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To the Graduate Council:

I am submitting herewith a thesis written by Lois Pearl Lord entitled "The Genus Saxifraga L. in the Southern Appalachians." 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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THE GENUS SAXIFRAGA L. IN THE SOUTHERN APPALACHIANS

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
Lois Pearl Lord

June 1960

33
No. 10

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The author wishes to thank the curators of the herbaria which lent the specimens of Saxifraga used in this study. The abbreviations used to denote particular herbaria are those suggested by Lanjouw and Stafleu (1954). An asterisk following the abbreviation indicates an abbreviation not in Index Herbariorum but coined for use in this thesis.

AP* - Austin Peay State College, Clarksville, Tennessee

CINC - University of Cincinnati

DUKE - Duke University

ET* - East Tennessee State College, Johnson City, Tennessee

GH - Gray Herbarium, Harvard University

ILL - University of Illinois

MO - Missouri Botanical Garden

NCU - University of North Carolina

NPH* - Great Smoky Mountain National Park Herbarium, Gatlinburg, Tennessee

NY - New York Botanical Garden

OKL - University of Oklahoma

PH - Philadelphia Academy of Natural Sciences

TENN - University of Tennessee

UARK - University of Arkansas

UCHATT* - University of Chattanooga, Chattanooga, Tennessee

US - United States National Museum

VDB - Vanderbilt University

VPI - Virginia Polytechnic Institute

WVA - West Virginia University

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INTRODUCTION

The genus Saxifraga Tourn. ex L. (saxum - stone, frangere - to break), is composed of many complex genetic systems which are very plastic in their phenotypic expression. There have been over 300 species of Saxifraga described. The genus is of arctic and north temperate distribution, with centers of distribution in the arctic and boreal regions. From these centers, there are finger-like extensions of the genus southward into various parts of the world.

In North America, the center of distribution of Saxifraga is in the northern one-third of the continent. However, the genus is represented in the central and southern parts of the continent by several outlying groups of species. These outliers are to be found in the mountain ranges of eastern and western North America. This investigation deals with that part of the genus which occurs in the Southern Appalachians.

The objects of the study are to understand more fully the relationship of the species of Saxifraga in this area to each other and to hypothesize their relationship to the rest of the genus. Six species have been reported in the Southern Appalachians: Saxifraga micranthidifolia (Haw.) Britt., S. virginensis Michx., S. michauxii Britt., S. careyana Gray, S. caroliniana Gray, and S. tennesseensis Small. All of these species except S. virginensis seem to be endemic to these mountains and to have affinities to representatives of the genus in western North America, Europe, and the boreal and arctic regions of

the world. It is felt that the true relationship of the Southern Appalachian species to the rest of the genus will not be fully understood until the entire genus, or at least the sections of the genus to which they belong, is studied thoroughly using all of the methods of modern taxonomy.

HISTORICAL TREATMENT

The genus, Saxifraga, was established in 1700 by Tournefort, whose treatment was used by Linnaeus in the first edition of Genera Plantarum (1737). Adrian Haworth, working on the succulent plants found in English gardens, became interested in the saxifrages and in the fourth and fifth Dissertations of Miscellanea Naturalia (1803) he suggested that the Linnean genus was composed of several genera. He segregated Saxifraga sarmentosa as a new genus Sarmentia. In the appendix of a later publication, Synopsis Plantarum Succulentarum (1812), he recognized three new genera: Micranthes, Robertsonia, and Miscopetalum, and described several new species. In 1821, he published Saxifragearum Enumeratio in which he treated all the members of the genus known to him, dividing it into thirteen more genera, thus making a total of seventeen genera.

Haworth based these divisions not only on the characters of fructification used by Linnaeus but also on what he called "habit": the general aspect of the plant. He felt that certain botanists would think that too many new genera were made out of the old genus, and he defended his action with the following statement:

. . . that it is not the botanist who actually makes genera. He merely attempts, by his art to discriminate those which the mighty hand of his own maker have already made; and not only made, but sealed; each as it were with some peculiar mark; which we distinguish by the name habit.

He concluded by saying that if characters of fructification alone are used erroneous conclusions may be formed and that natural habit "if duly

appreciated, will serve like beacons, and the light of a lighthouse, to direct us to the Truth."

Mr. Haworth was assisted and stimulated in his investigations of the saxifrages by Rev. W. T. Bree. Mr. Bree was an ardent worker; he did much collecting and observing of the saxifrages in the mountains of England, Scotland, Wales, and Ireland. He was well aware of the variation that occurred among certain of the species to be found in the mountains of Ireland. Haworth said of Bree

. . . he scarcely found anything constant amongst them, except their constant tendency to endless variation; and all this apparently through the hybridizing processes of cross impregnation.

Mr. Haworth and Mr. Bree did not agree completely on their interpretations of the various species of Saxifraga. Haworth, however, did not propose his treatment of the saxifrages as the final one; but he hoped that it would be an improvement. He was aiming for a "natural classification" of the group, and he realized that whatever arrangement was proposed would be at best an approximation.

David Don (1822) published a comprehensive work on Saxifraga in the form of a monograph. He divided the genus into five sections: BERGENIA, GYMNOPIPERA, LEIGYNA, MICRANTHES, and SAXIFRAGA VERA. The characters that he used were those of fructification.

Haworth predicted the reactions of most of his fellow botanists well. They did not feel that the division of the Linnean genus into the numerous genera was justified. However, I. F. Tausch (1823) used Haworth's genera as the basis for the sections of Saxifraga in his

treatment of the group. N. C. Seringe (1839) in DeCandolle's Prodromus followed Tausch's work as did W. J. Hooker (1840), and John Torrey and Asa Gray (1838-1840). Ledebour (1844) modified Tausch's system greatly by combining several of Tausch's sections into a single section. Later workers felt that Ledebour based his classification on characters of minor importance.

Rafinesque (1836) made some pertinent remarks concerning Saxifraga in his Flora Telluriana. Although there is some question in many taxonomists' minds about the validity of Rafinesque's work, it yields some thought-provoking ideas and should be examined. Rafinesque considered Saxifraga an obsolete genus: one which was "a strange medley of blunders, ambiguities and absurdities." He was greatly disturbed because he believed that the Linnean genus contained plants that had nothing in common, not even habit. He suggested that the description of the Linnean genus should be:

Calix inferior or superior, equal or unequal, with 5 to 10 parts, Petals 5 equal or unequal, with glands or no glands, with claws and nerves or none, Stamens fertile or sterile, Ovary inferior or superior with glands or no glands, 2 styles or 3 to 6 or no styles, Capsule bifid or bicornate or 2, 3, 4, 5, 6, Capsules, naked or crowned or covered . . . ! At which rate and with many . . . OR . . . OR we can make a single genus of Roses and Cabbages! and without any OR, a single Genus of all Cruciferae.

In reworking the genus he erected twelve new genera: Saxifraga, Hydaticea, Aphomonix, Ponista, Hexophoma, Rupifraga, Piarophylla, Telesonia, Tulorina, Hirculus, Hemieva, and Evaiezoa; and he also recognized two of Hooker's genera, Eriogyna and Leptarrhena, but not without

comment: "I shall propose 12 new Genera quite as good as Eriogyna and Leptarrhena of Hooker."

The next work on Saxifraga was done by Adolph Engler who, in 1869, published Index Criticus Specierum atque Synonymorum Generis Saxifraga and in 1872, Monographie die Gattung Saxifraga. He did not follow the concepts of Haworth or Rafinesque in dealing with the genus and said of Haworth: "Er erweiterte die Zahl der Genera und zersplitterte in seiner 'Enumeratio Saxifragearum' das Genus in 17 neue Gattungen welche jedoch von ungleichem Werth waren." That Engler believed that the family Saxifragaceae made up a natural group of plants and that Saxifraga was a natural group is indicated by the statement:

Besonders ist die Gattung Saxifraga Tourn. em L. eine natürliche, dass nur in wenigen Fällen die Entscheidung schwer fällt, ob eine Pflanze mit zu unserer Gattung zu rechnen sei oder in einer anderen geeigneter unter gebracht werde.

In the Monographie die Gattung Saxifraga (1872) he proposed that the genus be divided into fifteen sections in which he treated 132 species.

In 1905, John K. Small and P. A. Rydberg published their treatment of the Saxifragaceae in North American Flora. The portion of the family with which the present investigation is concerned was described by J. K. Small, who divided the Linnean genus into thirteen genera. Most of these genera were not created by Small but rather by previous workers such as Haworth, Rafinesque, and Robert Brown. It is interesting to note the close correlation between the genera recognized by Small and by Haworth. In such a comparison it becomes obvious that Small and Haworth used somewhat the same approach in developing their concept of what delimits a

genus in the Saxifragaceae. It should be noted that Small, who has been considered by many to be a "splitter," proposed very few genera in this group himself but rather adopted genera already proposed by other taxonomists.

The treatment of Saxifraga in Das Pflanzenreich (1916-1918) by Engler and Irmscher was based on Engler's monograph (1872). The only innovation was that the larger sections such as BORAPHILIA, HIRCULUS, NEPHROPHYLLUM, DACTYLOIDES, EUAZOONIA, KABSCHIA, and PORPHYRION were divided into groups. This arrangement was followed by Engler in Engler and Prantl's Die Natürlichen Pflanzenfamilien (1930). This, the last major monograph written on the genus, treated 302 species.

Other work on the genus includes a paper on the North American Saxifragaceae and their relationships in the light of their geographic distribution published by Rosendahl (1905). In addition, A. M. Johnson (1923) published a revision of the North American species of the section BORAPHILIA Engler. Johnson considered Engler's section to be a heterogeneous group made up of species of widely differing affinities. He maintained that the characteristics of the shape and the mode of dehiscence of the capsule, which Engler used to distinguish between sections, were not diagnostic characters. He felt that the section BORAPHILIA could not be differentiated from other of Engler's sections on these characteristics. He proposed that the section BORAPHILIA be divided into nine sections: HYDATICA, CATHOPHYLLUM, AULAXIS, DERMASEA, CHINOPHILIA, MICRANTHES, TRICARPUM, ARABISA, and HETERISIA. The characters upon which

he based his classification are the types of trichomes, the degree of development of the nectary gland at the base of the ovary, and the shape, degree of fusion, number and position of the carpels.

B. F. Bush (1928), working on some saxifrages of southern Missouri and Arkansas, noted that Johnson's coverage of the genus in the eastern and central United States was inadequate. He also questioned Johnson's taxonomic treatment of the species with which he did work.

Most of the work on the genus Saxifraga since 1930 has been on isolated groups of species or species "Formenkreis," particularly in respect to their genetics and cytotaxonomy. Marsden-Jones and his collaborators in England have worked intensively on the genetic constitution of some of the English saxifrages and, in 1930, succeeded in producing a true-breeding tetraploid of known parentage. This hybrid, X Saxifraga potternensis, is the result of crossing Saxifraga rosacea Moench. (of Engler's section DACTYLOIDES) with Saxifraga granulata L. (of Engler's section NEPHROPHYLLUM). Despite the fact that the two species of different sections were cross-fertile, Marsden-Jones and Turrill felt that Engler's sectional characteristics seemed ". . . to have considerable taxonomic value and, in general, bring together species most alike in the total of their characteristics."

Later Marsden-Jones and Turrill (1956) made crosses among three species of the section DACTYLOIDES: Saxifraga rosacea, S. caespitosa, and S. hypnoides. From the results of these experiments they concluded that in this group (in which Haworth and Bree found nothing constant except the ever-present tendency for variation) genetic sterility barriers

are either absent or incomplete and thus they are not important in keeping the taxa distinct.

G. W. Burns (1942) did a cytotaxonomic study of Saxifraga pensylvanica L. and its related forms. He suggested that the polymorphism within this group was due to three things: autopolyploidy, hybridization of intraspecific chromosome races, and genic modification within the races.

J. L. Hamel (1953), in a cytotaxonomic study of the family Saxifragaceae, found that the basic number of chromosomes of the genus Saxifraga varied greatly ($X = 8, 9, 10, 11, 13, 14, 17, \text{ and } 19$), whereas the basic chromosome numbers for the rest of the genera of the family are uniform for the specific genera concerned. From this information he concluded that:

Cette Hétérogénéité évidente du genre Saxifraga, si différente de l'Homogénéité des autres genres, semble indiquer, comme j'en suggèrerais tantôt l'idée qu'il est composé de plusieurs sous genres, et bien plus, que, artificiellement formé, il résulte peut-être de l'addition de véritables genres dont il faudrait fixer les limites. Certains taxonomistes américains admettent cette coupure: C'est ainsi, par exemple, qu'ils considèrent la première section BORAPHILIA comme un genre véritable; Micranthes mais celle-ci justement paraît être composée d'éléments dissemblables. Pour faire d'une manière satisfaisante de telles coupures, il faudrait connaître tous les nombres chromosomiques ou à tout le moins en connaître beaucoup plus à l'heure actuelle, tant pour les espèces de cette section que pour celles sections voisines. Peut-être ce que Babcock et ses collaborateurs ont réalisé pour le genre Crepis.

From this survey, some of the problems involved in the genus, Saxifraga, have become apparent. It is a large group of plants composed of many complex genetic systems and within these systems there appears

to be great interspecific fertility and great genetic variation. These complex genetic systems have been interpreted taxonomically in various ways without agreement. We still are faced with the problem as to whether this group of plants is a single natural genus or actually a large artificial genus that consists of a group of smaller genera. In this study the species of the Southern Appalachian saxifrages are interpreted as members of a single, highly complex genus.

ECOLOGICAL CONSIDERATIONS

The genus, Saxifraga Tourn. ex L., has long been known to be one whose plants are found in the crevices and crannies of rocks. The members of the genus which are found in the Southern Appalachians are no exception, usually occurring on dripping rocks or moist crevices of bluffs.

Saxifraga virginensis is the most widely distributed species in this study. It extends from eastern Canada into northeastern United States, westward to Minnesota and Missouri, and southward to Alabama and Georgia. Throughout its range it is found associated with a rock substrate, for example, in the crevices of rocks, on moss-covered rocks, or on talus slopes. It grows equally well on sandstone, limestone, or granite, in both dry and moist situations.

This species long has been considered to be a polymorphic one as a result of its great genetic plasticity. This plasticity is reflected not only in morphological variation but also in the ability of the species to occupy various ecological situations.

Saxifraga careyana, although more limited in distribution than S. virginensis, is found in several types of ecological niches: on moist rocks of various kinds--limestone, sandstone, and gneiss. It is found on the Cumberland Plateau, in the Ridge and Valley Province, and the mountains of east Tennessee and of western North Carolina and southwestern Virginia.

Saxifraga caroliniana has been found only in five counties in the

Blue Ridge Province: Alleghany, Ashe, and Avery counties of North Carolina, and Smyth and Washington counties of Virginia, where it seems restricted to moist, mossy, limestone rocks.

Saxifraga michauxii has a much more limited ecological tolerance than either S. virginiensis or S. careyana, for although it extends from northern Georgia and South Carolina to northern Virginia and West Virginia in the Blue Ridge Province, it is always associated with non-calcareous rocks in moist situations.

The distribution pattern of Saxifraga micranthidifolia is very similar to that of S. michauxii. It is limited to the Blue Ridge Province, but it does extend farther north into Maryland and Pennsylvania. It is more specific in its habitat requirements; for it is always found growing in association with cold water on the edges of brooks, moss-covered rocks in brooks, or cold water seepage areas.

These species of Saxifraga show no specific pattern of distribution if they are considered together. Each of them, however, when they are considered individually does have one. These patterns, of course, reflect the genetic complement of the species as it is expressed in the ecological tolerance of that species. Those species that have a limited distribution have a more limited ecological tolerance, and those species that have a greater distribution have a greater ecological amplitude.

MORPHOLOGICAL AND TAXONOMIC CHARACTERS

In the various studies on the genus, Saxifraga, criteria of four major types have been used to differentiate the numerous taxa. These criteria are: floral structure, fruit structure, vegetative characters, and habit. In the most successful attempts to delimit the taxa of this genus all these criteria have been employed. A primary concern of this study has been to discover means of separating the five species which occur in the Southern Appalachian area. A discussion of morphological differences follows.

STEM: All the species possess a much-shortened main stem with a basal rosette of leaves (S. careyana and S. micranthidifolia have been found to have rhizomatous stems also).

LEAVES and PETIOLES: Leaf shape has been found to be a distinct characteristic of two of the species. S. michauxii has spatulate and coarsely dentate leaves while S. micranthidifolia has spatulate and shallowly dentate leaves. The leaf shape of the other three species is very inconstant. In regard to petiole differences the five species fall into two classes: S. michauxii and S. micranthidifolia have leaf blades which narrow only slightly forming a pseudopetiole, whereas the other three species have leaf blades that narrow abruptly into a winged petiole (Figure 1).

PUBESCENCE: The amount of pubescence and its distribution have been found to be of little use in distinguishing the species. The type of trichomes, however, has been of some use. The trichomes of S.

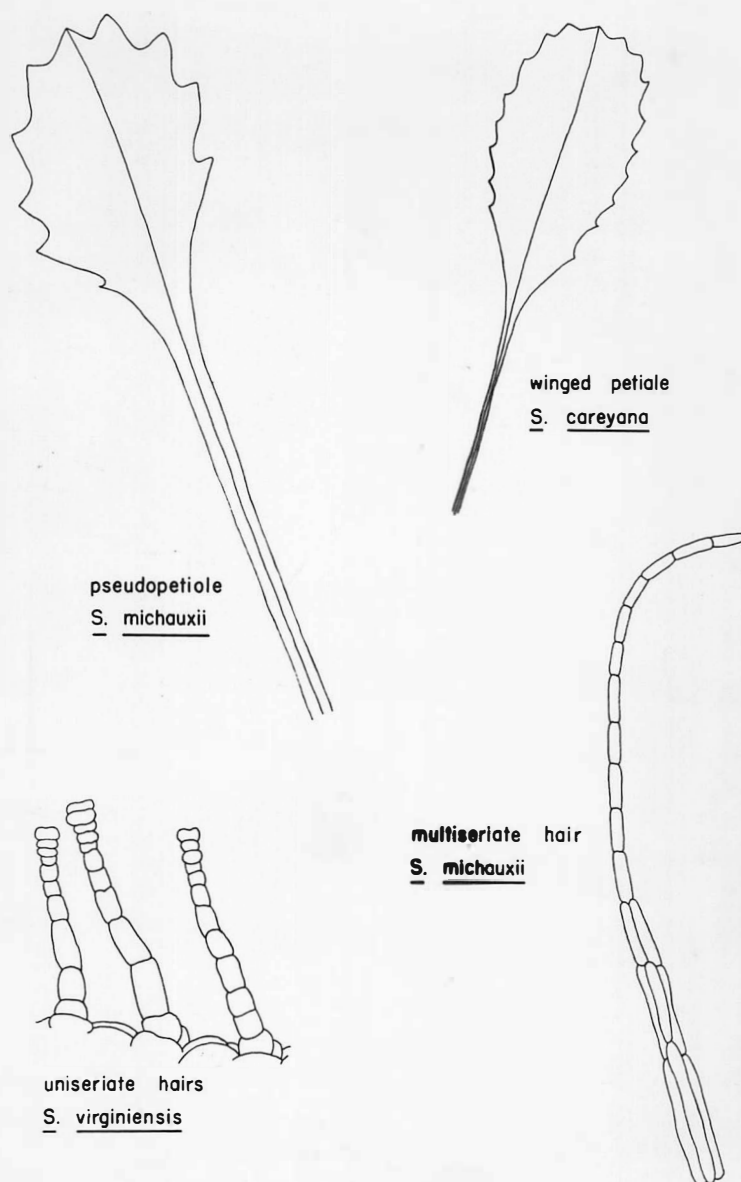


Fig. 1 - Petiole and pubescence types.

michauxii are of the multiseriate type, while the other four species have trichomes that are of the uniseriate type (Figure 1).

HYPANTHIUM: All degrees of hypanthium are encountered in this complex genus. However, S. virginensis is the only species in the Southern Appalachian area that has a hypanthium. The hypanthium of this species is united with the two follicles for about one-half of their length.

SEPALs: The position of the sepals at anthesis has been found to be of use in separating these species one from another. In S. michauxii, S. micranthidifolia, and S. caroliniana the sepals are reflexed, while in S. virginensis and S. careyana they are erect or slightly spreading. The length, width, and shape of the sepals do not seem to be of any taxonomic significance.

PETALS: The species considered in this study have two types of corollas: actinomorphic and zygomorphic. Actinomorphic corollas are characteristic of S. micranthidifolia, S. careyana, S. caroliniana, and S. virginensis. The sizes of the petals of the four species do not differ greatly. However, there is a difference in the degree of the development of the claw of the petal. The claws of the petals of S. micranthidifolia are well developed as compared to those of S. careyana and S. caroliniana, while those of S. virginensis are indistinct (Figure 2). The corollas of S. michauxii are zygomorphic, with two types of petals; the upper three are sagittate, short-clawed, with two yellow spots each; the lower two are oblanceolate to lanceolate, long-clawed, and unspotted (Figure 2).

