.0	0	11.0	8.5	0	10.0	8.5	.5
9.0	5.0	0	11.0	8.0	0	5.5	4.0	0
15.0	12.5	0	10.5	6.5	0	10.0	8.5	0
10.0	5.0	0	10.0	7.0	0	12.0	10.0	0
8.5	3.5	0	11.0	9.5	0	9.0	8.0	0
13.0	8.5	0	9.5	5.5	0	13.0	10.0	0
9.0	8.5	0	11.5	14.0	.5	16.5	16.5	0
11.5	8.5	0	15.5	14.5	0	8.5	6.5	0
11.5	8.0	0	8.0	6.0	0	11.0	9.0	0
8.5	5.0	0	9.5	7.5	0	9.5	9.0	.5
10.0	8.5	0	9.5	6.5	0	14.0	8.0	0
10.5	9.0	0	11.0	9.0	0	11.5	10.0	.2
9.0	6.5	0	11.0	12.5	.5	16.0	15.0	.5
9.5	7.5	0	10.0	7.0	0	11.0	9.0	0
11.0	8.5	0	7.5	6.0	0	14.0	7.0	.2
11.0	8.5	0	$\bar{x} = 10.4$	8.9	0.02	11.5	8.0	0
10.0	9.5	0				8.0	5.0	0
10.5	10.5	0				10.0	5.5	0
9.5	9.0	0	<u>Cimicifuga racemosa</u>			8.5	9.0	0
11.0	9.0	0				8.5	7.5	0
11.0	10.5	0	8.5	7.5	0	9.0	7.0	0
10.5	10.5	0	10.5	7.0	0	9.5	8.0	0
10.0	7.5	0	8.5	5.0	0	10.5	10.5	.2
11.0	9.5	0	11.0	10.0	0	9.5	8.5	0
11.0	9.5	0	10.5	8.0	.2	9.5	8.5	.2
10.0	7.5	0	8.5	5.5	0	11.5	8.0	0
12.0	12.5	0	11.0	9.0	0	9.5	6.0	0
11.0	9.0	0	7.5	7.0	0	11.5	8.0	0
11.5	10.5	0	15.0	11.0	0	15.0	9.5	0
6.5	4.0	0	11.0	11.0	0	7.0	5.5	0
8.0	5.5	0	15.0	11.0	0	12.5	11.0	.5
11.0	7.0	0	11.5	10.5	0	9.0	5.5	0

TABLE VII. (continued)

Length	Width	Depth	Length	Width	Depth	Length	Width	Depth
16.0	15.0	1.0	17.0	25.0	4.0	12.0	16.5	2.0
12.0	15.0	2.5	16.5	21.0	3.5	14.5	16.0	2.0
14.5	15.0	2.0	17.0	17.5	2.5	14.5	17.0	2.5
13.0	12.5	2.0	14.0	15.0	.8	16.5	18.5	2.0
12.0	12.5	1.0	14.0	13.5	2.5	20.5	21.0	3.0
12.0	17.0	2.0	17.5	20.1	3.0	19.5	20.5	1.5
11.0	10.0	1.0	16.0	18.5	2.5	14.0	17.0	1.5
13.5	14.0	.5	23.0	26.5	3.0	16.5	15.5	3.0
14.0	14.0	1.5	21.0	22.0	2.0	13.5	12.5	1.0
10.0	11.0	.5	20.5	14.0	.5	15.0	18.0	2.0
11.0	11.0	.5	16.0	20.0	3.0	21.0	23.0	4.5
14.0	15.0	1.5	10.5	11.0	1.0	17.5	21.0	2.0
17.0	18.0	3.0	12.0	16.0	2.5	21.0	23.5	2.0
14.0	17.0	2.0	15.0	15.0	1.0	19.5	25.0	4.0
18.0	16.0	1.0	17.0	21.5	2.0	17.0	12.0	2.0
14.0	12.0	.5	16.0	18.0	2.5	15.0	14.0	1.5
17.0	16.0	1.0	17.0	23.0	3.0	18.0	19.0	1.0
14.0	15.0	1.5	13.0	10.0	1.0	11.5	9.0	1.5
15.5	10.5	1.0	14.0	18.0	3.5	23.0	32.0	5.5
13.5	10.5	1.0	16.0	13.5	.2	15.0	17.0	2.0
21.5	24.0	4.0	16.5	17.0	1.0	12.0	10.5	1.5
14.0	15.5	2.0	12.0	14.0	1.5	13.0	15.5	1.5
13.5	15.0	1.5	17.0	18.5	2.0	11.5	10.5	1.0
14.0	17.0	2.5	14.5	16.0	2.5	9.5	9.0	.2
14.5	14.0	2.0	17.5	17.0	3.5	15.5	10.5	1.0
17.0	18.0	3.5	14.0	12.0	.5	13.0	10.0	1.5
15.5	14.5	.5	14.0	14.0	2.5	13.5	7.5	1.5
14.0	15.0	2.0	14.0	14.5	3.5	12.5	10.0	1.0
16.0	14.0	.5	12.0	10.5	1.5	16.0	16.5	1.5
12.5	13.0	1.0	14.5	17.5	2.5	15.5	14.5	1.0
14.0	16.0	2.5	15.0	12.5	1.0	17.0	16.5	2.5
23.0	19.0	1.0	13.5	15.0	2.5	18.5	21.0	2.5
21.0	22.0	2.0	13.0	15.0	3.0	18.5	19.0	2.0
21.0	24.5	4.0	14.0	19.5	2.0	13.5	15.0	3.0
12.5	11.0	.5	14.5	18.0	2.0	16.0	23.0	3.5
18.0	22.0	2.5	13.5	14.0	.2	10.0	11.5	1.5
12.0	10.5	.2	16.0	20.1	2.5	12.5	12.5	1.5
16.0	17.0	2.5	15.0	17.5	2.5	14.0	13.0	2.0
12.0	16.5	2.0	16.5	17.5	2.0	11.5	11.5	1.5
10.0	9.0	.5	13.0	15.5	2.0	12.0	11.5	1.5
12.5	13.5	1.0	14.0	17.0	1.5	10.0	9.0	.5
11.0	10.0	.5	15.5	17.5	2.0	11.5	12.0	1.0