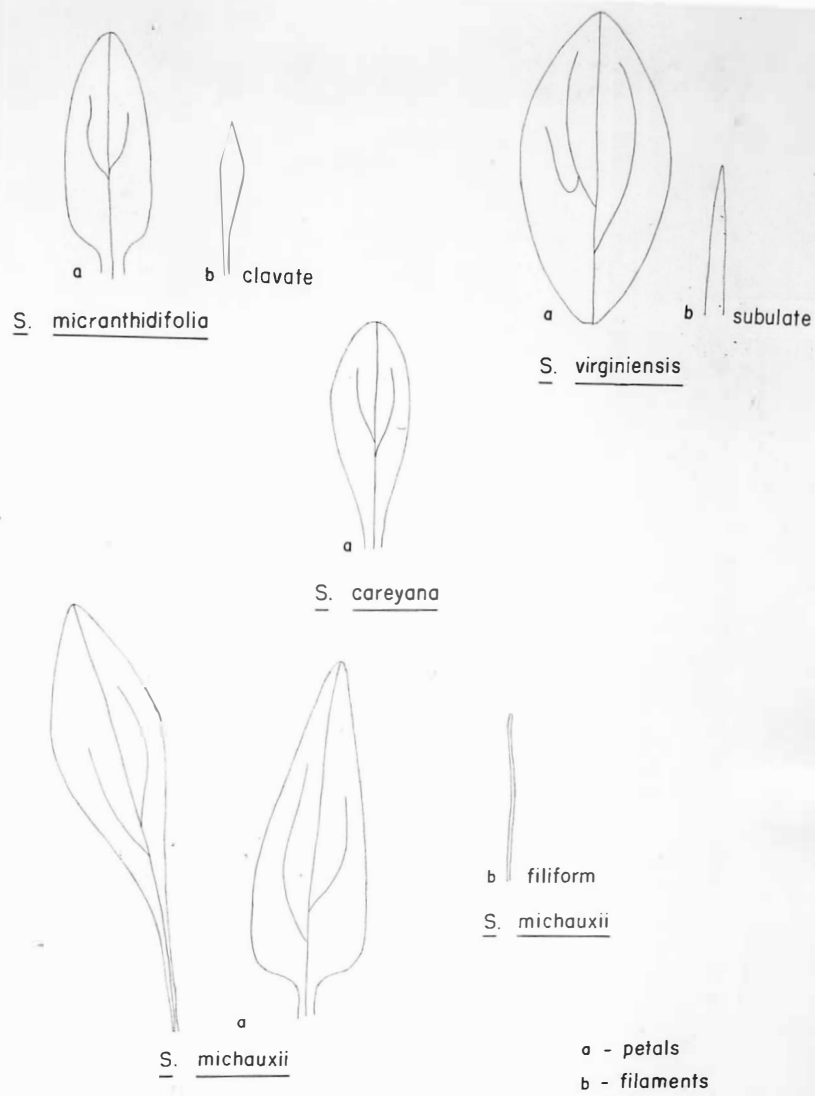


Fig. 2 - Petal and filament types.

FILAMENTS of the STAMENS: The filaments of the stamens of S. virginiensis are very short (1.0 mm. - 1.5 mm.) in comparison to those of the other four species (2.5 mm. - 4.5 mm.). Another useful characteristic of the filaments is shape. Two of the species, S. micranthidifolia and S. caroliniana, possess clavate filaments. Those of the other three species, S. virginensis, S. careyana, and S. michauxii, are subulate to filiform (Figure 2).

NECTARY: Johnson has been the only student of the group to mention and to make use of the presence and shape of the nectary (gland) at the base of the follicles as a character to distinguish between species. Before anthesis the gland is a narrow ridge around the base of the follicles in S. michauxii, S. careyana, S. caroliniana, and S. virginensis; in S. micranthidifolia it covers approximately one-half of the ovary. The gland disappears at maturity of the fruit in all the species.

KEY TO THE SPECIES OF SAXIFRAGA FOUND

IN THE SOUTHERN APPALACHIAN AREA

1. Corollas zygomorphic; trichomes of
plant multiseriate2. S. michauxii Britt.
1. Corollas actinomorphic; trichomes of
plant uniseriate 2.
2. Sepals reflexed at anthesis;
stamen filaments clavate 3.
2. Sepals erect or slightly spreading at
anthesis; stamen filaments filiform 4.
3. Leaves 8.3 cm. to 25.0 cm. long, narrowing
gradually to a pseudopetiole; petals without
yellow spots1. S. micranthidifolia (Haw.) Britt.
3. Leaves 5.5 cm. to 16.5 cm. long, narrowing
abruptly to a winged petiole; petals with
yellow spots4. S. caroliniana Gray
4. Hypanthium present, 1.5 mm. to 2.0 mm.
long; stamen filaments 1.0 mm. to 1.5
mm. long5. S. virginensis Michx.
4. Hypanthium lacking; stamen filaments
2.5 mm. to 3.5 mm. long3. S. careyana Gray

SYSTEMATIC TREATMENT

1. SAXIFRAGA MICRANTHIDIFOLIA (Haworth) Britton

SYNONYMY

Robertsonia micranthidifolia Haw. Syn. Pl. Succ. 322 (1812)

Saxifraga erosa Pursh Fl. Am. Sept. 311 (1814)

Aulaxis micranthifolia Haw. Saxifrag. Enum. 47 (1821)

Saxifraga micranthifolia Steud. Nom. Bot. 736 (1821)

Saxifraga caroliniana Schleich. (1821) ex Ser. in DC. Prod. iv, 41

Saxifraga wolleana T. & G. Fl. N. Am. 1569 (1840)

Saxifraga micranthidifolia (Haworth) Britton B. S. P. Prel. Cat. N. Y.
17 (1888)

Micranthes micranthidifolia (Haworth) Small Fl. S. E. U. S. 501 (1903)

Perennial herb with a rhizomatous stem and fibrous roots. Leaves in a basal rosette, 8.3 cm. - 25.0 cm. long, 1.7 cm. - 6.5 cm. wide, spatulate with obtuse apex, tapering toward the base to a pseudopetiole equal to one-third to one-half the total length of leaf, margin of expanded portion of leaf dentate and ciliate, margin of pseudopetiole entire and villous; expanded portion of leaf thin and membranous, puberulent on both upper and lower surfaces. A single, erect, many-flowered scape, 14.0 cm. - 33.0 cm. long, arising from the basal rosette, longitudinally ribbed, villous the entire length, paniculately branched, 7 - 12 branches per scape, 1.5 cm. - 9.0 cm. long, with the longest basal, the shortest terminal, villous, subtended by bracts, basal bracts foliaceous with acute apices, sessile, upper bracts reduced in size,

margins entire, ciliate, apices obtuse, sessile. Three to twelve flowers per branch, actinomorphic, pedicels 7.0 mm. - 15.0 mm. long, filiform, villous, subtended by a narrowly spatulate bracteole, entire, ciliate, apex obtuse, sessile. Sepals 5, oblong, 1.5 mm. - 2.0 mm. long, 0.5 mm. - 1.5 mm. wide, obtuse apex, a few scattered hairs occasionally present, reflexed at anthesis, fused about one-fourth of length. Petals 5, obovate, clawed, 1.7 mm. - 4.5 mm. long, 1.0 mm. - 1.8 mm. wide; inner surface papillose, one main nerve with two lateral branches, pariorigin or impariorigin. Stamens 10, unicyclic, anthers elliptical, dehiscing longitudinally, basifixed, ring of callus tissue around the point of attachment. Filaments 2.5 mm. - 3.3 mm. long, clavate, distal portion acute. At anthesis, filaments at least twice as long as follicles. Follicles 2 (occasionally 3), usually equal, 3.6 mm. - 5.3 mm. long at maturity, ribbed, coherent one-fourth to one-third of length, ovary ovoid, narrowing to a short, slender style, stigma small, slightly thickened. At maturity tips of the follicles spreading at right angle to the main axis of the follicles. At anthesis, lower half of ovary surrounded by a lobed gland which disappears at maturity. Follicle line of dehiscence adaxial; placentation axial; seed fusiform, brown to black, longitudinally ridged.

Distribution: moist, cool situations, mountains of east Tennessee, western North Carolina, Virginia, West Virginia, Maryland, and also the Lehigh Mountains of Pennsylvania (Figure 3).

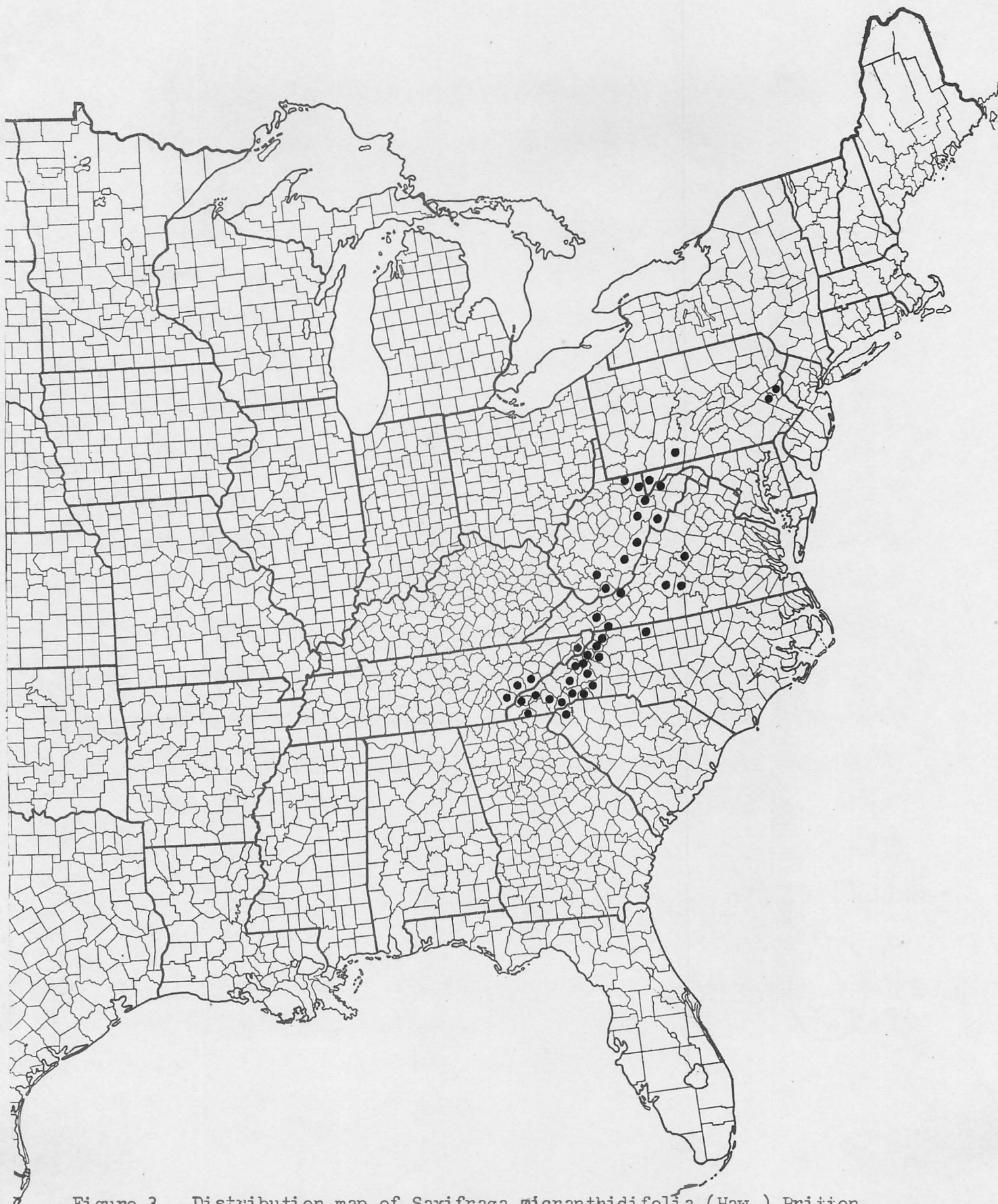


Figure 3. Distribution map of Saxifraga micranthidifolia (Haw.) Britton.

Specimens examined:

SOUTH CAROLINA. Pickens Co.: rich wooded slope 2.4 mi. s. of N. C. - S. C. state line on U. S. rt. 178, 6 June 1956, C. R. Bell & H. E. Ahles 14277 (NCU); state hwy. 11, near Nimmons, 12 April 1957, O. M. Freeman 52114 (NCU).

TENNESSEE. Blount Co.: moss-covered rocks in stream, Cades Cove, 18 May 1935, R. J. Fleetwood 1843 (NPH). Carter Co.: Roan Mt., 1 mi. below Cold Spring, 26 May 1934, D. M. Brown 24 (DUKE, ET); head of Stony Creek Valley, 15 May 1941, A. J. Sharp 1433 (TENN). Cocke Co.: near mts. of E. Tennessee, along Wolf Creek, July 1896, A. Ruth sn (MO, ILL, NY). Sevier Co.: stream bank, Greenbrier, 10 April 1939, R. Bebb sn (OKL); near Gatlinburg, 29 April 1934, R. Godfrey sn (TENN); Greenbrier, 26 April 1936, M. N. Black sn (TENN); Chimney Caps, 8 May 1933, S. A. Cain sn (TENN); Woolly Tops Branch, Greenbrier, 10 April 1937, S. A. Cain & W. H. Duncan 86-2 (TENN); W. O. Whittle's place, Gatlinburg, 22 April 1934, H. M. Jennison 313 (GA, TENN); Jungle Brook, above Gatlinburg, 24 April 1934, J. K. Underwood 645 (TENN); Trail up Mt. LeConte, 4 May 1935, Troy Jones sn (TENN); Roaring Fork, Mt. LeConte, 13 May 1934, A. J. Sharp 651 (TENN).

NORTH CAROLINA. Avery Co.: Grandfather Mt., 16 June 1891, J. K. Small & A. A. Heller sn (ILL, NY); Grandfather Mt., wet places, 25 June 1930, H. L. Blomquist 3785 (DUKE); dripping cliffs, 0.3 mi. n. of Ingalls on U. S. 19E, 17 June 1958, J. A. Duke & H. E. Ahles 43481 (NCU). Buncombe Co.: Big Craggy Mt., June 1892, Leroy & Ruger sn (NY); Black Mt., June 1872, Leroy & Ruger sn (NY); Biltmore, June 1896, 885 (ILL, MO,

NCU, NY); Bull Gap, May, sn (ILL); gneiss in hardwood cove near Bull Gap, 2 mi. n. of Riceville, 3 May 1953, B. M. Taylor, Jr., C. E. Wood, Jr., & A. E. Radford 6948 (NCU). Caldwell Co.: mixed deciduous forest, Buffalo, $\frac{1}{2}$ mi. n., 12 May 1956, A. E. Radford 11071 (NCU). Clay Co.: roadside, Buck Creek, U. S. 64, 2 mi. sw. Clay-Macon county line, 2 June 1956, A. E. Radford 12187 (NCU). Graham Co.: mixed deciduous forest, 4 mi. e. of Fontana, 26 May 1956, A. E. Radford 11883 (NCU). Henderson Co.: seepage on gneiss, 3 mi. n. of Fruitland, 5 June 1953, J. G. Haesloop & A. E. Radford 7115 (NCU). Jackson Co.: stream below Soco Falls, 19 June 1935, O. R. Hendrix B-10 (NY); wooded slope 0.1 mi. e. of county line, about $5\frac{1}{2}$ mi. w. of Old Fort above old U. S. Hwy., 20 April 1956, C. R. Bell 2019 (NCU). Mitchell Co.: mountains of North Carolina, W. W. Ashe sn (MO); wet places, flank of Roan Mt., 30 June 1902, W. A. Cannon 40 (NY); Roan Mt., 20 June 1879, A. Gray, C. S. Sargent, J. H. Redfield & W. Canby sn (NY); Roan Mt., 25 June 1880, J. W. Chickering, Jr. sn (DUKE, GA, NCU, TENN); Roan Mt., July 1880, T. Meehan, T. C. Porter, J. Leidy & J. Wilcox sn (NY); by brook, in meadow on lower slope of Roan Mt., 11 June 1947, F. W. Hunnewell 18751 (WVA). Polk Co.: Melrose, 19 May 1899, J. R. Churchill sn (MO, TENN); moist ravine, 4 mi. w. of Tryon, 1 June 1947, R. L. Wilbur 151a (DUKE); with rocks between Tryon and Melrose, 23 April 1916, W. W. Ashe sn (NCU); on dripping rocks, Pearson's Fall, Melrose, 2000' elev., 20 April 1922, D. C. Peattie 1675 (NCU). Rutherford Co.: woodland 3 mi. n. of Lake Lure, 21 April 1956, C. R. Bell & H. E. Ahles 11249 (NCU). Stokes Co.: moist wooded bank along Peter's Creek, 24 May 1939, D. S. Correll & G. W. McDowell 10732 (DUKE);

wet rocks, edge of stream Peter's Creek near Campbell, 19 May 1940, H. L. Blomquist 11095 (DUKE). Swain Co.: branch of Bradley Fork, Smokemont, 9 May 1936, H. M. Jennison 100 (NPH, TENN); Hughes Ridge Trail, Smokemont, 24 April 1936, J. G. Smith & H. M. Jennison 2177 (NPH, TENN); Indian Creek above Bryson City, 23 August 1942, A. J. Sharp s-04251 (TENN); wooded mountain slopes 3.5 mi. from N. C. Hwy. 28 on Mica Knob Rd., 6 June 1956, C. R. Bell 3124 (NCU); rock in hardwood forest in Nantahala Gorge, 1 mi. s. of Talc Mt., 7 June 1953, J. G. Haesloop & A. E. Radford 7230 (NCU). Transylvania Co.: margin of brook near Brevard, 24 April 1957, O. M. Freeman 57161 (NCU). Watauga Co.: Linville Road, 18 June 1899, J. R. Churchill sn (MO); stream banks in wooded cove, 3.7 mi. s. of Aho, on dirt road, 4 May 1958, R. P. Ashworth & H. E. Ahles 39512 (NCU); mixed deciduous forest, 4 mi. se. of Aho, 12 May 1956, A. E. Radford 11056 (NCU); wooded stream bank, 0.4 mi. ne. of Avery-Watauga county line on N. C. 603, 4 May 1958, R. P. Ashworth & H. E. Ahles 39641 (NCU). Yancey Co.: rocky brooks in the shade, 27 May ?, sn (NY); wooded coves, 3.8 mi. n. of Swiss, 7 June 1958, J. A. Duke & H. E. Ahles 42741 (NCU).

VIRGINIA. Bedford Co.: 21 May 1872, A. H. Curtiss sn (NY); 1 June 1872, A. H. Curtiss sn (MO); 15 May 1871, A. H. Curtiss sn (NY); Peaks of Otter, 30 May 1951, F. H. Sargent sn (GA, OKL); 25 May 1868, A. H. Curtiss sn (ILL). Campbell Co.: in the vicinity of Lynchburg, 1 July 1892, N. L. Britton, E. G. Britton & A. M. Vail sn (NY). Giles Co.: Mountain Lake, 1 June 1890, A. Brown, T. Hogg, A. M. Vail, M. Timmerman & Dr. & Mrs. N. L. Britton sn (NY); 0.6 mi. s. se. of Kire P. O., 23 July 1943, H. H. Iltis 1909 (TENN); Mt. Lake, 16 June 1907, E. L. Braun sn

(CINC). Grayson Co.: On the slopes of White Top Mt., 29 May 1892, N. L. & E. G. Britton & A. M. Vail sn (NY); Mt. Rodgers, 28 June 1892, N. L. & E. G. Britton & A. M. Vail sn (NY). Nelson Co.: edge of cold mountain brook, Three Ridge, about 3000' elev., 16 May 1936, E. S. Rawlinson 3n (VPI). Smyth Co.: Staley's Creek, in the vicinity of Marion, 19 May 1892, A. M. Vail & N. L. & E. G. Britton sn (NY); Hutton's Branch, East Marion, 6 June 1892, J. K. Small sn (MO); Hutton's Branch in the vicinity of Marion, 6 June 1892, N. L. & E. G. Britton & A. M. Vail sn (NY); White Top Mt., near base, 19 June 1936, W. H. Camp 1552 (NY).

WEST VIRGINIA. Greenbrier Co.: Little Clear Creek, 16 May 1946, C. Peck sn (WVA). Mercer Co.: Athens, 27 April 1939, E. Meade McNeill sn (WVA). Mineral Co.: along Spring Hill, Sulphur, July 1955, M. Brown sn (WVA). Monongalia Co.: Granville, 20 May 1891, C. F. Millspaugh 962 (WVA). Pendleton Co.: Panther Mt., 15 & 19 June 1936, P. A. Rydberg 9044 (NY); Spruce Knob, 29 June 1938, Mr. & Mrs. H. A. Davis 2389 (WVA). Pocahontas Co.: Spruce, 4 August 1931, E. L. Core sn (NY); 15 June 1896, W. M. Pollock sn (MO); Fred Gray sn (WVA). Preston Co.: Kingwood Pike, 3 mi. w., vicinity of Terra Alta, 16 June 1924, E. S. Steele 8 (NY); s. of Breedlove, in cool springy place, 1 June 1940, Mr. & Mrs. H. A. Davis 3766 (WVA); edge of small stream by roadside, Cranesville-Albright, 8 June 1908, J. L. Sheldon 1405 (WVA). Raleigh Co.: Cranberry Glades, 1 June 1925, P. D. Strausbaugh 609 (WVA). Randolph Co.: Dry Fork, 24 May 1893, A. D. Hopkins sn (WVA); Laurel River, 10 May 1929, W. Va. Botanical Expedition 609 (WVA). Tucker Co.: along an old log road, 1 mi. se. of St. George, elev. 1900', 19 May 1956, Roy B. Clarkson 812 (WVA); Canaan

Valley, 1 June 1940, E. L. Core, J. C. Myers & E. A. Bartholomew sn (WVA); Canaan Valley, wet bank of Back Bone Mt., near Thomas, 30 May 1946, H. A. Allard 11892 (WVA).

MARYLAND. Garrett Co.: Kelso Gap, Backbone Mt., 24 June 1931, H. N. Moldenke 6773 (NY, WVA).

PENNSYLVANIA. Bedford Co.: common along mt. stream at Sulphur Springs, 23 May 1933, J. Bright 2131 (WVA). Lehigh Co.: rill on Lehigh Mts., 24 June 1880, C. D. Fretz sn (NY); Lehigh Mts., June 1875, sn (MO); mountains, Allentown, June 1866, sn (ILL). Northampton Co.: Bethlehem, J. Torrey sn (NY); Bethlehem, 6 June 1863, F. C. P. sn (NY); Bethlehem, 1 June 1872, T. C. Porter sn (MO); Bethlehem, 1841, Wolle sn (NY).

2. SAXIFRAGA MICHAUXII Britton

SYNONYMY

Saxifraga leucanthemifolia Michx. Fl. Bor. Am. 1:268 (1803) non

Saxifraga leucanthemifolia LaPeyrouse (1801)

Spatularia leucanthemifolia (Michx.) Haw. Saxifrag. Enum. 48 (1821)

Saxifraga leucanthemifolia Don Trans. Linn. Soc. 13:440 (1822)

Hexaphoma petiolaris Raf. Fl. Tell. 2:67 (1836)

Saxifraga michauxii Britton Mem. Torr. Bot. Club 4:118 (1894)

Spatularia petiolaris (Raf.) Small No. Am. Flora 22:2:150 (1905)

Hydaticea petiolaris (Raf.) Small Fl. S. E. U. S. ed. 2, 504, 1375 (1913)

Saxifraga petiolaris (Raf.) Bush Am. Mid. Nat. 11:224 (1928) non

Saxifraga petiolaris R. Br. (1819)

Micranthes petiolaris (Raf.) Bush Am. Mid. Nat. 11:225 (1928)

Perennial herb with much-shortened stem and fibrous roots. Leaves in basal rosette, 2.5 cm. - 19.0 cm. long, 1.0 cm. - 4.5 cm. wide, spatulate, tapering toward the base to a pseudopetiole equal to one-third to one-half the total length of leaf, margin of expanded portion of leaf coarsely dentate and ciliate, margin of pseudopetiole entire, ciliate to villous; expanded portion of the leaf thin and membranous, puberulent on both upper and lower surfaces. A single (rarely two), erect, many-flowered scape, 3.5 cm. - 18.0 cm. long, arising from the basal rosette, villous the entire length, paniculately branched, 3 to 12 branches per scape, 2.0 cm. - 12.0 cm. long, with the longest basal, the shortest terminal, villous, subtended by bracts, basal bract foliaceous with acute apices, sessile, upper bracts reduced in size, margins entire, ciliate, apices acute, sessile. Three to twenty flowers per branch, zygomorphic, pedicels 5.0 mm. - 12.0 mm. long, filiform, villous, subtended by a narrowly-lanceolate bracteole, bracteole entire, ciliate, apices acute, sessile. Sepals 5, oblanceolate, 1.5 mm. - 3.0 mm. long, 0.5 mm. - 1.0 mm. wide, acute apex, reflexed at anthesis, fused about one-fourth of length. Petals 5, 3 sagittate, white with two yellow-green spots (occasionally the two spots appear as one), 2 oblanceolate to lanceolate, white clawed, 3.5 mm. - 6.5 mm. long, 1.0 mm. - 2.0 mm. wide, inner surface papillose, margin satiny, one main nerve with two lateral branches pariorigin or impariorigin. Stamens 10, unicyclic, anthers elliptical, dehiscent longitudinally, basifixed, ring of callus tissue around the point of attachment. Filaments 2.5 mm. - 3.5 mm. long, subulate to filiform, distal portion acute. Follicles two, usually equal, 3.0 mm. -

3.5 mm. long, ribbed, coherent one-half to two-thirds of length, not spreading at maturity, ovary oblong, narrowing to a short, slender style, stigma small, slightly thickened. At anthesis, gland (nectary) a narrow band around ovary, disappearing at maturity. Follicle line of dehiscence adaxial; placentation axial; seeds fusiform, slightly flattened on one side, brown to black, longitudinally ridged with papillae.

Distribution: moist cliffs, ledges and banks, mountains of north-west South Carolina, northwestern Georgia, east Tennessee, western North Carolina, western Virginia, and West Virginia (Figure 4).

Saxifraga michauxii is a very distinct species. It is so different that it has been placed in a separate genus by several taxonomists (Haworth, 1821; Rafinesque, 1836; and Small, 1905) who have worked on the group in the past. It differs from the rest of the saxifrages of the Southern Appalachian area in having zygomorphic corollas and multiseriate trichomes. Its follicles are very similar in structure to those of S. micranthidifolia; and under certain ecological conditions, the leaves may resemble those of S. careyana.

Within the species there is a great deal of variation in the length of the scape. This variation is directly correlated with the ecological niche that the individual plants occupy. The plants that grow in crevices of rocks with very little soil are usually of small size (8.0 cm. - 10.0 cm. tall), whereas those that grow in more favorable sites may attain a height of 50 - 60 cm.

Several plants have been observed in which vegetative reproduction by plantlets borne on the stem had replaced the more typical sexual

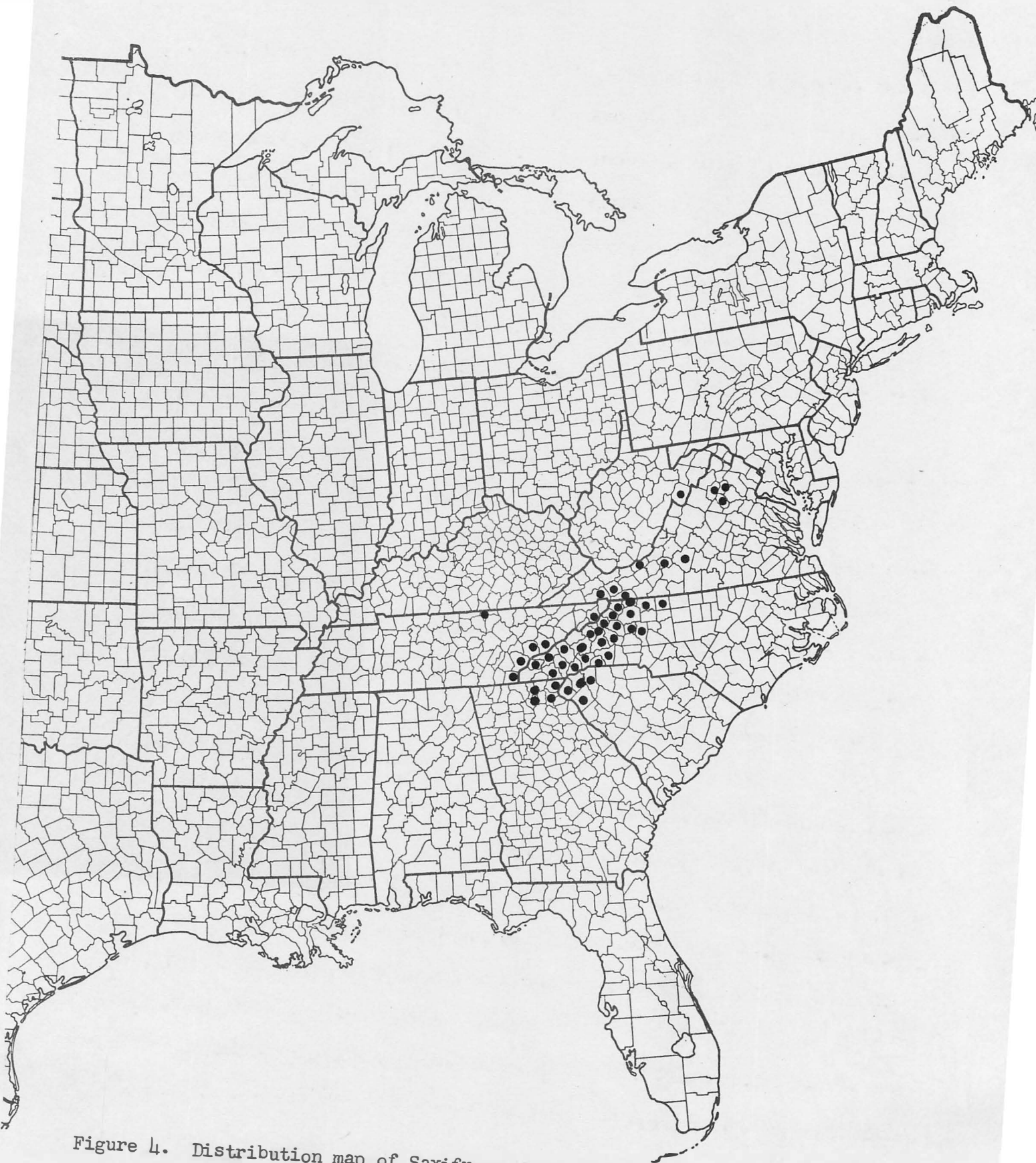


Figure 4. Distribution map of Saxifraga michauxii Britton.

reproduction. This is of great interest because vegetative reproduction appears regularly in certain species (which are related to S. michauxii) of Saxifraga from western North America and the boreal region of the world, although it has not previously been reported to occur in this species.

Specimens examined:

SOUTH CAROLINA. Anderson Co.: 1885, F. Earl sn (VPI).
Greenville Co.: Cedar Mt., in north central part of county, 27 May 1958, O. M. Freeman 5845 (NCU); cavernous places, Caesar's Head, 9 August 1881, J. D. Smith sn (GH). Oconee Co.: moist rocks, Whitewater River, above Jocassee, 10 June 1950, W. T. Batson, Jr. 205 (DUKE).
Pickens Co.: edge of rock, seepage, Table Rock Top, 12 April 1942, Leland Rogers 460 (DUKE, MO); in seepage area on wet rocks of Round Top Mt., 24 August 1936, D. S. Correll 6713 (DUKE).

GEORGIA. Habersham Co.: Jonah Mts., August 1846, T. C. Porter sn (PH); in moist places, summit of Jonah Mts., and at Tallulah Falls, August and September 1846, T. C. Porter sn (PH); crevices of dripping cliffs of gorge, Tallulah Falls, 31 May 1934, M. Straham & L. M. Perry 877 (GH, US); Tallulah, September 1866, T. C. Porter sn (GH); moist rocky places near bottom of Tallulah Gorge, 5 May 1940, D. Eyles 6907 (DUKE, GH); south rock exposure, Troy Mt., 4275', 11 June 1934, F. Harper 613 (PH); Tallulah Gorge, 11-13 June 1910, J. M. Reade E3726 (WVA). Lumpkin Co.: damp places among steep, sloping rocks, Frogtown Gap, ca. 3150', 31 May 1934, A. N. Leeds 2024 (PH); moist rocks at gap just below Blood

Mt., ca 4000', 7 July 1940, D. Eyles 7224 (GH); moist rocky slopes, 3 mi. s. of Neel Gap, 14 May 1938, J. H. Pyron & R. McVaugh 2898 (DUKE, PH); moist places on granite cliff just e. of Woody Gap, 3300' elev., 1 June 1947, A. Cronquist 4505 (PH); on wet dripping rock face along road near Vogel State Park, 30 March 1950, W. J. Dress & J. Hanson 2102 (GA). Rabun Co.: Tallulah Gorge, 28 July 1956, H. W. Bookout 17 (GH); in seepage spots on gneiss outcrops just below summit of Rabun Bald, 13 October 1946, A. Cronquist 4202 (PH); moist rocks on Black Rock Mt., 21 August 1936, D. S. Correll 6631 (DUKE); Tallulah Gorge, in moist rocky places, 14 April 1937, D. Eyles 1384 (DUKE). Union Co.: in wet moss on exposed granite rock under oak woods between Wolf Pen Gap and Slaughter Mt., about 10 mi. s. of Blairsville, 3500' elev., 1 June 1947, A. Cronquist 4504 (US).

TENNESSEE. Blount Co.: top of Gregory's Bald, 2 July 1934, M. B. Wilson & A. J. Sharp 1796 (TENN); Cade's Cove, August 1899, J. H. Ferris sn (MO). Carter Co.: Roan Mt., in the bald, 17 June 1953, Fred Galle 17741 (TENN); in moist sandy humus, rock crevices, Roan Mt., 22 August 1937, H. M. Jennison sn (TENN); Roan Mt., 5000', moist n. slope, 22 July 1948, S. Fairchild, E. Clebsch, E. Hernández & A. J. Sharp 11727 (TENN); summit of Roan Mt., 18 August 1887, Roland Thaxter sn (GH, US); on rocky places, Roan Mt., 23 June 1935, A. Caton, M. B. Wilson & L. R. Hesler 3692 (TENN); Roan Mt., near the summit, 14 July 1913, Biltmore Herbarium 1231g (US); from damp rocks near path leading down from grassy bald, Roan Mt., 2 July 1940, L. Stewart 1532 (NCU). Monroe Co.: rocky ridge top of Beech Gap, Cherokee Nat'l. Forest, 30 May 1940, A. J. Sharp 704

(GH, TENN); Rattlesnake Rock, 4800' elev. rock faces, 20 June 1946, E. Clebsch 1889 (TENN). Pickett Co.: Pickett State Park, moist, sandy shelf beneath bluff of Hazard Cave, 24 June 1947, R. E. Shanks, E. Clebsch & A. J. Sharp 4133 (GH). Polk Co.: wet bluffs along Ocoee Lake, 8 June 1958, N. H. Russell, F. H. Norris & A. J. Sharp 23631 (TENN). Sevier Co.: Myrtle Point on Mt. LeConte, 21 August 1940, W. B. Fox sn (WVA); moist bank, roadside at Walker Prong, 7 August 1956, F. Brown & H. L. Sherman 20941 (TENN); in rock crevice on upper ledge of Ramsey Cascades ca. 5000', vicinity of Greenbrier, 1 September 1936, J. R. Raper & H. M. Jennison 3356 (NPH, TENN); in rich, moist, black humus, in rock crevices along trail to Jump Off at 5500', Newfound Gap, 6 July 1935, H. M. Jennison 454 (NPH, TENN); Walker's Camp, Little Pigeon River, 3700', 2 August 1930, S. A. Cain sn (TENN); Chimney's Trail, 4 August 1934, A. J. Sharp s71 (NPH, TENN); in moist crevices of rock near summit of Mt. Chapman, ca. 6200', vicinity of Cosby, 16 August 1936, J. R. Raper & H. M. Jennison 3372 (NPH, TENN); in moist soil on cliffs near Clingman's Dome, 3 September 1944, W. H. Judd & F. T. McFarland 4869 (GH); Newfound Gap, 5500' elev., 16 July 1956, D. L. Crandall sn (TENN); Alum Cave Bluff, Mt. LeConte, alt. 4900', 17 October 1944, G. S. Miller 2254 (US); Alum Cave Trail to Mt. LeConte, ca. 6200', wet rocky area near trail, 20 July 1956, D. L. Crandall sn (TENN); Pinnacle Mt., Greenbrier, elev. 1256', 6 July 1934, M. B. Wilson & A. J. Sharp 1256 (TENN); in moist humus on cliff, ca. 5000' elev., vicinity of Mt. LeConte, 21 June 1936, J. G. Smith & H. M. Jennison 2514 (NPH, TENN); moist rocky soil, Clingman's Dome, 6 August 1935, A. J. Sharp & H. M. Jennison 593 (NPH,

TENN); Alum Cave in damp soil, 27 June 1934, M. B. Wilson 1711 (TENN); Shultz Creek, above Greenbrier, 5 July 1934, J. K. Underwood 1972 (GA, TENN); damp sphagnum covered rocks, Boulevard Trail, near Myrtle Point, 14 August 1939, L. Stewart sn (NCU); spruce-fir forest, Mt. Chapman ne. ridge near summit, 19 August 1956, G. S. Ramseur 1715 (NCU); spruce-fir forest, Mt. Guyot, along the Appalachian Trail, on ne. slope, 19 August 1956, G. S. Ramseur 1699 (NCU); spruce-fir forest, Mt. LeConte, n. slope of w. ridge, about 6000', 14 August 1956, G. S. Ramseur 1659 (NCU); spruce-fir forest, Boulevard Trail, w. of Mt. Kephart, 12 August 1956, G. S. Ramseur 1585 (NCU); wind throw in spruce-fir forest, near summit of Laurel Top, 17 August 1957, G. S. Ramseur 4057 (NCU); heath bald, Cliff Top, Mt. LeConte, 16 August 1957, G. S. Ramseur 4002 (NCU); Mt. LeConte, alt. 6500', opening at summit, 12 August 1930, H. K. Svenson 4009 (GH); rocky cliffs, Alum Cave, 27 June 1934, S. A. Cain 664 (TENN); in humus rock pockets on old trail down n. slope of Clingman's Dome, ca. 5500', 10 July 1936, H. M. Jennison 2609 (NPH, TENN); Mt. LeConte, rocky openings 6000', 31 July 1929, S. A. Cain sn (TENN); Greenbrier, Pinnacle Mt., 6000', 7 June 1934, M. B. Wilson & A. J. Sharp 1260 (TENN); Clingman's Dome, 12 June 1947, G. S. Miller 2269 (US).

NORTH CAROLINA. Alexander Co.: Rocky Face, in centers of large moist lichen mats on bare granitic rock, 4 May 1952, T. Daggy 1977 (NCU); rock mat, Rocky Face Mt., hiddenite, 14 April 1941, C. Keever 257a (DUKE). Allegheny Co.: wet rock, Blue Ridge Pky., 24 July 1946, F. H. Hunnewell 18439 (GH); rock outcrop, near N. C. 18, 4 mi. sw. of Whitehead, 30 May 1958, A. E. Radford 34171 (NCU); cedar mats, granitic rock, Stone Mt.,

near Miles, 27 August 1948, Lewis Anderson et al. 8219 (DUKE); in rock crevices on upper slope of Bluff Mt., 14 July 1948, D. S. Correll & H. L. Blomquist 14520 (DUKE). Ashe Co.: rocky places, 2 June 1940, P. O. Schallert sn (GH, MO); on cliff, near top of Negro Mt., 7 September 1949, W. B. Fox & R. K. Godfrey 3339 (TENN); Negro Mt., top near Jefferson, 30 July 1891, W. W. Ashe sn (NCU). Avery Co.: Cranberry, 22 September 1898, J. Muir, C. S. Sargent & W. M. Canby 45 (MO); summit of Beech Mt., alt. 1650 m., 23 August 1915, E. S. Steele 13 (GH, US); Grandfather Mt., 6000' elev., August 1896, J. D. Smith sn (US); Grandfather Mt., 22 August 1890, A. A. Heller sn (MO, PH); Grandfather Mt., 15 July 1891, B. H. Smith sn (PH); Grandfather Mt., 11 July 1891, J. K. Small & A. A. Heller sn (US); Grandfather Mt., 25 August 1893, A. A. Heller sn (GH, US); wet rocks, Grandfather Mt., 18 June 1899, J. R. Churchill sn (TENN); Grandfather Mt., 12 August 1891, A. B. Seymour 91 8 12 (DUKE, GH); wet cliff on Grandfather Mt., 18 August 1954, L. E. Hicks & F. Bartley 2041 (US); wet rocks, Grandfather Mt., 7 July 1924, F. W. Hunnewell 9274 (WVA). Buncombe Co.: Black Mt., 27 June 1872, sn (GH); peak of Black Mt., June 1872, P. V. Leroy & M. Ruger sn (US); common on moist rocks and around seepage areas at Craggy Gardens on the Blue Ridge Pky., about 20 mi. ne. of Asheville, 1 September 1955, R. L. Wilbur 4895 (GH); wet rocks, vicinity of Montreat, 23 August 1913, P. C. Standley & H. C. Bollman 9978 (US); wet rocks near summit of Craggy Mt., 8 July 1897, Biltmore Herbarium 1231d (GH, MO, PH, US); rock outcrops, in grassy bald top of Craggy Mt., 15 July 1935, H. J. Oosting 35448 (DUKE); Bald Knob Mt., growing in rock crevices, open, dry, on Mt. top,

7 July 1934, D. S. Correll 112 (DUKE); at 3000' elev., in rich woods above Montreat, 10 July 1921, D. C. Peattie 950 (NCU); grass bald, Craggy Dome, sw. slope near Blue Ridge Pky., 10 July 1956, G. S. Ramseur 755 (NCU); frequent on moss-covered rocky bank, along Blue Ridge Pky., at Craggy Dome, 30 June 1951, R. M. Schuster a3944 (DUKE, GA). Burke Co.: summit of Table Rock, 20 July 1904, Biltmore Herbarium 1231i (US). Caldwell Co.: on moist slope along trail near "Attic Window," Grandfather Mt., 22 July 1940, L. Stewart & A. E. Radford 1597 (NCU). Graham Co.: along Little Santeetlah River, siliceous, wet bluff, 21 May 1955, A. J. Sharp 18862 (TENN); rock cliff, 4.6 mi. w. of Santeetlah Gap, on Santeetlah Creek, 29 May 1956, A. E. Radford & H. E. Ahles 13333 (NCU). Haywood Co.: moist cliffs, in vicinity of Eagle's Nest near Waynesville, alt. 900-1500 m., 31 August 1910, Paul Standley 5399 (US); damp rocks, summit of Junaluska Mt., alt. 6225', Balsam range, 5 August 1882, J. D. Smith sn (US); Balsam Mts., 6000' elev., 2 June 1909, H. D. House 4214 (US); rocky open Mt. side, Mt. Pisgah, Curso, 19 June 1939, Margaret Murley 927 (OKL); damp rocks, upper Mt. Pisgah, 16 June 1931, K. M. Wiegand sn (MO); Sunburst, 3200', 5 June 1910, H. D. House 4444 (US); Eagle's Nest, Waynesville, 22 June 1932, H. L. Blomquist 3783 (DUKE); mixed deciduous forest, 4200' s. of Sunburst, 5 October 1958, S. Steward sn (NCU); wet cliff, 5.3 mi. n. of Beech Gap on road to Sunburst, 5 June 1958, J. A. Duke & H. E. Ahles 42267 (NCU); roadside ditch, 4.1 mi. n. of Beech Gap on road to Sunburst, 15 July 1958, J. A. Duke & H. E. Ahles 46686 (NCU); spruce-fir forest, Silver Mine Bald, at summit, 23 July 1957, G. S. Ramseur 3593 (NCU); heath bald, Devil's Courthouse, near summit, 23 July