TABLE VII. (continued)

Length	Width	Depth	Length	Width	Depth	Length	Width	Depth
15.5	16.0	2.5	13.0	13.0	2.0	16.0	17.0	3.0
14.5	13.0	1.5	12.0	12.5	2.0	14.0	15.0	2.0
11.5	10.5	.5	14.5	14.0	2.5	15.0	15.5	1.5
11.0	18.0	1.5	13.0	13.0	2.0	10.5	12.5	1.0
15.0	17.5	3.0	20.0	19.0	2.0	13.0	11.0	1.0
11.0	9.5	.3	14.0	13.0	1.0	19.0	11.5	0.0
12.5	11.5	1.0	14.5	15.0	1.0	14.0	12.5	.2
11.5	10.5	.5	18.0	20.0	3.0	16.0	13.5	.2
13.5	14.5	2.5	16.5	16.0	2.0	15.0	20.0	3.0
15.5	13.0	1.0	15.0	16.0	1.5	12.5	12.5	1.0
12.5	13.5	1.5	17.0	17.5	2.0	13.0	12.0	.5
15.0	19.5	2.0	13.5	13.0	1.0	18.0	18.0	2.0
12.0	12.0	1.0	16.0	16.0	1.0	13.5	14.0	1.5
13.5	14.5	2.0	15.0	17.0	1.5	13.5	17.0	2.0
17.0	14.5	1.5	14.5	15.5	1.5	15.0	12.0	1.0
14.5	14.0	2.0	13.0	11.5	1.0	14.0	13.0	1.0
17.0	16.5	3.0	11.0	13.0	1.0	16.0	13.0	1.5
14.5	14.5	3.0	15.0	14.0	2.0	16.0	16.0	1.5
13.0	14.0	1.0	17.0	21.0	3.5	11.0	10.5	1.0
13.5	14.0	2.5	12.0	14.0	1.5	16.5	15.5	1.0
14.0	15.5	2.0	18.5	20.0	3.5	20.0	20.0	3.0
14.0	14.5	1.0	13.0	17.5	1.5	14.0	15.5	2.0
17.5	22.0	4.5	15.0	14.0	1.0	16.0	18.0	2.0
13.0	12.5	1.0	21.0	22.5	2.5	10.5	12.5	2.0
16.0	15.5	2.0	20.0	23.0	3.0	13.0	10.5	.2
15.5	17.0	2.0	15.0	12.0	.2	$\bar{X} = 14.4$	15.6	1.8
14.0	15.5	2.0	17.0	15.5	.5			
12.5	11.0	1.0	11.0	12.0	2.0			
10.0	9.5	.5	15.0	20.0	3.5			
13.0	14.5	2.0	13.0	14.0	3.0			
11.0	12.0	1.0	10.0	10.0	1.0			
12.5	11.0	1.0	14.0	14.0	.5			
17.0	21.0	4.0	14.0	16.0	1.5			
13.5	13.0	1.0	15.0	18.0	3.0			
10.5	9.5	1.0	14.5	17.0	2.5			
10.5	14.0	1.0	14.5	20.0	3.0			
11.5	16.5	2.5	12.0	14.0	2.0			
13.0	16.0	2.5	15.0	19.0	3.0			
14.5	20.0	3.5	12.5	11.0	1.0			
10.0	9.5	1.0	17.0	18.0	3.0			

^aAll measurements in centimeters