1957, G. S. Ramseur 3623 (NCU); heath bald comm., Sam Knob, e. slope near summit, 30 June 1956, G. S. Ramseur sn (NCU); spruce-fir forest, Plott Balsam Mt. slope near summit, 4 July 1956, G. S. Ramseur 683 (NCU); fire cherry-heath comm. near summit of Sam Knob, 27 June 1958, G. S. Ramseur 4734 (NCU); birch-cherry comm., e. side of Pigeon River on road to Beech Gap, elev. 5000', 14 August 1954, Stillman & Munson sn (NCU); Mt. Pisgah, 21 June 1931, E. H. Walker 1543 (NCU); on rocky bank of stream, 6 mi. s. Lake Logan, 4400' elev., 18 July 1954, Henry Wright & J. W. Hardin 219 (GA). Henderson Co.: moist soil on rocks, Flat Rock, 14 June 1904, Biltmore Herbarium 1231j (US); moist rock near summit of Bald Mt., 12 May 1898, Biltmore Herbarium 1231a (US); Flat Rock, 14 June 1885, E. R. Memminger sn (NCU). Iredell Co.: Statesville, M. E. Hyams sn (CINC); Rocky Fall Mt., w. of Statesville, 1 October 1937, Hoffman & Raynal sn (NCU). Jackson Co.: between Highlands and Cullowhee, Tuckaseegee Falls, 1887, Ronald Thaxter sn (GH); Balsam, E. L. Braun sn (CINC); abundant on large rocks, spruce-fir, summit of Judaculla Ridge, 29 August 1951, H. Wright & R. K. Godfrey 52173 (DUKE, GH); in seepage area of face of rock cliffs, e. fork of Tuckaseegee River, about 4 mi. e. of Tuckaseegee, 6 June 1951, R. K. Godfrey 51268 (DUKE, GH); moist cliffs, e. fork of Tuckaseegee River at Bonas' Defeat, 23 August 1951, R. K. Godfrey 52018 (PH, US); moist granite rock face e. of Cashiers, 16 September 1927, F. W. Pennell & E. T. Wherry 14168 (PH); rocks near Tuckaseegee Falls, 16 July 1927, F. W. Hunnewell 10343 (WVA); Chattooga River between Narrows and Gov'ment bridge of Bull Pen Road, 24 August 1949, T. T. Bannister & L. E. Anderson 427 (DUKE); moist bare rock cliff near upper Tuckaseegee

Falls, 4 July 1934, H. J. Oosting 34522 (DUKE); crevices in rock bank 6 mi. s. of Tuckaseegee, 3 June 1947, R. L. Wilbur 210b (DUKE); heath-weed comm., at 5650' se. slope of Judaculla Ridge, 1 August 1957, G. S. Ramseur 3840 (NCU); grass bald, Rough Butt Bald, Mt., nw. slope near summit, 23 June 1956, G. S. Ramseur 242 (NCU); Wesner Bald, Balsam, 19 July 1911, E. L. Braun sn (CINC). Macon Co.: Cullasaga Gorge, near Highlands, 27 May 1934, H. M. Jennison 905 (TENN); 3 mi. from Highlands, on the Horse Cove road, rock by waterfall, 10 June 1944, C. Kever 812 (DUKE, VDB); on rock at Sherwood, Highlands, 10 July 1901, T. G. Harbison sn (GH); Satulah Mt., May 1896, J. A. Bates sn (OKL); wet rocks near the summit of Satulah Mt., 9 May 1896, Biltmore Herbarium 1231 (PH, US); wet rock near the summit of Satulah Mt., 25 May 1897, Biltmore Herbarium 1231b (GH, US); bare rock slope, edge of moss mat, Whiteside Mt., 21 June 1936, H. J. Oosting 3646 (MO); Mt. Satulah, Highlands, 27 July 1932, J. K. Underwood 2862 (TENN); wet rocks, Wild Cat Ridge, Whiteside Mt., 12 June 1934, M. B. Wilson sn (TENN); on rocks in bed of small stream near Dry Falls, nw. of Highlands, 16 July 1951, R. K. Godfrey 51363 (PH); Satulah Falls, 2 mi. s. of Highlands on Wahalla Rd., s. slope of Mt. Satulah, 18 August 1949, T. T. Bannister & L. E. Anderson 129 (DUKE); moist rocks below Dry Falls, Cullasaga River, 24 June 1934, H. J. Oosting 34419 (DUKE); summit of Mt. Satulah, 18 August 1949, T. T. Bannister & L. E. Anderson 201 (DUKE); on rock outcrop 5 mi. e. of Highlands, 11 August 1948, R. L. Wilbur 1177 (DUKE); near Wild Cat Cliff, Highlands, 24 July 1931, W. C. Coker sn (NCU); rock quarry near J. E. Potts at Highlands, 28 July 1938, H. Hechenbleickner & L. Stewart

sn (NCU); on top of Bear Pen Mt., at Highlands, 30 July 1940, G. Burton
sn (NCU); on road up Satulah Mt., Highlands, 11 August 1932, W. C. Coker
sn (NCU); on gneiss, Horse Cove, on Black Rock Mt., 19 June 1946, A. E.
Radford 2522 (NCU); Satulah Mt., near Highlands, 4 September 1932, H. R.
Totten sn (NCU); Glen Falls, Highlands, 21 July 1940, G. Burton sn (NCU);
 on rocks above Glen Falls, near Highlands, 13 July 1938, I. Stewart sn
 (NCU, VPI). McDowell Co.: hemlock woods near Big Craggy, on Blue Ridge
 Pky., 1 September 1956, C. R. Bell 4439 (NCU). Mitchell Co.: on rocks,
 Roan Mt., July, A. H. Curtiss 852 (GH, PH, US); Roan Mt., H. Stratton sn
 (ILL); Roan Mt., alt. 6300', 15 July 1880, J. W. Chickering sn (DUKE, GA,
 TENN, US); Roan Mt., 27 June 1887, A. Sharpless & A. H. Goodwin sn (PH);
 damp ground, Roan Mt., alt. 6100', 11-15 September 1884, J. D. Smith sn
 (US); top of Roan Mt., 12 July 1880, T. C. Porter sn (PH); Roan High
 Knob, 28 June 1902, W. A. Cannon 25 (US); Roan Mt., 20 July 1879, C.
Mohr sn (US); Roan Mt., 1900 m., 8 August 1892, C. H. Merriam sn (US);
 Roan Mt., alt. 6000-6318', 7-8 July 1925, P. A. Rydberg 9330 (PH); Roan
 Mt., alt. 6000-6318', 12-20 July 1880, J. D. Smith sn (US); Roan Mt.,
 16 September 1877, J. W. Chickering, Jr. sn (US); Roan Mt., June 1880,
F. D. Hyams sn (US); Roan Mt., 9 September 1885, N. L. Britton sn (US);
 moist bank beside trail spruce-fir, Roan Mt., 15 June 1936, H. J. Oosting
368 (DUKE); heath bald, Roan High Bluff, exposed bluff, 6 August 1956,
G. S. Ramseur 1219 (NCU); grass bald, Bald Mt., in pasture on n. slope,
 6 August 1956, G. S. Ramseur 1365 (NCU); grass bald, Roan High Knob, at
 summit, 7 August 1956, G. S. Ramseur 1187 (NCU); on rocky areas of grass
 bald, Round Bald, alt. 5650' s. aspect, 6 August 1956, A. F. Mark sn

(DUKE). Polk Co.: wet rocks, Skyuka Mt., 25 May 1899, J. R. Churchill sn (MO, TENN, US); wet rocks near the summit of White Oak Mt., (elev. 2800'), near Columbus, 4 May 1897, Biltmore Herbarium 1231c (GH, MO, NCU, PH, US); below the fall, near Columbus, 17 April 1897, E. C. Townsend sn (US). Rutherford Co.: moist rocky cliff along stream below Chimney Rock, 14 July 1934, H. J. Oosting 54709 (DUKE). Stokes Co.: oak-hickory woods on Hanging Rock, 10 May 1953, A. E. Radford 6992 (NCU); dry stony woods at base of Hanging Rock, about 100 ft. from top of rock, Hanging Rock State Park, about 4 mi. w. of Danberry, 1 July 1940, A. E. Radford & L. Stewart 503 (NCU); on top of Moore's Knob, Moore's Spring, alt. 4000', 20 August 1921, P. O. Schallert 5306 (DUKE). Surry Co.: Pilot Mt., 30 May 1924, P. O. Schallert 5309 (DUKE). Swain Co.: moist open rock sides, Narrows near Double Spring Gap, 14 June 1935, L. Barksdale & H. M. Jennison 1296 (NPH, TENN); in wet clay sand, on sheer slope at about 1800', Epps Springs, 4 May 1937, H. M. Jennison 3834 (NPH, TENN); mossy rocks, Mt. Kephart, 12 July 1936, F. H. Hunnewell 14210 (GH); Pinnacle Rock, Clingman's Dome, alt. 6660', 25 August 1891, H. C. Beardlee & C. A. Kofoed sn (GH, MO, PH); wet banks beside road, above Indian Gap, 0.3 mi. below Clingman's Dome parking area, 10 October 1954, J. P. Gillespie, F. D. Robinson & H. S. Forest 18932 (TENN); Clingman's Dome, 26 August 1946, F. H. Sargent 115 (US); on wet rocks, 5000-6000', Mt. Buckley, 30 July 1935, L. Barksdale & H. M. Jennison 1261 (NPH, TENN); ledges along trail about 1 mi. n. of Newfound Gap, alt. 5500', 7 September 1935, S. K. Harris 1851 (GH); moist humus in pocket of rocks, of siliceous nature in shady places, ca. 6250', vicinity of

Clingman's Dome, 7 August 1936, H. M. Jennison 2595 (NPH, TENN); spruce-fir forest, Clingman's Dome, n. slope, near summit, 11 August 1956, G. S. Ramseur 1452 (NCU); fire cherry-weed comm. sw. slope of Mt. Buckley, 26 June 1958, G. S. Ramseur 4436 (NCU); Standing Indian, 6 July 1930, H. L. Blomquist 3784 (DUKE). Transylvania Co.: wet soil on rocks, Pink Beds, 16 June 1904, Biltmore Herbarium 1231h (US); mossy rocks, Pink Beds, 25 August 1908, H. D. House 4010 (GH); wet rocks, "Pink Beds Valley," 18 July 1909, H. D. House 4345 (US); near Haywood County line, at top of ridge, s. of Sunburst, (Lake Logan), 12 June 1955, J. W. Hardin 728 (GH, NCU); U. S. Hwy. 64, at Toxaway Falls, 22 May 1957, O. M. Freeman 57290 (NCU); Horse Pasture River, just downstream from Bahaynee Road bridge, 17 August 1949, T. T. Bannister & L. E. Anderson 45 (DUKE). Watauga Co.: the Blowing Rock, 14 June 1899, J. R. Churchill sn (MO); Blowing Rock Mt., elev. 4000', 28 June 1891, J. K. Small & A. A. Heller sn (PH); in vicinity of Blowing Rock, 19 July 1890, A. A. Heller 51 (PH); Blowing Rock, 16 July 1890, E. A. Vinton sn (US); dry soil, exposed rocky ledges, Blowing Rock, 1 August 1922, L. F. & F. R. Randolph 1163 (GH); spruce-fir forest, Calloway Peak, near summit, 5 August 1957, G. S. Ramseur 3940 (NCU); Linnville, 28 June 1911, F. W. Hunnewell sn (WVA); Blowing Rock, 17 September 1957, O. M. Freeman sn (DUKE). Wilkes Co.: spray from falls, "Cascades," Blue Ridge Pky., 8 June 1948, H. J. Oosting 2496 (DUKE); Stone Mt., 25 June 1938, L. Stewart sn (DUKE, NCU). Yancey Co.: moist soil on rocks, Mt. Mitchell, 12 August 1905, Biltmore Herbarium 1231L (US); summit of Mt. Mitchell, alt. 6711', 20 June 1898, Biltmore Herbarium 1231e (US); summit of Mt. Mitchell, alt. 6711', 25 August 1898,

Biltmore Herbarium 1231f (US); balsam woods, top of Mt. Mitchell, elev. above 6650', 22 August 1947, W. B. Fox 993 (GH); Mt. Mitchell, summit, 6 September 1913, P. C. Standley & H. C. Bollman 10351 (US); Mt. Mitchell, alt. 5500', 15 June 1931, J. A. Drushel 7720 (US); Mt. Mitchell, 9 August 1954, L. E. Hicks & F. Bartley 2054 (US); crevices of wet rocks, Clingman's Peak, 6000', elev., 5 October 1957, A. J. Sharp 22677 (TENN); Mt. Mitchell, 3 September 1931, Ward M. Sharp sn (MO); spruce zone of Mt. Mitchell, on moist, moss-covered rocks, common, 28 July 1956, H. F. L. Rock & R. B. Channell 9 (GH); 3 mi. s. of the Carolina Hemlocks Campground, 30 July 1958, O. M. Freeman 58270 (NCU); bald area, Mt. Mitchell, 17 August 1949, A. E. Radford 4881 (NCU); summit of Mt. Mitchell, in balsam woods, 10 July 1921, D. C. Peattie 916 (NCU); Mt. Mitchell, 3 August 1918, J. S. Holmes sn (NCU); fire cherry-yellow birch comm., Black Bros. Mt., e. slope along old r. r. grade, 12 July 1956, G. S. Ramseur 791 (NCU); fire cherry-yellow birch comm., along r. r. grade, e. slope of Mt. Mitchell, 28 June 1958, G. S. Ramseur 4818 (NCU); spruce-fir forest, Potato Hill Mt., near summit, 12 July 1956, G. S. Ramseur 798 (NCU); spruce-fir forest, Cattail Peak, near summit, 12 July 1956, G. S. Ramseur 816 (NCU); spruce-fir forest, Blackstone Mt., near summit, 18 July 1956, G. S. Ramseur 890 (NCU); spruce-fir forest, Potato Knob, near summit, 18 July 1956, G. S. Ramseur 901 (NCU); spruce-fir forest, Deer Mt., near summit, 27 July 1956, G. S. Ramseur 1128 (NCU); spruce-fir forest, Black Bros. Mt., near the summit, 27 July 1956, G. S. Ramseur 1042 (NCU); spruce-fir forest, Celo Knob, near summit, 26 July 1956, G. S. Ramseur 1084 (NCU); spruce-fir forest, Mt. Mitchell,

along trail to summit, 28 July 1956, G. S. Ramseur 1031 (NCU); wind fall in spruce-fir forest ne. slope, on Commissary Ridge, 28 June 1956, G. S. Ramseur 1023 (NCU).

VIRGINIA. Bedford Co.: Peaks of Otter, wooded Mt. slope, on rocks, Flat Top at 4000', 20 August 1907, W. Palmer 195 (VPI); Peaks of Otter, 4200', June ?, A. H. Curtiss sn (US); Peaks of Otter, 1 August 1868, A. H. Curtiss sn (MO, US); Peaks of Otter, 27 July 1869, sn (PH); summit of Peaks of Otter, 27 July 1869, "Ex Herb. Maggie Twaddett" sn (PH); Sharp Top, Peaks of Otter, Natural Bridge Forest, 24 June 1923, W. W. Eggleston 18637 (US); Sharp Top, Peaks of Otter, Natural Bridge Forest, 24 June 1923, W. W. Eggleston 18638 (GH); Peaks of Otter, Herb. Schweinitz sn (PH); Peaks of Otter, 24 July 1906, W. Palmer 91 (US); Peaks of Otter, 11 August 1877, R. H. Ward sn (ILL). Giles Co.: bald knob above Mountain Lake, alt. 5000', 24 June 1923, H. B. Meredith sn (PH, US); Mt. Lake, 15 June 1907, E. L. Braun sn (CINC); Bald Knob, Mt. Lake, 24 June 1893, sn (VPI); Salt Pond Mt., 4800', 19 August 1875, J. H. Redfield 5559 (MO); Salt Pond Mt., September 1876, J. H. Redfield sn (US); Salt Pond Mt., 20 June 1887, T. O. Fuller sn (GH); Salt Pond Mt., 1867, E. D. Cope sn (PH); bald top peak of Salt Pond Mt., W. W. Canby sn (GH); Bald Knob, Salt Pond Mt., 31 May 1890, A. Brown, T. Hogg, A. M. Vail, M. Timmerman & N. L. & E. G. Britton sn (US); Salt Pond Mt., 25 August 1899, C. L. Pollard & W. R. Maxon 68 (US); Bald Knob of Salt Pond Mt., Mountain Lake, between the rocks, 6 August 1931, P. A. Warren 77-4-2 (GH); wet rock ledges, summit of Bald Knob, alt., 4300', just s. of Mt. Lake, P. O., 1 August 1937, J. M. Fogg, Jr. 12874 (MO); below the summit

of Bald Knob, Mt. Lake, 2-4 September 1936, D. H. Linder sn (GH); on top of Bald Knob, 3/4 mi. s. of Mt. Lake P. O., in rock crevices of open exposed cliffs, 11 July 1943, H. H. Iltis 1851 (TENN); Bald Knob, exposed rock, 4300' elev., 15 July 1931, E. L. Core 3048 (WVA); Mt. Lake, 19 July 1932, E. L. Core 4286 (WVA); on rocky outcroppings, summit of Bald Knob, 5 August 1940, W. B. Fox sn (WVA); Bald Knob, Mt. Lake, 24 June 1893, sn (VPI). Grayson Co.: moist rocks, mature spruce-deciduous forest transition, around bluffs on n. slope, w. ridge of White Top Mt., 11 June 1958, G. S. Ramseur 4274 (NCU). Madison Co.: near the summit of Old Rag, Shenandoah N. P., 18 September 1941, E. K. Ball B7710 (US). Page Co.: atop Hawksbill Mt., 4049', 9 September 1945, J. T. Baldwin, Jr. 5477 (GH); Stony Man Mt., crevices of rocks, n. side where wet, 19 August 1901, W. Palmer & W. H. King 234 (US); Hawksbill Mt., 30 August 1901, W. Palmer & W. H. King sn (US); Stony Man Mt., crevices of rocks on w. side, 18 August 1901, W. Palmer & W. H. King 69 (US); at the base of waterfall on sandstone rocks, s. end of Waterfall Mt., near New Market Gap, in Massanutten Mt., deep shade, moist soil, 26 May 1949, Lena Artz 878 (GH); on sandstone rocks, moist, Massanutten Mt., at base of waterfall n. of New Market Gap, 26 May 1949, Lena Artz 636 (US); Stony Mt., 3900', 10 August 1924, N. Hotchkiss 1601 (US); Hawksbill Mt., near Luray, 3700' alt., 4 September 1901, E. S. Steele & Mrs. Steele 76 (GH, MO, US); Massanutten Mt., wet places near waterfall, New Market Gap, 3 July 1933, Lena Artz 307 (VPI). Rappahannock Co.: Shenandoah N. P., summit of Mary's Rock, dry exposed rocks, 3500', 16 June 1951, F. H. Sargent sn (GA, OKL). Roanoke Co.: crevices and pockets of exposed sandstone slabs

capping summit of McAfee Knob, alt. ca. 3000', 22 June 1946, C. E. Wood, Jr. 6054 (GH, US, WVA). Smyth Co.: moist rocky ledges, White Top Mt., vicinity of Mt. Rogers, 2 September 1931, W. M. Sharp sn (MO). Washington Co.: on the summit of White Top Mt., alt. 5678', 11-12 August 1892, J. K. Small sn (GH, MO); White Top Mt., 28 June 1939, sn (VPI).

WEST VIRGINIA. Pendleton Co.: crevices of rocks, summit of Panther Knob, elev. 4990', 9 July 1946, E. L. Core, H. A. Davis, P. D. Strausbaugh & H. P. Sturm sn (WVA); Panther Mt., alt. 4000-4500', 15-19 June 1925, P. A. Rydberg 9164 (PH).

3. SAXIFRAGA CAREYANA Gray

SYNONYMY

Saxifraga careyana Gray Am. Journ. Sci. and Arts, 1st series XLII:32 (1841)

Saxifraga grayana Kearney Bull. Torr. Bot. Club 21:262 (1894) non Britton Mem. Torr. Bot. Club 5:178 (1894)

Saxifraga tennesseensis Small Bull. Torr. Bot. Club 23:364 (1896)

Micranthes careyana (Gray) Small Fl. S. E. U. S. 501 (1903)

Micranthes tennesseensis Small Fl. S. E. U. S. 501 (1903)

Perennial herb with rhizomatous stem and a fibrous root system. Leaves in a basal rosette, 2.7 cm. - 13.5 cm. long, 1.2 cm. - 4.8 cm. wide, reniform to ovate to broadly spatulate, blade narrowing to a winged petiole equal to one-half to two-thirds the total length of leaf, margin of leaf shallow dentate to crenate, ciliolate, base truncate to attenuate, margin of petiole ciliate to villous; blade thin and membranous,

puberulent on both upper and lower surfaces. A single (rarely two), erect, many-flowered scape, 5.7 cm. - 14.5 cm. long arising from basal rosette, pilose, paniculately to cymosely branched, 4-7 branches per scape, 1.5 cm. - 7.5 cm. long, the longest basal, the shortest terminal, ciliolate, subtended by bracts, bracts linear (the lowest sometimes foliose, the upper greatly reduced in size), apices acute, sessile. Sepals 5, ovate, 1.0 mm. - 2.0 mm. long, 0.5 mm. - 1.2 mm. wide, apices acute to bluntly acute, slightly spreading at anthesis, fused about one-fifth to one-fourth of length. Petals 5, elliptical to oblanceolate narrowing to a short claw, 1.8 mm. - 5.0 mm. long, 0.6 mm. - 1.6 mm. wide, white with two yellow-green spots (sometimes indistinct), inner surface papillose, nerves indistinct. Stamens 10, unicyclic, anthers elliptical, dehiscing longitudinally, basifixed, ring of callus tissue around the point of attachment. Filaments 2.5 mm. - 3.3 mm. long, subulate, distal portion acute. Follicles 2 (occasionally 3 or more), usually equal, 1.8 mm. - 4.2 mm. long at maturity, ovary elliptical, narrowing to a short, slender style, stigma small, slightly thickened. At maturity follicles spreading at least to a 45 degree angle to the main axis. At anthesis ovary surrounded by a gland (narrow, lobed band about 1 mm. wide). Follicle line of dehiscence adaxial; placentation axial; seeds fusiform, brown to black, longitudinally ridged with papillae.

Distribution: moist rocks, cliffs and slopes, east Tennessee and mountains of North Carolina with single stations known in Virginia and Georgia (Figure 5).

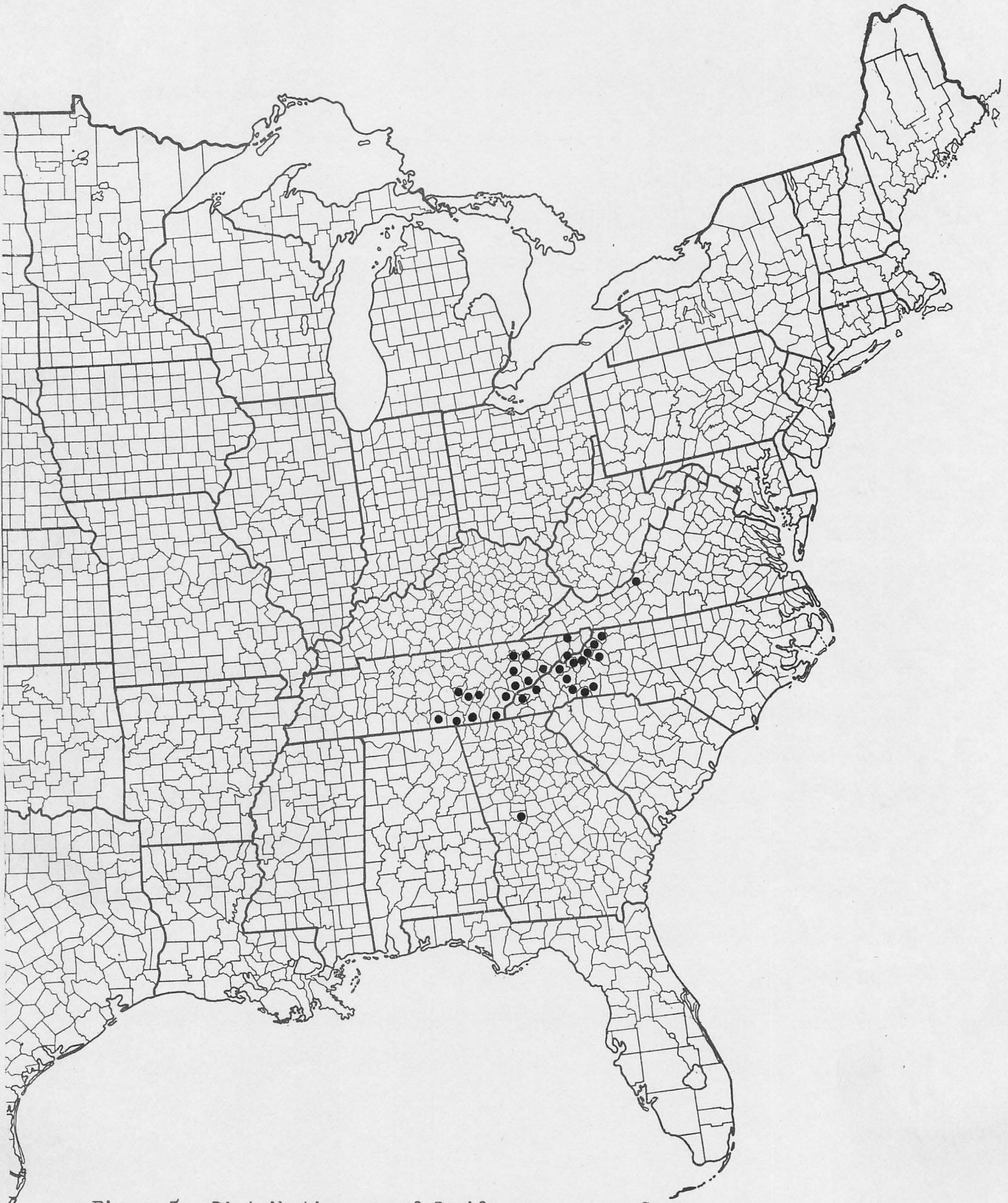


Figure 5. Distribution map of Saxifraga careyana Gray.

Specimens examined:

GEORGIA. Upson Co.: wet sandstone ledges, Dripping Rocks, west of Crest, 23 March 1935, J. H. Pyron & R. McVaugh 2315 (GA).

TENNESSEE. Bledsoe Co.: wet sandstone ledges, Brush Creek, alt. 1800', 17 May 1939, H. K. Svenson 10178 (GH, PH). Blount Co.: Little River near fork, moist roadside cliff, 6 May 1956, L. P. Lord sn (TENN); along Little River below Sinks, 29 April 1934, A. J. Sharp 386 (TENN); shallow soil, shale bluffs along Little River, 4 mi. below Sinks, 29 April 1934, H. M. Jennison 376 (TENN); Townsend, 7 May 1932, J. B. Kinsey sn (TENN); Little River below Sinks, moist rocky bluffs, 25 April 1934, S. A. Cain & W. H. Duncan 165-2 (TENN); bluffs above Townsend, forks of Little River, 8 May 1950, A. J. Sharp 13451 (TENN). Cocke Co.: near Del Rio, bluffs along Newport road, 18 April 1953, A. J. Sharp, E. B. Sharp & H. Silva 17256 (TENN). Franklin Co.: along stream, plateau slope near Sewanee-Winchester road, 20 May 1946, R. E. Shanks 1847 (TENN); cliff on the Alto road, Sewanee, alt. 1600', 29 April 1936, H. K. Svenson 7633 (GH, MO, PH, TENN). Grainger Co.: limestone soil, Lea Lakes near Blaine, 9 May 1934, Virginia Cook m-23 (GA, TENN). Hamilton Co.: Little Falling Water, 14 April 1933, E. McGilliard sn (UCHATT); Lookout Mt., near the line between Tennessee and Georgia which crosses the mountain, 8 May 1906, J. R. Churchill sn (GH, MO, TENN). Knox Co.: on rocks along the Tennessee River, 10 April 1885, A. Ruth 50 (TENN); rocks on Tennessee River, Knoxville, April 1891, A. Ruth sn (NY); bluffs along the Tennessee River, Knoxville, May 1894, A. Ruth sn (TENN); along Tennessee River, Knoxville, April 1895, A. Ruth sn (GH, ILL, MO, NY, PH,

TENN, US); rocks along Tennessee River, Knoxville, May and June 1896, A. Ruth sn (NY); rocks, Tennessee River, Knoxville, April 1896, A. Ruth sn (MO); bluffs on Tennessee River, Knoxville, April & May 1897, A. Ruth sn (US); rocks along Tennessee River, Knoxville, April 1897, A. Ruth sn (NCU, US); Cliff, Tennessee River, Knoxville, May 1897, A. Ruth sn (NY); rocks along Tennessee River, Knoxville, A. Ruth sn (MO, NY, US); rocks, Knoxville, April 1900, A. Ruth sn (NY); bluffs, Knoxville, June 1900, A. Ruth sn (US); Knoxville, on bluffs along Tennessee River, 3 April 1902, A. Ruth 2 (PH); Knoxville, April 1915, A. Ruth sn (US); humus on rocks, Cherokee Bluffs near Knoxville, 11 April 1934, M. Dickson 10 (TENN); bluffs near Knoxville, 1 May 1903, Biltmore Herbarium 1204e (US); bluffs along Tennessee River, Knoxville, April 1894, S. M. Bain sn (US); woodland thicket, The University of Tennessee Farm at Knoxville, 11 April 1934, M. B. Wilson & H. M. Jennison 255 (GA, TENN); Cherokee Bluffs, University Farm, 27 April 1943, A. J. Williams sn (TENN); Cherokee Bluffs, 22 March 1925, S. C. Fain sn (TENN); rocky slope, w. bank of Tennessee River, opp. U. T. Farm, 15 April 1954, A. A. Ichida 6 (TENN); dry crevices of dolomite, woods, Cherokee Bluffs, 29 March 1933, D. C. Bain 5 (TENN); rich woodland soil, Cherokee Bluff, Knoxville, 12 April 1939, L. Lawhorn sn (TENN); bluffs along Clinch River, Gallaher Ferry Rd., sw. corner of county, 6 June 1950, A. J. Sharp, R. E. Shanks & F. H. Norris 15159 (TENN); Cherokee Bluffs, Knoxville, 26 April 1928, W. A. Anderson sn (TENN); rich soil in rock crevices, Cherokee Bluffs, Knoxville, 28 March 1934, A. Morrison 37-49 (TENN); rich soil on hillside, Cherokee Bluffs, near Knoxville, 11 April 1934, N. Hodges 1 (TENN); Cherokee Bluffs, 11

April 1934, N. McCarrol m3 (TENN); Knoxville, 5 May 1895, J. D. Smith sn (MO); wet rocks, Cherokee Bluffs, near Knoxville, 11 April 1934, V. Cook 16 (TENN); ne. of Boyd's bridge, 2 April 1933, D. C. Bain 15 (TENN); abundant on bluffs of Tennessee River, Knoxville, April 1893, T. H. Kearney, Jr. sn (NY); at bottom of Cherokee Bluffs, University farm, 29 April 1943, C. Anderson sn (TENN); Tennessee River bluffs, opp. Island Home airport, Knoxville, 25 April 1931, M. B. Wilson sn (TENN); rocky slope, w. bank of Tennessee River, opp. U. T. farm, 15 April 1954, R. E. Lee 6 (TENN); Knoxville, along Tennessee River, April 1903, A. Ruth sn (CINC). Marion Co.: dripping sandstone bluffs, Big Fiery Gizzard Cove, e. of Tracy City, 13 May 1939, H. K. Svenson 10064 (TENN). Monroe Co.: along Little Tennessee River, wooded slopes, upstream from Chilhowee dam, 6 May 1956, A. J. Sharp & E. B. Sharp 20548 (TENN); wet ledges, Tellico Plains, F. H. Sargent 27 (US). Polk Co.: w. of Little Frog Mt., bluffs, along Ocoee River, 30 March 1956, C. W. James & L. P. Lord 20428 (TENN); wet bluffs along Ocoee River, on U. S. Hwy. 64, 5 mi. e. of Parksville, 18 March 1939, F. J. Hermann 10203 (GH, NY, US); sandy limestone bluffs, Hiwassee River Gorge, 19 March 1939, A. J. Sharp & S. A. Cain 275 (TENN). Rhea Co.: valley of Richland Creek, above Dayton, wet crevices of bluffs, 27 June, R. E. Shanks, A. J. Sharp & E. Clebsch 4357 (GH, TENN). Sevier Co.: Rainbow Falls Trail of Mt. LeConte, below falls, mossy rocks in stream, 13 May 1956, L. P. Lord 20600 (TENN); Roaring Fork Trail, Mt. LeConte, Gatlinburg, 16 June 1929, H. M. Jennison & L. R. Hesler 1317 (TENN); on moss on limestone outcropping, Roaring Fork Creek, Mt. LeConte, 5500' elev., 25 June 1933, J. K. Underwood &

A. J. Sharp 133 (TENN); Cannon's Creek, Greenbrier, 3700', on mossy rocks along stream, 12 May 1934, S. A. Cain & W. H. Duncan 342:2 (TENN); Mill Creek, Mt. LeConte, 4500', on mossy rocks of small brook, 12 May 1934, S. A. Cain & W. H. Duncan 315:2 (TENN); Roaring Fork, Mt. LeConte, 5500', on mossy rocks in brook, 13 May 1934, S. A. Cain & W. H. Duncan 338:2 (TENN); Mt. LeConte, 4500', near Rocky Spur Trail, 13 May 1934, J. K. Underwood 669 (TENN); Roaring Fork Trail, 13 May 1934, A. J. Sharp 402 (TENN); Roaring Fork Creek, Mt. LeConte, 13 May 1934, A. J. Sharp 652 (GA, TENN); Rainbow Falls, on wet mossy rock, 10 June 1934, S. A. Cain 579 (TENN); Rainbow Falls Trail, Mt. LeConte, 4 May 1935, Troy Jones sn (TENN); near Rainbow Falls, Mt. LeConte, 4000', wet crevices of rocks, 17 May 1942, A. J. Sharp & H. H. Iltis 1722 (TENN); Balsam Point, in moss by spring, 11 June 1937, F. W. Hunnewell 14988 (GH); rich moist humus and moss on boulders and in stone crevices, near or in stream in shaded mixed mountain woods (deciduous), below Rainbow Falls on n. slope of Mt. LeConte, above Gatlinburg, 4000' elev., 17 May 1943, A. J. Sharp & H. H. Iltis 1725 (DUKE, GH, ILL, MO, NCU, NY, OKL, TENN, UARK, US); spruce-fir forest, Mt. LeConte, n. slope, w. ridge about 6000', 14 August 1956, G. S. Ramseur 1660 (NCU); Rainbow Falls Trail on Mt. LeConte, 16 June 1936, L. Stewart sn (NCU); Indian Orchard Trail to Mt. LeConte, on moist moss on boulders and embankments, J. Monachino sn (NY).

Sullivan Co.: on bluffs along Holston River, near bridge 10 mi. above Bristol, 19 May 1934, H. M. Jennison, A. J. Sharp & J. K. Underwood 795 (TENN); road between Bristol and Shady, bluff of n. fork of Holston River, 16 May 1941, A. J. Sharp 1456 (TENN). Unicoi Co.: bluffs high

above Nolichucky River, between Hwy. 23 and 19W and Unaka Springs, 4 May 1953, R. L. James 17347 (TENN); Nolichucky River Gorge, near Unaka Springs, rocky wet bank at end of r. r. bridge across river from Unaka Springs, 26 March 1955, C. Lyle 19276 (TENN); moist rocky ledge, Chestoa, 3 mi. s. of Erwin, along r. r. bank, 26 April 1936, A. L. Prince 470 (DUKE); moist rocky ledge, Stony Point Road, near county line, 27 April 1936, A. L. Prince 490 (DUKE). Union Co.: bluff along Pinnacle Rd., near Loyston, 6 May 1934, J. K. Underwood 710 (TENN). Van Buren Co.: moist shale at base of Fall Creek Falls, 25 April 1954, A. J. Sharp 18255 (TENN); Cane Creek Gulf, Fall Creek Falls State Park, w. talus just n. of Fall Creek Gulf, 3 May 1952, Don Caplenor 510 (VDB); wet shaded rocks, $\frac{1}{2}$ way down the steep side of Fall Creek Falls Gorge, Fall Creek State Park, Cumberland Plateau, 2 May 1947, H. H. Iltis & N. H. Russell 3153 (TENN).

NORTH CAROLINA. Ashe Co.: Negro Mt., 7 June ?, W. W. Ashe sn (NCU). Avery Co.: Grandfather Mt., A. Gray sn (MO, NY); in monte Grandfather dicto, Carolinae Septentrionalis, July 1841, A. Gray & J. Carey sn (GH, NY, PH). Buncombe Co.: gneiss in hardwood cove near Bull Gap, 2 mi. n. of Riceville, 3 May 1953, B. M. Taylor, Jr., C. E. Wood, Jr. & A. E. Radford 6947 (GH, ILL, NCU, US); moist slope of Craggy Mt., 18 May 1898, Biltmore Herbarium 5651a (GH, MO, NY, US); exposed, rocky places on Cedar Cliff Mt., 11 May 1897, Biltmore Herbarium 1204b (NY, US); moist soil on rocks, Cedar Cliff Mt., 8 May 1904, Biltmore Herbarium 5651e (NY); Pinnacle Mt., near Tyson's Hotel, 20 May 1901, C. L. Pollard sn (US); along stream on woods, 2 mi. above Dillingham, 8 May

1937, D. S. Correll 7291 (DUKE). Caldwell Co.: mixed deciduous forest, 5 mi. ne. of Mortimer on N. C. 90, 15 April 1956, A. E. Radford 9916 (NCU). Graham Co.: wooded rocky slope, junction of Little Tennessee River & U. S. 129 near Swain-Graham County line, 25 April 1958, J. A. Duke & H. E. Ahles 38895 (NCU); mixed deciduous forest near U. S. 129 on Cheoah River at Tapaco, 29 May 1956, A. E. Radford 11893 (NCU).

Henderson Co.: in crevices of rock cliffs s. side Bear Wallow Mt., at 4200', 13 May 1956, Dan Pittillo 70 (NCU); seepage on gneiss, 3 mi. nw. of Fruitland, 5 June 1953, J. G. Haesloop & A. E. Radford 7116 (NCU).

Madison Co.: Hot Springs, May 1889, C. E. Smith sn (PH); rich land near Marshall Bluff Rd., 20 April 1927, S. O. Trentham sn (DUKE); wooded slope, 6.3 mi. se. of Marshall on U. S. 25-70 (0.9 mi. n. of county line), 26 April 1958, J. A. Duke & H. E. Ahles 38922 (NCU); rock outcrop, 0.5 mi. w. of Marshall on ne. side of French Broad River, 26 April 1958, J. A. Duke & H. E. Ahles 38952 (NCU).

Mitchell Co.: Roandale Farm, Roan Mt., 31 May 1895, A. G. Wetherby 187 (US); Roan Mt., Roan High Bluff, 14 July 1902, W. A. Cannon 85 (NY, US); Roan Mt., 31 May 1895, A. G. Wetherby sn (NY); Roan Mt., June 1881, W. M. Canby sn (US); Roan Mt., Eagle Cliff, 25 July 1894, sn (US); Roan Mt., 1879, J. H. Redfield sn (NY); in shade of overhanging rocks, Roan Mt., 21 June 1879, J. H. Redfield 11721 (MO); Roan Mt., 5 July 1880, J. W. Chickering sn (DUKE, GA, MO, NCU, NY, TENN, US); under shady rocks, Roan Mt., 23 June 1879, A. Gray, C. S. Sargent, J. H. Redfield & W. M. Canby sn (US); Roan Mt., and vicinity, July 1880, T. Meehan, T. C. Porter, J. Leidy & J. Willcox sn (NY); under Roan High Bluff, in spruce-fir forest, found in very moist place along a brook, 2

June 1934, D. M. Brown 50 (ET); top of Roan Mt., 9 July 1880, T. C. Porter sn (FH); Roan Mt., 13 July 1880, J. D. Smith sn (US); wooded slope, 2 mi. e. of Red Hill on N. C. 26, 2 May 1958, R. P. Ashworth & H. E. Ahles 39303 (NCU); wooded cove, 1.2 mi. se. of Carver's Gap on N. C. 261, 16 June 1958, J. A. Duke & H. E. Ahles 43254 (NCU); wet places on rocky soil under Roan High Bluff at 5100', 2 June 1934, D. M. Brown 51 (DUKE). Polk Co.: cliff by r. r. near Melrose, 19 May 1899, J. R. Churchill sn (MO); beside mountain waterfall, Melrose, 11 May 1926, D. C. Peattie 2164 (NCU); wet rocks on w. side of r. r. tracks, near and below Melrose, 23 April 1916, W. W. Ashe sn (NCU). Rutherford Co.: wooded stream border, Bottomless Pool, on Pool Creek, 21 April 1956, C. R. Bell & H. E. Ahles 11256 (NCU). Swain Co.: wet shale rocks, Nantahala Gorge, half way between Bryson City and Toyston, 6 May 1934, H. M. Jennison 590 (TENN); rock in hardwood forest in Nantahala Gorge, 1 mi. s. of Talc Mt., 7 June 1953, A. E. Radford & J. G. Haesloop 7232 (NCU). Watauga Co.: stream bank in wooded cove, 3.7 mi. s. of Aho on dirt road, 4 May 1958, R. P. Ashworth & H. E. Ahles 39514 (NCU). Yancey Co.: rocky wooded slope, 0.4 mi. w. of Ramseytown, 27 April 1958, J. A. Duke & H. E. Ahles 39120 (NCU); Mt. Mitchell, 6711', 20 June 1923, P. O. Schallert 6849 (DUKE); Mt. Mitchell, 18 May 1901, C. L. Pollard sn (US).

VIRGINIA. Craig Co.: base of wooded slope along tributary to Craig Creek, w. of Craig's Creek, 6 mi. ne. of New Castle, 14 April 1936, E. T. Wherry & J. W. Adams 2691 (GH).

4. SAXIFRAGA CAROLINIANA Gray

SYNONYMY

Saxifraga caroliniana Gray Mem. Am. Acad. II 3:39 (1836)

Saxifraga careyana Gray var. caroliniana Engler Monogr. Saxifrag. 137
(1872)

Saxifraga grayana Britton Mem. Torr. Bot. Club 5:178 (1894)

Micranthes grayana (Britt.) Small Fl. S. E. U. S. 501 (1903)

Micranthes caroliniana (Gray) Small North Am. Flora 22:2:146 (1905)

Perennial herb with a much-shortened stem and fibrous roots. Leaves in a basal rosette, 5.5 cm. - 16.5 cm. long, 2.3 cm. - 7.0 cm. wide, broadly spatulate to ovate, narrowing abruptly to a winged petiole equal to one-half to two-thirds the total length of leaf, margin of leaf dentate, ciliolate, base attenuate to truncate, margin of petiole ciliate to villous; blade thin and membranous, puberulent on both upper and lower surface. A single (rarely two), erect, many-flowered scape, 6.0 cm. - 18.5 cm. long, arising from the basal rosette, pilose with glandular hairs the entire length, paniculately branched, 3-9 branches per scape, 1.0 mm. - 7.0 mm. long, the longest basal, the shortest terminal, ciliolate, subtended by a bract, linear in shape (the lower sometimes foliose, the upper greatly reduced in size), apices acute, sessile. Two to twelve flowers per branch, actinomorphic, pedicels 5.0 mm. - 12.0 mm. long, filiform, ciliolate to pilose, subtended by a linear bracteole, entire, ciliolate, apex obtuse to bluntly acute, sessile. Sepals 5, elliptical, 1.2 mm. - 2.3 mm. long, 0.5 mm. - 1.0 mm. wide, apex acute, reflexed at anthesis, slightly fused at base. Petals 5, obovate, narrowing to a

short claw, 2.0 mm. - 3.8 mm. long, 1.0 mm. - 1.5 mm. wide, white with a yellow-green spot near the base, inner surface papillose, nerves indistinct. Stamens 10, unicyclic, anthers elliptical, dehiscing longitudinally, basifixed, ring of callus tissue around the point of attachment; filaments 3.0 mm. - 4.3 mm. long, clavate, distal portion acute. Follicles 2, usually equal, 3.0 mm. - 4.6 mm. long at maturity, ovary elliptical, narrowing to a slender style, about one-third to one-half the total length of the follicles, stigma small, slightly thickened, at maturity follicles slightly spreading. At anthesis ovary surrounded by gland, merely a narrow ridge, disappearing at maturity. Follicle line of dehiscence adaxial; placentation axial; seeds fusiform, brown to black, longitudinally ridged with papillae.

Distribution: moist rocks and slopes, mountains of western North Carolina and southwestern Virginia.(Figure 6).

Specimens examined:

NORTH CAROLINA. Alleghany Co.: mixed deciduous forest, near New River, 2.6 mi. n. of Amelia, 2 May 1958, A. E. Radford 32669 (NCU); mixed deciduous forest, near New River, 1.8 mi. n. of Amelia, 30 May 1958, A. E. Radford 34117 (NCU). Ashe Co.: moist rocky soil along stream on the way to Johnson's Knob, n. side of Big Tree Mt., 26 May 1939, G. W. McDowell & D. S. Correll 10878 (DUKE); Negro Mt., 27 June 1879, A. Gray, C. S. Sargent, J. H. Redfield & W. M. Canby sn (NY); Grandfather Mt., 5000' elev., 20 July ?, W. W. Ashe sn (NY).

VIRGINIA. Smyth Co.: collected about Chatham Gap on Walker Mt., 3000' elev., 13 June 1892, J. K. Small sn (CINC, DUKE, GH, ILL, MO, NCU,



Figure 6. Distribution map of *Saxifraga caroliniana* Gray.

NY, OKL, PH, TENN, UARK, US); Walker Mt., s.w. Virginia, 21 June 1892, J. K. Small sn (NY); Walker Mt., in the vicinity of Marion, 2100' elev., 21 June 1892, A. M. Vail & N. L. & E. G. Britton sn (NY, PH, VPI). Washington Co.: Abrams Falls, moist limestone rock, 15 June 1942, Lloyd G. Carr 568 (GH); Abrams Falls, 4 May 1958, A. Randolph Shields sn (TENN).

The Saxifraga careyana - Saxifraga caroliniana complex has long been a puzzle to those working with the Southern Appalachian saxifrages. Saxifraga careyana and S. caroliniana were described by Gray in 1841 and 1846, respectively. When he described Saxifraga caroliniana in 1846, he admitted that it could not be distinguished from S. careyana unless it was in flower. He had collected both of them in the autumn of 1843 and cultivated them, and it was not until the following spring that he realized he had two species instead of just S. careyana. Saxifraga caroliniana differs from S. careyana in that it has a reflexed calyx and clavate stamen filaments. Asa Gray noted that these characters remained constant under cultivation. Saxifraga caroliniana has been collected only in Smyth and Washington counties in Virginia and Ashe, Avery, and Alleghany counties in North Carolina. In this study of the Southern Appalachian saxifrages, Gray's observations that the two, S. careyana and S. caroliniana, remain distinct have been verified. The two characters mentioned above are constant, and there is no apparent intergradation between the two species.

Saxifraga careyana, itself, has been a troublesome taxonomic unit. The concept of what this taxon embraces has varied greatly. Upon referring

back to Gray's original description (1841) and to specimens that he named, it has become obvious that some of the problems in the Southern Appalachian saxifrages have been due to a lack of understanding of what is included in this species. The interpretation of this taxon has been a narrow one, including only part of what Gray considered in his original description: those plants which have reniform leaves with truncate bases. However, Gray, in addition, admitted all those that have ovate to obovate to spatulate leaves with bases that are truncate to subcordate. He also noted that there was variation in the amount of pubescence on the scape, pedicels and leaves, that the leaf margins might be either dentate, shallow-dentate or crenate, and that the bracts of the scape were on occasion foliose rather than linear.

Thomas H. Kearney, Jr. (1894), while studying a group of plants from the Cherokee Bluffs of the Tennessee River at Knoxville, first noticed the population of plants subsequently known as Saxifraga tennesseensis. He called this group of plants S. grayana Britt. (S. caroliniana Gray), even though he noticed that they had a spreading calyx rather than a reflexed one and thought the plants had clavate stamen filaments. J. K. Small (1896), working on the same plants, noted that Kearney's observations were not accurate; the stamen filaments were subulate rather than clavate. He felt that this group of plants was more closely related to S. virginensis than to S. caroliniana, and he described this group as the new species S. tennesseensis.

J. K. Small was correct in that this group definitely does not belong to S. caroliniana. It does, however, have many characteristics

in common with S. careyana, the only major differences being that the plants he called S. tennesseensis are much coarser in their general aspect. However, there are collections from the same general area that do not exhibit this character. It has been shown in the course of this study, by taking measurements of collections of both taxa, that the larger size is not a constant phenomenon. J. K. Small (1905) used as key characters the length of follicles and petals: S. careyana, petals 2.5 mm. - 3.0 mm. long, follicles 2.5 mm. - 3.0 mm. long; S. tennesseensis, petals 4.0 mm. - 4.5 mm. long, follicles 4.5 mm. long. Measurements of these structures were made on 109 collections (5 measurements per collection). It was found that 42.9 percent of the collections would not fall into the classes set up by Small but rather fall in between the two sets of measurements. A scatter diagram (Figure 7) was made of the two measurements: plotting follicle length against petal length; and it did not show any distinct segregation into two groups. Thus Small's name, Saxifraga tennesseensis, applies only to a population of plants (which should be included in S. careyana) on the Cherokee Bluffs of the Tennessee River, Knox County, Tennessee.

5. SAXIFRAGA VIRGINIENSIS Michaux

SYNONOMY

Saxifraga virginensis Michaux Fl. Bor. Am. 1:269 (1803)

Saxifraga vernalis Willd. Hort. Berol. 43 (1805)

Saxifraga vernalis Stern. Rev. Saxifr. 8 (1810)

Saxifraga nivalis Muhl. Cat. 44 (1813)

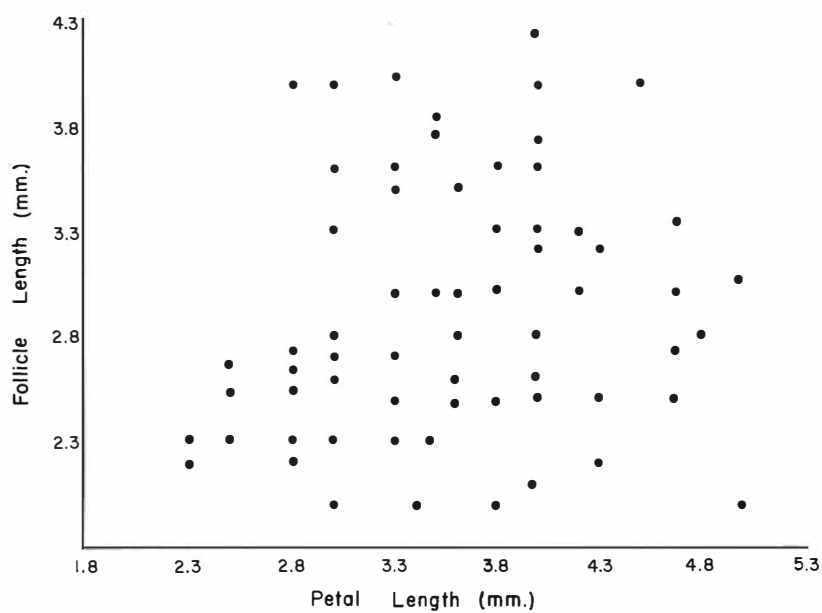


Fig. 7 - Scatter diagram of Saxifraga careyana -

Saxifraga tennesseensis

Saxifraga virginensis Pursh Fl. Am. Sept. 310 (1814)

Dermasea pilosa Haw. Saxifr. Enum. 8 (1821)

Dermasea pilosa var. verna Haw. Saxifr. Enum. 8 (1821)

Dermasea elongata var. pubescens Haw. Saxifr. Enum. 9 (1821)

Micranthes virginensis (Michx.) Small Fl. S. E. U. S. 501 (1903)

Saxifraga pilosa (Haw.) Bush Am. Mid. Nat. 11:219 (1928)

Perennial herb with a much-shortened stem and fibrous roots. Leaves in a basal rosette, 2.0 cm. - 15.0 cm. long, 1.0 cm. - 4.0 cm. wide, ovate to oblong to elliptical, narrowing abruptly to a winged petiole equal to one-third to one-half the total length of leaf, margin of leaf sinuate, crenate or shallowly dentate, ciliolate, base attenuate to truncate, margin of petiole ciliolate to ciliate, leaf base thin puberulent to glabrous. A single (occasionally several), erect, many-flowered scape, 7.0 cm. - 38.0 cm. long, arising from the basal rosette, pilose with glandular hairs the entire length, paniculately branched, 3-10 branches per scape, 1.0 cm. - 15.0 cm. long, the longest basal, the shortest terminal, ciliolate, subtended by a bract, linear in shape (the lower sometimes foliose, the upper greatly reduced in size), apex obtuse, sessile. Five to fifteen flowers per branch, actinomorphic, pedicels 4.0 mm. - 15.0 mm. long, filiform, ciliolate, subtended by a linear bracteole, entire, ciliolate, apex obtuse, sessile. Sepals 5, ovate to triangular ovate, 1.5 mm. - 2.5 mm. long, 1.0 mm. - 1.5 mm. wide, apex obtuse, erect at anthesis, fused at base to form a hypanthium, 1.5 mm. - 2.0 mm. long. Petals 5, oblong to elliptical, may be slightly narrowed at the base, 3.0 mm. - 6.0 mm. long, 1.0 mm. - 2.5 mm. wide, inner surface papillose, nerves indistinct. Stamens 10, unicyclic, anthers

elliptical, dehiscing longitudinally, basifixed, ring of callus tissue around the point of attachment. Filaments 1.0 mm. - 1.5 mm. long, subulate, distal portion acute. Follicles 2 (occasionally 3), usually equal, 1.0 mm. - 3.0 mm. long at maturity, ovary ovate, narrowing to a slender, short style about one-fifth of the total length of the follicles, stigma small, slightly thickened at maturity, tips of the follicles slightly spreading at maturity, the base of the follicles adnate to the hypanthium but not coalescent. At anthesis gland a distinct ridge just above the point of fusion of the hypanthium and the follicles, disappearing at maturity. Follicle line of dehiscence adaxial; placentation axial; seed fusiform, brown, longitudinally ridged with papillae.

Distribution: wet or dry limestone, sandstone and granite outcrops and gravelly openings of shady slopes. Quebec, Ontario, to Minnesota, south through New England and New York to Alabama and Georgia, west to Arkansas and Missouri (Figure 8).

Saxifraga virginensis Michx. has been long known to be a very variable species. Engler (1872) in his monograph of Saxifraga designated it as a polymorphic species. Other investigators (Small 1896, Johnson 1923, Bush 1928) have made the same observation.

In the course of this study, it has been found that there are some characters which are stable throughout the entire range of the species. One such character is the presence of a hypanthium which is fused to the follicles for about one-half their length. The length of the stamen filaments is always very short (1.0 mm. - 1.5 mm.) in relation to the length of the petals (3.0 mm. - 6.0 mm.).

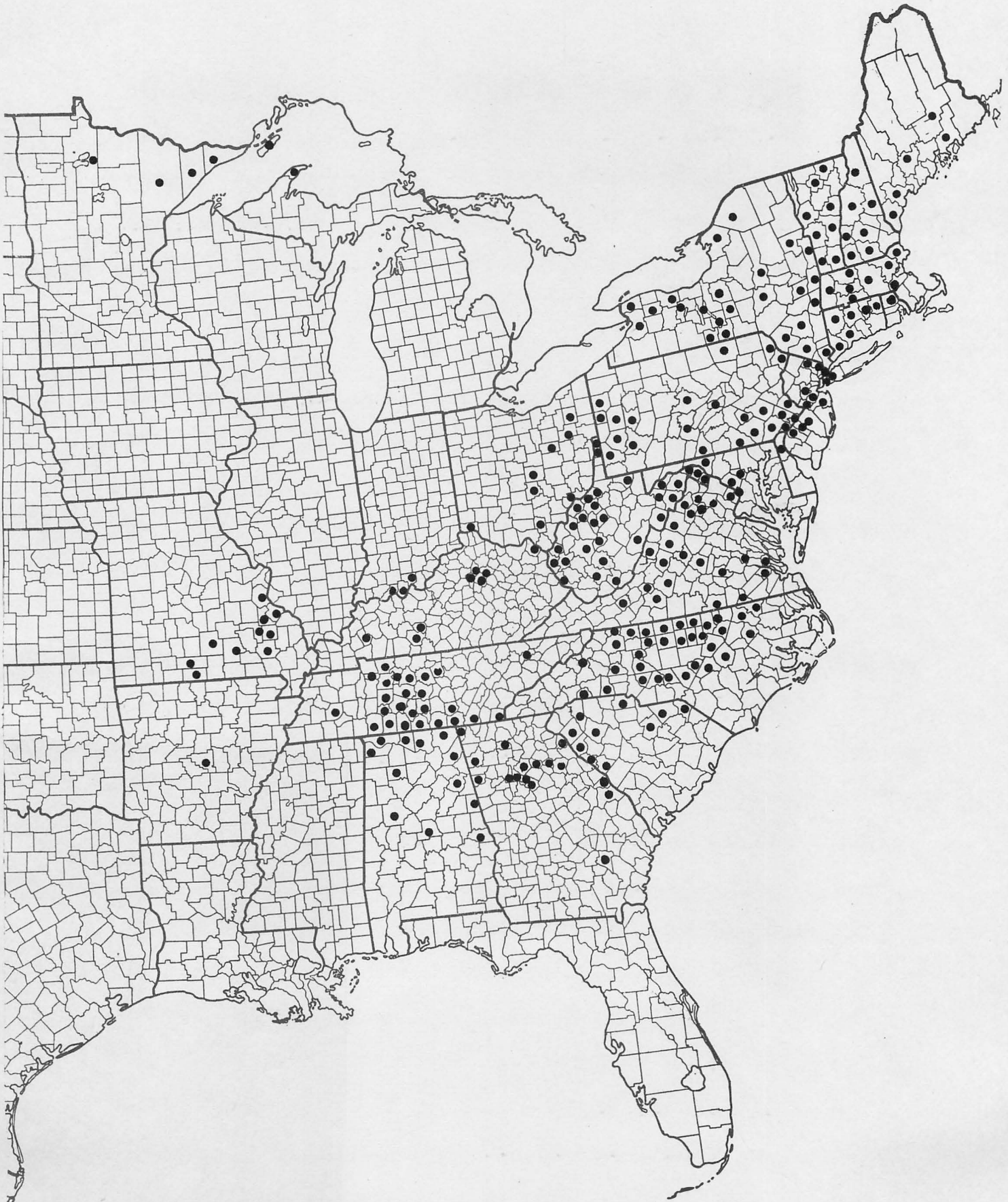


Figure 8. Distribution map of *Saxifraga virginensis* Michaux.

Variations have often been noted in the amount of distribution of pubescence, the shape and margin of the leaves, in the number of follicles, and the branching of the scape. M. L. Fernald (1950) cites four forms of Saxifraga virginensis in the eighth edition of Gray's Manual: S. virginensis Michx. forma plena Eames, which has numerous petals and a reduced number of stamens; S. virginensis Michx. forma glomerulata Fernald, which has all the flowers and fruits sessile; S. virginensis Michx. forma chlorantha (Oakes) Fernald, which has green petals rather than the usual white petals; and S. virginensis Michx. forma pentadecandra (Sterns) Fernald, in which the petals have been replaced by stamens. All these forms are local variations in New England and New York and have not been found in the Southern Appalachian region.

Bush (1928) segregated Saxifraga pilosa from Saxifraga virginensis. He considered S. pilosa to be a southern and midwestern species and S. virginensis, a northern and eastern species. Saxifraga pilosa has crenate leaf-blades, racemose inflorescences and single scapes, in contrast to the serrate leaf-blades, cymose inflorescences and several scapes of S. virginensis. It has been shown (Steyermark, 1959) that these characters intergrade between the plants of the two regions.

Johnson (1931), in a study on teratological phenomena in the North American species of Saxifraga, found abnormalities in twenty-six species of Saxifraga (including S. virginensis). He suggested that perhaps these abnormalities may have resulted from hybridization. Certainly the presence of such phenomena within a genus indicates a lack of genetic stability.

Specimens examined:

SOUTH CAROLINA. Abbeville Co.: oak-hickory forest, Savannah River, $3\frac{1}{2}$ mi. s. of Calhoun Falls, 29 March 1957, A. E. Radford 20052 (NCU). Anderson Co.: 1885, F. Earle sn (VPI); mixed deciduous forest, Lynches River near S. C. 903, 7 mi. s. of Jefferson, 31 March 1956, A. E. Radford 9083 (NCU). Edgefield Co.: mixed deciduous forest, Sawney's Creek, 8 mi. nw. of Camden, 7 April 1957, A. E. Radford 20857 (NCU). Laurens Co.: steep rocky slope of Reedy River at Boyd Mill Pond, 12 mi. sw. of Laurens, 12 April 1957, C. R. Bell 5581 (NCU). Marlboro Co.: mixed deciduous forest, Pee Dee River, 5 mi. e. of Bennettsville, 2 April 1956, A. E. Radford 9296 (NCU). McCormick Co.: mixed deciduous forest, Stevens Creek, e. of Modoc, 30 March 1957, A. E. Radford 20233 (NCU). York Co.: wooded slope of creek 0.4 mi. nw. of Jet, county rt. #72 and rt. #345 on county rt. #72 (s. sw. of Hickory Grove), 14 April 1957, J. G. Haesloop & H. E. Ahles 22874 (NCU).

ALABAMA. Calhoun Co.: Weaver Cave, in crevices of rock, moist area, 30 March 1954, Barbara Shirley sn (TENN). Chilton Co.: w. side of Coosa River, deciduous woods of steep river bluffs below dam at Verbena - Rockford crossing, 14 March 1956, Francis Harper & G. R. Cooley 4434 (GH). Colbert Co.: among rock outcrops above Tennessee River, T. V. A. Wilson Dam reservation, 25 March 1944, Duane Isely 3936 (PH); mixed woods on steep slope, 2 mi. from Mississippi state line, 8 April 1942, D. E. Eyles & M. S. Eyles 8008 (GH). DeKalb Co.: Mentone, 28 May 1892, C. Mohr sn (US). Jackson Co.: crevices of Porter's Bluff, sandstone, equally dense in limestone crevices of

Nickajack Cave, Bryant, 25 March 1939, Lillian V. Porter sn (GH).
 Lauderdale Co.: rocky, shady bank, Cypress Creek, Florence, 20 March 1893, C. Mohr sn (US). Lee Co.: Auburn, 2 April 1898, F. S. Earle & C. F. Barker sn (US); on dry granite outcrop 2 mi. nw. of Auburn, 7 April 1900, F. S. Earle & Esther Earle 21 (GH, MO, NY, US). Limestone Co.: banks along Elk River, 8.4 mi. w. of Hwy. 127 on Hwy. 62, rock outcrops, 22 March 1958, J. P. Gillespie 889 (DUKE). Madison Co.: Monte Sano State Park, 6 mi. se. of Huntsville, 12 April 1941, Leslie Hubricht B2013 (MO). Randolph Co.: edge of granite outcrop, 5 mi. w. of Wedowee, 10 March 1935, F. J. Hermann 10035 (GH). Tuscaloosa Co.: rocky slope of ravine at first tributary of North River, w. of Holt, alt. 75 m., Edna R. Clausen & R. T. Clausen 5738 (NY); Lock 13, near Peterson, on sandstone cliffs, 23 March 1955, Mrs. O. D. Chermock 44 (GH); mesic ravine, bluffs of Warrior River, below Lock 13, 21 April 1951, J. W. Hardin, F. W. Woods & R. E. Shanks 15567 (TENN); Tuscaloosa, 14 March 1872, E. A. Smith sn (US). Winston Co.: in fissuris rupestrium per reg. montosa, 1 May 1881, C. Mohr sn (US).

GEORGIA. Appling Co.: cliff s. bank of the Altamaha River above Baxley, 25 April 1936, F. Harper & A. N. Leeds 2787 (PH). Barrow Co.: moist rocky places, 2.5 mi. n. of Auburn, 17 March 1937, J. H. Pycn & R. McVaugh 1347 (GA). Burke Co.: slopes of Shell Bluff on Savannah River, 23 April 1936, F. Harper & A. N. Leeds 2767 (PH). Clarke Co.: rock outcrop, near Oconee River, Athens, 13 March 1931, J. M. Reade sn (TENN); rock bluff between Epps and Mitchell bridge, 1 March ?, K. M. Drewry E7763 (GA); moist open ground, Ag. College campus, Athens, 9

March 1928, J. M. Reade E3729 (GA); moist soil, near r. r. and cemetery, Ag. campus, Athens, 26 March 1927, A. G. Story E1074 (GA); on dripping rocks, campus, Athens, 30 March 1934, Lily M. Perry 878 (GH); rock outcrop, Athens, 12 March 1930, J. H. Pyron sn (DUKE, PH); rock outcrops, Oconee River, Athens, 2 March 1929, J. M. Reade sn (DUKE). Dade Co.: in rocks at base of cliff at edge of waterfall, 19 May 1940, W. H. Duncan 2366 (GA); on moist ledges, shade, bluffs of Lookout Mt., 21 April 1929, E. J. Palmer 35481 (GH, MO, NY); on and around limestone boulders near top of wooded w. facing slope of Lookout Mt., about Trenton, 1 April 1950, W. J. Dress & J. Hanson 2086 (GA). DeKalb Co.: shallow soil, Stone Mt., 15 March 1936, J. H. Pyron & R. McVaugh 472 (DUKE, GA); on dripping rocks, Pine Mt., 1 mi. n. of Lithonia, Lily Perry & M. C. Myers 879 (GH); moist pockets of humus and sand on granite outcrop, Rock Chapel, 28 March 1956, M. P. Burbank sn (NY, TENN, WVA); Stone Mt., on moist soil and in moss among granite outcroppings, 10 April 1941, S. L. Meyer & R. E. Shanks 1199 (TENN); moist places on the slope of Stone Mt., 15 April 1897, Biltmore Herbarium 1204c (GH, MO, NCU, NY, US); thin soil, granite ledges of Stone Mt., 16 April 1932, E. J. Palmer 39911 (GH, MO); moist soil, Stone Mt., 1-18 May 1895, J. K. Small sn (NY); on and about Little Stone Mt., 5 July 1895, J. K. Small sn (NY); moist places on the slope of Stone Mt., 15 April 1897, Biltmore Herbarium 1204d (US); shallow soil on granite, Little Stone Mt., 15 March 1936, J. H. Pyron & R. McVaugh 461 (GA). Floyd Co.: Rome, sn (MO, US). Fulton Co.: in shallow sandy soil on n. side of mountain in abundance, Stone Mt., 29 March 1930, Hattie Rainwater E7326 (GA). Gwinnett Co.: Thompson's Mill and vicinity,

1 April 1908, H. A. Allard 92 (NY, US); Thompson's Mill and vicinity,
 5 April 1908, H. A. Allard 93 (US); Thompson's Mill and vicinity, H. A. Allard sn (US); Thompson's Mill and vicinity, 29 March 1908, H. A. Allard 91 (US); on thin soil on granite rocks, near moisture, about 1 mi. w. of Logansville, 24 March 1949, G. H. M. Lawrence, H. E. Moore, Jr. & W. J. Dress 596 (GA). Haralson Co.: Tallapoosa, April & May 1900, P. M. Way 41 (US). Hart Co.: on rocks in woods on Savannah River within 1 mi. s. of mouth of Tugaloo River, 4 May 1940, F. Harper 1574 (PH). Newton Co.: edges of outcrops and patches of moist soil on granite, grass outcrops, near Oxford, 21 March 1937, Don Eyles 959 (DUKE). Oglethorpe Co.: moist places about granite outcrops, Echols Mill, 12 mi. ne. of Lexington, 4 April 1938, J. H. Pyron & R. McVaugh 2420 (GA). Pickens Co.: rocky crevices in woods, 3 mi. e. of Tate, 8 March 1936, J. H. Pyron & R. McVaugh 434 (GA). Richmond Co.: on sandstone rocks on high bluff along McBean Creek, 26 March 1904, Roland Harper 2061 (GH, MO, NY, US); rocks along the river, Augusta, 30 April 1901, A. Cuthbert 445 (NY). Rockdale Co.: shallow soil, edge of rock outcrops, "The Rocks," 5 km. n. ne. of Conyers, J. H. Pyron & R. McVaugh 1323 (GA); $\frac{1}{2}$ mi. n. of apex, on s. slope of creek at edge of "Flat Rock," 13 March 1956, F. Harper & G. R. Cooley 4405 (GH).

TENNESSEE. Bedford Co.: nw. of Halls Mill, cedar barrens, 11 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11255 (TENN); between Shelbyville and Unionville, on Tenn. 16, cedar glade along road, 24 April 1954, R. Stauffer & E. Quarterman 5016 (VDB). Cheatham Co.: Sycamore Creek, 30 March 1934, H. Bold & A. J. Sharp 75 (TENN); 25 April 1949,

Rheta Helm sn (VDB). Davidson Co.: on moist limestone ledges, wooded bluffs of Cumberland River near Nashville, 23 April 1929, E. J. Palmer 35502 (GH, MO, PH, US); Nashville, April ?, A. Gattinger sn (US); Little Marrowbone Rd., dry slope along road, P. W. Felts 28 (VDB); Nashville, 18 mi. s. just off Old Hickory Blvd. near Burnett's Chapel, cedar glade, roadside, 12 April 1947, E. Quarterman 1975 (DUKE, VDB); Nashville, Percy Warner Park, wet rocky bank, 11 April 1951, E. Quarterman 30 (VDB); near Linton, 6 April 1940, F. Wolfe sn (VDB); Nashville, Percy Warner Park, moist hillside, deciduous woods, 13 May 1944, E. Quarterman 805 (VDB); White Creek Pike, 15 April 1940, J. Stewart sn (VDB); Tyne Lane, 3 April 1940, F. Wolfe sn (VDB). Dickson Co.: near Big Barton Creek bridge, on Hwy., bluffs along creek, 20 April 1942, C. J. Felix, B. Adams & A. J. Sharp 10046 (TENN). Franklin Co.: exposed limestone rocks, Sewanee, 30 April 1936, H. K. Svenson 7586 (PH, TENN); near Winchester, bluffs along creek, 20 April 1940, R. E. Shanks & A. J. Sharp 391 (TENN); e. of Eastbrook, bluffs of Elk River, 4 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10764 (TENN); Sewanee, 6 May 1898, H. Eggert sn (MO); Cumberland Mt., at Sewanee, 6 May 1898, H. Eggert sn (MO, NY); Sewanee, 20 April 1881, E. Kirby Smith 849 (CINC). Giles Co.: near Campbellville, along Big Creek, 7 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10939 (TENN); s. of Elkton, bluff along Elk River, 7 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10978 (TENN). Grainger Co.: very steep, high limestone bluff, near Indian Cave, along Holston River, sparsely wooded and sometimes open rock crevices, and limestone covered with very rich humus on moist lower position of bluff, 24 April 1943, J. Norman & H. H.

Iltis 1673 (TENN). Grundy Co.: upper end of Goose Pond, 31 March 1949, P. H. W. Webb 643 (TENN). Hamilton Co.: near Chattanooga, slope along Chickamauga Creek in the Elise Chapin Sanctuary, 1 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10589 (TENN); Lookout Mt., April 1934, E. McGilliard sn (GH); Point Lookout, w. side of Lookout Mt., near line between Tennessee and Georgia, 23 April 1903, J. R. Churchill sn (GH); Suck Creek, Signal Mt., 11 April 1931, E. McGilliard sn (UCHATT); Raccoon Mt., 7 April 1934, B. Jaffe 44 (UCHATT); Chattanooga, 18 March 1883, J. F. James sn (CINC); at the point, Lookout Mt., 11 May 1901, J. Schneck sn (ILL). Hickman Co.: bluffs along Duck River, n. of Centerville, 27 March, 1956, R. E. Shanks 20430 (TENN). Houston Co.: moist rocks, wooded bluffs, near Erin, 24 May 1920, E. J. Palmer 17605 (MC); Tenn. 49, 2 $\frac{1}{2}$ mi. from Dickson county line, between Salem and Erin, roadside near small creek, 17 April 1954, E. Quarterman & J. Stauffer 4883 (VDB). Lawrence Co.: w. of Barnsville, Buffalo River bottoms, bank, 8 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11003 (TENN); edge of Ethridge, creek bluff, 8 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11070 (TENN). Lewis Co.: sw. of Hohenwald, bottoms, and bluffs of Trace Creek near bridge of Tenn. Hwy. 48, 21 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10083 (TENN); Meriwether Lewis Nat. Monument, Little Swan Creek, bluffs and hillsides open woods, moderately dry soil, 2 April 1945, C. B. King & E. Quarterman 8 (VDB). Lincoln Co.: se. of Gazetteville, roadside, wet limestone, 6 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10885 (TENN). Madison Co.: sandy hills, Pinson, April 1892, S. M. Bain 84 (GH, NY); hills, in very sandy soil, April

1892, S. M. Bain sn (US); Marion Co.: on n. facing slope, near bend in Sequatchie River, immediately e. of bridge on U. S. 41-64-72, about 2 mi. s. of Jasper, 5 April 1959, A. J. Sharp, R. D. Houk & H. L. Sherman 25380 (TENN). Marshall Co.: n. of Lewisburg, bluffs of Big Rock Creek, 10 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11194 (TENN); e. of Wilhoite Mills, bluffs of Duck River, 10 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11165 (TENN). Maury Co.: above Rockdale, roadside slope, 9 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11149 (TENN); e. of Columbia, roadside, limestone, thin soil, 9 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11129 (TENN). Montgomery Co.: Porter's Bluffs, e. of Clarksville, 17 March 1942, R. E. Shanks 1712 (AP); Cumberland River, bluff above Seven Mile Ferry, $2\frac{1}{2}$ mi. se. of Clarksville, moist cliff, 19 March 1949, A. Clebsch 494 (AP); west end of King and Queen's Bluff on Cumberland River, $2\frac{3}{4}$ mi. se. of Clarksville, moist cliff, 26 February 1949, A. Clebsch 495 (AP). Polk Co.: moist shale bluff, Ocoee River Gorge, 19 March 1939, A. J. Sharp & S. A. Cain 271 (TENN); near Reliance, 17 March 1955, J. A. Wolfe, J. R. Wells, A. J. Sharp & L. P. Lord 19021 (TENN); Hiwassee Gorge, between Wetmore and Reliance, steep slope, 31 March 1949, C. J. Felix, B. Adams & A. J. Sharp 10530 (TENN); Hiwassee Gorge, base of bluff, 30 March 1956, L. P. Lord 20431 (TENN). Rutherford Co.: cedar barrens, s. of Murfreesboro, 20 April 1940, R. E. Shanks & A. J. Sharp 416 (TENN); in sink, Snail Shell Cave, 28 April 1957, A. J. Sharp & F. Brown 22098 (TENN); s. of Bethel, bluff of w. fork of Stone's River, 19 April 1949, C. J. Felix, B. Adams & A. J. Sharp 11812 (TENN). Smith Co.: limestone bluff, along

U. S. 70N, at Cordell Hull Bridge, Carthage, 22 March 1957, A. J. Sharp & Harry Sherman 21829 (TENN); near Carthage, bluffs, 1 April 1934, A. J. Sharp 86 (TENN). Wayne Co.: e. of Leatherwood, bluffs of Beech Creek, 22 April 1949, C. J. Felix, B. Adams & A. J. Sharp 10212 (TENN); bottom-land forest, 6 April 1948, W. B. McDougall 1572 (US). Williamson Co.: calcareous shale bank, along Harpeth Creek, Tenn. 96, Fernvale comm., 21 March 1957, H. L. Sherman & A. J. Sharp 21822 (TENN). Wilson Co.: moist area, ledges of limestone outcrops, 5 mi. sw. of Lebanon, Diane Rollins & R. C. Rollins 5204 (GH, NY, TENN, US).

NORTH CAROLINA. Alamance Co.: n. slope, 2 mi. w. of Chapel Hill, on Haw River, 1 April 1958, J. Southern 41 (NCU). Alleghany Co.: mixed deciduous forest, near New River, 2.6 mi. n. of Amelia, 2 May 1958, A. E. Radford 32668 (NCU). Cabarrus Co.: woodland, along Roberta Mill road, 4 mi. sw. of Concord, 29 April 1956, C. R. Bell 2266 (NCU). Caswell Co.: mixed deciduous forest and granite outcrops, by Reedy Creek between Yancyville and Leasburg, 22 April 1958, C. R. Bell 11273 (NCU). Catawba Co.: rocky open bluff, Catawba River w. of Mooresville, along N. C. rt. 150, 4 April 1949, R. K. Godfrey, W. B. Fox & F. W. Woods 49115 (DUKE). Cleveland Co.: state Hwy. 150, at the Broad River, 22 March 1956, O. M. Freeman 5616 (NCU); state Hwy. 150, at Broad River, O. M. Freeman 5717 (NCU). Davie Co.: mixed deciduous forest, 2 mi. n. of Advance, 14 April 1956, A. E. Radford 9775 (NCU). Durham Co.: rocky places near stream, Duke Forest, 2 April 1932, H. L. Blomquist 340 (GH); moist rocky banks, Eno River, Durham, 15 March 1928, H. L. Blomquist 3787 (DUKE); open pine woods n. of Durham, along old Oxford Rd., 8 March 1942,

H. J. Oosting 2238 (DUKE); found in field 1 mi. e. of Durham on Hwy. 15, 20 April 1957, J. Porter sn (NCU); along wooded stream bank emptying into Eno River near Guess River bridge, 12 April 1936, D. S. Correll 5066 (DUKE). Edgecombe Co.: alluvial woods near Tar River, 1.5 mi. ne. of Rocky Mount, 23 April 1958, A. E. Radford 32034 (NCU). Forsyth Co.: on exposed rocks, Nitong Rock, 7 April 1940, P. O. Schallert sn (MO); Flat-Rock, W-S, in dry, rocky woodland, 12 April 1912, P. O. Schallert 1341 (DUKE); on open poor soil near Mt. Carmel, 29 March 1936, D. S. Correll & H. Butts 5025 (DUKE); wooded slope, 4.4 mi. n. of Kernersville, 17 May 1958, R. Britt & H. E. Ahles 40736 (NCU). Franklin Co.: mat of rock outcrop, Flat Rock, sw. of Bunn, 1 May 1938, H. J. Oosting 1764 (DUKE). Granville Co.: wooded slopes of Tar River, 3.7 mi. n. of Wilton on the Dickson Rd., 5.7 mi. s. of Dickson, 26 April 1956, A. E. Radford & H. E. Ahles 11533 (NCU); Camp Butner, 26 April 1951, W. T. Batson 856 (DUKE). Guilford Co.: Greensboro, 1932, L. Barksdale sn (DUKE); low, wooded pasture, to w. of Hwy., 2 mi. n. of Gibsonville, 1 May 1958, C. R. Bell 11664 (NCU); hillsides, 12 April 1936, Gladys F. Mitchell sn (DUKE). Halifax Co.: on Roanoke River, Weldon, 27 April 1897, J. K. Small sn (NY). Harnett Co.: alluvial woods, along Cape Fear River, between Fish River and Camel Creek, 31 March 1957, H. Laing 767 (NCU). Johnson Co.: mixed deciduous forest, Neuse River, 1.6 mi. n. ne. of Clayton, 29 April 1957, A. E. Radford 21742 (NCU). Lee Co.: n. bluff, 2 mi. w. of Moncure, on s. slope of Deep River, 15 April 1958, J. Southern 49 (NCU); 2 mi. w. of Moncure, s. side of Deep River, river flood plain, 15 April 1958, M. L. Matthews 51 (NCU); n.

slope, rock outcrop, s. side of Deep River, 2 mi. w. of Moncure, 15 April 1958, Boyd Barrier 313 (NCU); 2 mi. w. of Moncure, s. of Deep River, in woods, 15 April 1958, P. Carlton 177 (NCU). Mecklenburg Co.: flat pine-oak woods, 3.4 mi. s. of Pineville, on U. S. 521 and 4.5 mi. e., 22 April 1958, R. F. Britt & H. E. Ahles 38732 (NCU). Mitchell Co.: Roan Mt., June 1878, M. E. Hyams sn (US). Montgomery Co.: swamp-forest, Unharrie River, 1 mi. nw. of Unharrie, 30 March 1956, A. E. Radford 8946 (NCU). Moore Co.: steep, rocky bank of Deep River, High Falls, 25 April 1948, W. B. Fox & R. K. Godfrey 1377 (GH); Horse Shoe Bend, n. facing slope, on moist hillside, with moss on rock outcrops, 23 March 1955, P. A. Kessler 117 (NCU); on mossy rocks from bluffs, Horse Shoe Bend, $3\frac{1}{2}$ mi. se. of Glendon, 4 March 1956, D. H. Houch 857 (NCU); alluvial woods on n. facing slope, Horse Shoe Bend of Deep River, $3\frac{1}{2}$ mi. se. of Glendon, 17 April 1955, D. H. Houch 93 (NCU); upper alluvium of mossy rocks, just downstream from Horse Shoe Bridge, 11 March 1956, D. H. Houch 884 (NCU). Northampton Co.: creek bank Author's Creek, 2.2 mi. n. nw. of Garysburg on N. C. 46, 18 April 1958, J. A. Duke & H. E. Ahles 38362 (NCU). Orange Co.: wet rocks, in the vicinity of Chapel Hill, April 1898, W. W. Ashe sn (NY); rocky woods, Chapel Hill, 10 April ?, W. W. Ashe sn (NY); low moist woods along stream in Duke Forest, New Hope Creek division, 13 April 1936, D. S. Correll & W. H. Duncan 5068 (GH); along New Hope Creek, Duke Forest, 29 March 1936, W. H. Duncan sn (DUKE); stream banks, 23 April 1932, H. L. Blomquist 3786 (DUKE); Caves, Chapel Hill, 24 April 1939, G. Christenberry sn (NCU); Tenny's meadow, $\frac{1}{4}$ mi. w. of Durham road, bridge across Bolin's

Creek, 13 April 1940, L. Stewart & A. E. Radford 429 (NCU); open deciduous woods, n. slope, Paul Green's woods, about 2 mi. from Chapel Hill, 13 April 1940, L. Stewart & A. E. Radford 415a (NCU); on flat lands adjoining Morgan's Creek in deciduous forest, 4 April 1942, Hamilton & Koch sn (NCU); roadside bank on road to Univ. lake, about $\frac{1}{2}$ mi. from Carrboro, 26 March 1943, H. Sherwin 27 (NCU); in the vicinity of Chapel Hill, May 1899, W. W. Ashe sn (NCU); from Fisherman's Path near ford, Morgan's Creek, 4 April 1942, P. W. Titman 6 (NCU); growing on rocks on left bank of Laurel Hill, Chapel Hill, 20 March 1939, L. Stewart & L. Olive sn (NCU); Chapel Hill, 20 April 1897, J. S. Murphy sn (NCU); growing in crevices of rocks by Morgan's Creek, between King's Mill on Scott's Hole, 25 March 1915, H. R. Totten sn (NCU); near Lone Pine Spring, 1 mi. e. of Chapel Hill, 6 April 1887, Lee Lynch sn (NCU); King's Mill, hillside, n. of stream, 11 March 1911, O. W. Hyman sn (NCU); rock outcrop in beech woods, 3 mi. e. of Hillsboro, 23 April 1952, A. E. Radford 6740 (NCU); alluvial soil near "The Caves," on New Hope Creek, $4 \frac{3}{4}$ mi. e. ne. of Chapel Hill, 13 April 1946, L. S. Radford & A. E. Radford 740a (NCU); meadow just off power line near old reservoir, on Bolen's Creek, Chapel Hill, 3 April 1932, W. L. Hunt sn (NCU); on stream $\frac{1}{2}$ mi. below "Meeting of the Waters," 8 May 1932, J. R. Raper sn (NCU); e. slope, Morgan Creek, near treatment plant, 31 March 1957, P. J. Crutchfield 99 (NCU). Person Co.: on roadside and thickets, 2.2 mi. n. of Ceffo, 22 April 1958, C. R. Bell 11248 (NCU). Polk Co.: Lynn, April 1902, W. P. Fisher sn (GH); Tryon Mt., April 1896, A. M. Huger sn (NY); Pearson's Falls, Tryon, 18 April 1919, M. E. Day sn (GH); wet soil on

rocks, Melrose, 28 April 1904, Biltmore Herbarium 1204g (US); moist soil on rocks, White Oak Mt., 22 April 1904, Biltmore Herbarium 1204f (US); slopes, Tryon Mt., May 1895, A. M. Huger sn (NY). Rockingham Co.: Spray, DeChalmont sn (US); pasture about 2 mi. e. of Thompsonville on N. C. rt. 87, 13 April 1956, H. E. Ahles & A. E. Radford 10731 (NCU); on rocks and open wood slope along the Smith River near Leaksville-Spray, 24 May 1939, G. W. McDowell & D. S. Correll 10691 (DUKE). Rowan Co.: Dunn's Mt., near Salisbury, 20 April 1896, J. K. Small sn (NY); swamp-forest, S. Yadkin River near U. S. 601, 21 April 1956, A. E. Radford 10329 (NCU); beside unused road, oak woods at the foot of the n. slope of Young's Mt., 20 April 1957, J. H. Horton 923 (NCU). Stanly Co.: the Falls of the Yadkin River, 20-24 April 1896, J. K. Small sn (NY). Stokes Co.: mixed deciduous forest, 0.6 mi. n. of Moore's spring, 4 May 1958, A. E. Radford 32916 (NCU). Surry Co.: oak-hickory forest, N. C. 268 and Mitchell River, 16 April 1956, A. E. Radford 10061 (NCU); on rocks, steep slope, Pilot Mt., 3 April 1942, R. M. Williams 678 (DUKE). Vance Co.: granite outcrop and stream bank, Gandy Creek, 3.3 mi. n. of Gillburg, 26 April 1957, J. Haesloop & H. E. Ahles 23854 (NCU). Wake Co.: wet shallow soil, granite rock exposures, Mitchell's Mill near Rolesville, 11 April 1948, R. K. Godfrey 48029 (DUKE, GH, NCU); rocky stream bank, 4 mi. n. of Raleigh, 11 April 1938, R. K. Godfrey 3410 (GH, NCU); moist soil on granite rocks, Mitchell's Pond, 30 March 1937, R. K. Godfrey sn (GH). Wilkes Co.: March 30, ?, W. W. Ashe sn (NY).

VIRGINIA. Amelia Co.: 23 April 1939, J. B. Lewis 178 (VPI); abundant in rich woods, preferring banks of small streams, occasionally

in open fields, 6 April 1937, J. B. Lewis 372 (VPI). Arlington Co.: Fort Myer's, 18 April 1895, E. A. Means sn (GH); Rosslyn, 14 April 1896, D. L. Topping sn (NY); near Rosslyn, 7 May 1897, T. H. Kearney sn (NCU); hillside near Potomac, Rosslyn, 7 May 1904, Agnes Chase 2125 (ILL, OKL); Glencarlyn, 20 April 1939, G. Jones & J. Tompkins 53 (VPI). Augusta Co.: Ramsey Gap, C. C. C. Camp, 1937, A. B. Massey & J. L. Pendleton 35 (VPI). Bath Co.: wet mossy rocks, Virginia Hot Springs, 19-20 April 1915, F. W. Hunnewell 3368 (GH). Bedford Co.: Peaks of Otter, 7 June 1890, A. Brown, T. Hogg, A. Vail, M. Timmerman & N. L. & Eliz. G. Britton sn (NY); Peaks of Otter, Sharp Top, 0.2 mi. below upper end of road to top, 8 May 1947, R. S. Freer 1386 (GH); 2 May 1871, A. H. Curtiss sn (GH, MO). Buckingham Co.: along rocky shaded river bluffs, near New Canton, 22 April 1952, E. J. Palmer 40000 (GH). Fairfax Co.: Great Falls, 9 April 1933, J. Aebly sn (PH); sandy open woods, near Alexandria, 7 May 1934, E. J. Palmer 42221 (GH). Fauquier Co.: edge of woods, 1 mi. n. of Beverley, w. slope of Bull Run Mt., 3 May 1936, H. A. Allard 1329 (MO); between Warrenton and hills, 4 mi. w. of city, 19 April 1913, I. Tidestrom 6238 (US); old pasture below Riley's cabin on w. slope of Bull Run Mt., $\frac{1}{4}$ mi. s. of Hopewell Gap, 3 April 1938, H. A. Allard 4365 (US); w. slope of Bull Run Mt., low moist woods, $\frac{1}{2}$ mi. n. of Beverley, 26 April 1936, H. A. Allard 1283 (NY); w. slope of Bull Run Mt., 1 mi. s. of Beverley, on wooded ridge of Pond Mt., 14 April 1935, H. A. Allard 221 (GH). Franklin Co.: exposed crevices of steep rocky w. face of Rocky Mount., 15 April 1936, E. T. Wherry & J. W. Adams 2743 (MO). Greenville Co.: alluvial woods by Maclin's Creek, 2 mi. n. of Emporia,

5 April 1937, B. Long and M. L. Fernald 7057 (GH). Henrico Co.: s. shore of James River, near Richmond, J. R. Churchill sn (MO); Richmond, DeChalmont sn (US); shady banks, U. of Richmond campus, March 1935, Estelle Venzey sn (GH); by lake on U. of Richmond campus, 23 April 1923, Ethel DuVal sn (VPI). James City Co.: Camp Wallace, n. bank of James River, rich soil of wooded slope, 14 March 1921, E. Jerome Grimes 3280 (NY); bank of pond along Chickahominy River, about 5 mi. w. of Toana, 20 April 1940, R. W. Menzel 1407 (GH). Mecklenburg Co.: rocky wooded slope, s. bank of Roanoke River, Good's bridge, 7 April 1937, B. Long & M. L. Fernald 7058 (GH, NY). Nelson Co.: rocky outcrop, right side of road, 0.3 mi. beyond Campbell Creek, 17 April 1947, R. S. Freer 1280 (GH); ravine on right side of rt. 151, 0.55 mi. n. of Brent's Gap, on Horse Shoe Mt., 24 April 1947, R. S. Freer 1316 (GH). Page Co.: moist crevices, Crescent Rocks and talus slopes below Hawksbill Gap, Shenandoah N. P., 30 May 1936, W. H. Camp 1246 (NY). Pulaski Co.: cliff of New River, 20 April 1909, F. S. H. sn (VPI). Rappahannock Co.: on rock near spring in open fields, Shenandoah N. P., Waterfall Branch, 1 May 1938, E. H. Walker 2268 (US). Roanoke Co.: Niagara, 17 April 1941, A. B. Massey sn (VPI). Rockbridge Co.: Natural Bridge, 9 May 1887, G. Kennedy sn (GH, PH). Rockingham Co.: the peak of the Massanutten Mt., alt. 1500-2900', 9 May 1893, A. A. Heller sn (NY). Shenandoah Co.: Fort Valley, dry slope, 25 March 1945, J. T. Baldwin 5006 (GH); Massanutten Mts., shale hills, Stone Wall Pond, near Woodstock, 14 April 1933, Lena Artz 344 (VPI). Surry Co.: rich wooded ravine ne. of Bacon's Castle, 7 April 1937, B. Long & M. L. Fernald 9741 (GH, VPI);

rich wooded ravine, nw. of Ingersall, 2 April 1940, A. S. Pease, B. Long & M. L. Fernald 11695 (GH). Warren Co.: limestone woods, Front Royal, 20 April 1912, F. W. Hunnewell sn (GH); on rocks, $\frac{1}{2}$ mi. s. of fire tower, 6 mi. from Linden, 1 May 1937, H. A. Allard 2564 (VPI).

WEST VIRGINIA. Berkely Co.: Camp Frame, 11 April 1937, H. I. Shreve sn (WVA). Brooke Co.: 2 May 1937, Oglebay Plant Club 105 (WVA). Cabell Co.: moist ravine, Huntington, 15 April 1928, F. A. Gilbert 66 (GH, WVA); along ditch, Milton, 24 April 1935, L. G. Williams 311 (MO, NY); rock cliff, "Robber's Hill," Milton, 7 April 1936, L. G. Williams 393 (CINC, DUKE, MO, PH, NY, TENN, US). Calhoun Co.: Sycamore, 22 April 1933, R. Harris sn (WVA). Clay Co.: humus clay and rock, very steep slope above Elk River, rt. 4, Clay Junction, 12 April 1953, G. B. Rossbach sn (WVA). Fayette Co.: near Glendell, 1 May 1937, M. Brooks & A. S. Margolin sn (WVA); on N. River, $\frac{3}{4}$ mi. above Thurmond on right side of road, found in dry and wet cracks, 15 March 1939, J. P. Tash sn (WVA). Gilmer Co.: near Glenville, 23 April 1955, S. A. B. C. Forey sn (WVA). Grant Co.: cabins, 29 April 1939, S. A. B. C. sn (WVA); on Mt., about Greenland Gap, in soil among rocks, 13 April 1946, Mr. & Mrs. H. A. Davis 7882 (NCU). Hampshire Co.: Hany Rock, 22 May 1937, W. Frye 556 (WVA). Hancock Co.: exposed rocks, dry hillsides, Tomlinson Run State Park, 10 May 1940, W. J. Sumpstine sn (WVA). Hardy Co.: 5 mi. s. of Moorefield, 25 April 1942, L. W. Wilson sn (WVA). Jackson Co.: W. Va. Youth Camp, 2 mi. e. of Ripley, R. Guthrie sn (WVA). Jefferson Co.: Terrapin Neck, 6 May 1939, J. L. Poland sn (WVA). Kanawha Co.: in open woods, along river and small streams, always in rich moist soil, Queen

Shoals, 10 April 1936, F. C. Randolph 96 (WVA). Lincoln Co.: near west Hamlin, May 1940, M. Thacker sn (WVA). Mineral Co.: New Creek, 4 May 1940, Mr. & Mrs. H. A. Davis 3575 (WVA); Blaine, rt. 42, May 1952, Melvin Brown sn (WVA). Mingo Co.: Chattaroy, 13 May 1955, Blanche Straley sn (WVA). Monongalia Co.: Samuel Minor Bridge, near Prentiss, 28 April 1934, E. L. Core sn (DUKE); Morgantown, 3 May 1904, J. L. Shelton 275 (WVA); damp rocky places, Morgantown, 11 April 1890, C. F. Millspaugh 4 (NY, WVA); Morgantown, 1821, 1081 (ILL). Morgan Co.: shady banks, Great Cacapon, 4 April 1938, A. S. Pease 26576 (GH). Pendleton Co.: Snowy Mt., alt. 4000-4500', 17 June 1925, P. A. Rydberg 9060 (NY). Pleasants Co.: above the bank of Bull Creek, below rt. 2 bridge, 16 April 1952, E. A. Bartholomew P-131 (WVA). Poncahontas Co.: steep, e. facing, hardwood slope, above Greenbrier R., Marlinton, 10 May 1952, G. B. Rossbach sn (WVA). Raleigh Co.: common on cliffs at Prince, 6 April 1940, J. P. Tash sn (WVA). Ritchie Co.: Cairo, April 1930, Mary Goodwin sn (WVA). Summers Co.: near Hinton, 30 March 1933, W. Boone 158 (WVA). Tyler Co.: on steep wooded hillsides about Wells Island, 1 mi. s. of Sistersville, 19 April 1942, E. A. Bartholomew T-8 (WVA). Wayne Co.: near Fort Gay, 5 March 1932, I. Lycan 39 (WVA). Wirt Co.: in woods opposite mouth of Reedy Creek, 19 April 1942, E. A. Bartholomew W-1154 (US); on wooded s. bank of Little Kanawha River about 1 mi. e. of Palestine, 1 April 1945, E. A. Bartholomew W-1408 (GH, MO, NY, TENN, VPI, US); near Owensport, 17 April 1933, E. A. Bartholomew sn (WVA). Wood Co.: on rock in pine woods just above entrance to Butcher Bend Park, along rt. 14, 16 April 1952, E. A. Bartholomew W-57 (WVA).

KENTUCKY. Bourbon Co.: Paris, 1826, 1081 (ILL). Caldwell Co.: shade and sandstone bluffs, moist ledges, near Dawson Springs, 7 May 1923, E. J. Palmer 22549 (MO). Edmonson Co.: Mammoth Cave N. P., Mammoth Cave entrance, limestone cliff, 19 October 1946, H. W. Lix 16 (US); cedar sinks, moist moss-covered sandstone cliff, 6 April 1947, H. W. Lix 150 (US). Fayette Co.: Elklick, 26 March 1927, W. A. Anderson 404 (GH); moist limestone ledges, Elklick Falls, 19 May 1923, Mary F. McFarland 103 (MO, PH). Greenup Co.: clay banks at top of Ohio River bluffs, South Portsmouth, 21 April 1935, Delzie Demaree 11258 (MO, NY, PH, US). Scott Co.: Elkhorn cliff, farm of W. Carlton, Stamping Ground, 22 March & 25 April 1930, J. W. Singer 7 (US); limestone ledges, Elkhorn Creek, 6 April 1949, M. E. Wharton 6425 (TENN). Warren Co.: Bowling Green, March 1892, S. F. Price sn (MO); Bowling Green, spring 1898, S. F. Price sn (NY). Woodford Co.: bank of stream 8 km. n. of Midway, 29 March 1942, R. T. & E. R. Clausen 5703 (NY).

MARYLAND. Howard Co.: Ellicot City, 1917, Bro. Arsenc 1415 (MO). Montgomery Co.: rocky hillside, near Echo Glen, 18 April & 2 May 1926, S. F. Blake 9315 (GH); High Island, 10 April 1889, M. B. Waite sn (GH); Glen Echo, abundant along hillside, 16 April 1895, L. H. Dewey 177 (GH); Chevy Chase, 24 April 1901, H. H. Bartlett 1909 (DUKE). Washington Co.: Harper's Ferry Heights, 17 April 1890, S. Watson sn (GH).

DISTRICT OF COLUMBIA. Palisades of the Potomac River, 5 April 1892, Ferdinand Blanchard sn (MO); woods, High Island, May 1897, W. S. Moffatt sn (ILL); banks and roadsides, 11 April 1897, E. S. Steele sn (DUKE).

PENNSYLVANIA. Allegheny Co.: near Pittsburgh, 26 April 1903, Otto Hatry sn (PH). Armstrong Co.: rich hillside woods, 1.5 mi. ne. of South Bend, 5 June 1946, H. A. Wahl 1833 (GH). Berks Co.: Wernersville, 10 May ?, M. P. Russell sn (GH). Bradford Co.: Sayre, upper Susquehanna, 23 April 1898, W. C. Barbour 25 (ILL). Bucks Co.: moist woods, 2½ mi. nw. of Nechaminy, 7 May 1928, F. McDowell 84 (GH); on wet red shale faces near canal Aby, New Hope, 28-29 May 1932, R. True 4 (TENN); 1867, I. S. Moyer sn (US). Butler Co.: upland woods e. of Yellow Creek, 4 mi. ne. of Harmony, 17 May 1937, L. J. Henry 613 (PH, US). Centre Co.: 8 May 1868, J. T. Ruthrock sn (GH); dry mountain clearing 5 mi. nw. of State College, 11 May 1944, H. A. Wahl 1427 (ILL); State College, 20 April 1922, C. M. Roberts sn (WVA). Chester Co.: serpentine barrens 2 mi. nw. of Unionville, 11 May 1935, Eliz. C. Earle 237 (TENN); April 1858-1864, S. P. Sharples sn (GH). Delaware Co.: serpentine slope, Lima, 24 April 1926, J. M. Fogg, Jr. 1504 (GH); n. along Dismal Run on serpentine outcrop, 26 April 1925, W. R. Thomas & J. W. Adams sn (MO); wooded slopes along Darby Creek, 1 mi. n. of Springfield, 13 April 1935, E. C. Earle 178 (TENN); Swarthmore, 1891, J. M. Greenmann sn (MO); 1 mi. nw. of Swarthmore, along Crum's Creek in rich woods, 14 May 1939, H. K. Long, J. W. Long & R. L. Schaeffer, Jr. 1429 (ILL). Franklin Co.: Mercersburg, 15 April 1845, 10-2 (PH); woods, Mercersburg, 11 May 1850, T. C. Porter sn (PH). Huntingdon Co.: Alexandria, April 1845, sn (PH). Lancaster Co.: rock woodland, Safe Harbor, 10 April 1939, L. F. A. Tanger 2988 (GH); on the Conestoga, s. of Lancaster, 25 April 1900, A. A. Heller sn (US); banks of Conestoga Creek, May 1894, A. F. Eby sn (MO); s.

of Lancaster, on the Conestoga, 24 April 1893, A. A. Heller & E. G. Hallbach 804 (GH, MO, US); in the vicinity of Conewago, 14 May 1891, J. K. Small sn (NY, US). Lawrence Co.: rocky woods 3 mi. nw. of Newcastle, 10 June 1948, E. T. Wherry sn (PH). Lebanon Co.: moss on the top of stone, $\frac{1}{4}$ mi. s. of Annville, 30 April 1911, C. H. Arndt sn (TENN). Montgomery Co.: on wet rocks, Lafayette, 22 April 1899, F. L. Lewton 19 (NCU, US). Mercer Co.: woodland bank, Narrows Woods, Slippery Rock, 13 May 1946, N. Russell 869 (WVA). Philadelphia Co.: vicinity of Philadelphia, 6 May 1888, J. B. Brinton sn (NY); Fishers, Germantown, 3 May 1894, T. W. Edmondson 735 (NY). Pike Co.: Milford, 10 May 1905, C. D. Mill sn (US); rocky places, Milford, 15 May 1905, C. D. Mill sn (MO); Milford, 24 May 1905, C. D. Mill sn (US). Snyder Co.: on sunny hilltop, Penn Avon, 16 April 1925, H. N. Moldenke 2280 (NY). Washington Co.: wooded ravines n. side of Harmon Creek, vicinity of Hardin Station, 21 May 1940, L. K. Henry sn (PH); branch of Little Tenmile Creek, 5 mi. nw. of Marianna, 11 May 1950, L. K. Henry & F. H. Beer sn (WVA); in moist wooded hollow on the Andy Farm, $2\frac{1}{2}$ mi. from the county fair grounds, near Washington, 10 May 1952, D. Wilsen 55 (WVA). Wayne Co.: rocky hillside pasture, South Stirling, 24 April 1921, Alex MacElwee sn (PH). Westmoreland Co.: woods along Loyalhanna Creek, above the dam, 16 May 1940, L. K. Henry sn (US); 16 April 1878, P. E. Pierron sn (MO); woods along Loyalhanna Creek, $2\frac{1}{2}$ mi. below junction with Whitehorn Creek, 26 April 1938, L. J. Henry sn (WVA). York Co.: Glen Rock, 30 May 1895, N. W. Glatfelter sn (MO).

DELAWARE. New Castle Co.: dry rocks, Greenbank, 10 May 1881,

A. Commons sn (GH); dry rocky places, Mt. Cuba, 10 May 1875, A. Commons sn (NY).

NEW JERSEY. Bergen Co.: Fort Lee, 30 April 1894, C. L. Pollard sn (US); Fairview, 27 April 1893, W. M. VanSickle sn (US); seams in ledges of the Palisades at Alpine, 24 April 1910, G. C. & A. K. Harrison sn (GH); Palisades, Englewood, 14 May 1884, J. R. Churchill sn (GH). Burlington Co.: moist wooded slopes, n. along streamlet, tributary to Rancoco Creek, Pemberton, 15 May 1917, B. Long 15872 (GH); moist wooded slope, near A. C. R. R. station, fork of N. branch of Timber Creek, Garden Lake, 14 April 1917, B. Long 15645 (GH). Gloucester Co.: moist wooded slope, sw. along Still Run, Mickleton, 6 May 1919, B. Long 20462 (GH); moist wooded slopes, w. along streamlet tributary of s. branch of Timber Creek, Blackwood, 27 April 1919, B. Long 20320 (GH). Mercer Co.: moist woods, foot of Goat Hill, brookside, near Delaware River, Lambertville, 11 April 1925, B. Long 31926 (GH); Princeton, 1886, Woodrow sn (US); Trenton, April 1888, 47 (ILL). Mammouth Co.: moist sandy loamy, wooded slope, e. of Marlboro, along Big Brook, 28 May 1932, B. Long 37506 (GH). Middlesex Co.: wooded banks, Milltown, 17 May 1908, K. K. MacKenzie 3045 (US). Passaic Co.: rocky banks, Greenwood Lake, 19 May 1907, K. K. MacKenzie 2566 (MO); vicinity of Clifton, 21 May 1893, G. V. Nash sn (US). Somerset Co.: Peapack, R. C. Perry sn (MO); shaley cliffs near Neshanic Station, 3 April 1953, W. J. Dix sn (PH); common on rocky bank of stream, First Watchung Mt., Bound Brook, 17 May 1936, M. A. Johnson sn (DUKE).

NEW YORK. Albany Co.: ledge, Clarksville, 13 May 1934, H. D.

House 21121 (NY); ledges, Glenmont, 9 May 1939, H. D. House sn (MO); exposed sunny shale ledges, 9 May 1943, H. D. House 13778 (ILL). Chemung Co.: wet cool banks of the Susquehanna, 3 June 1894, T. F. Lucy sn (US). Columbia Co.: dry open places, s. end of Mt. Merina, Greenport, 24 April 1934, Rogers McVaugh 4070 (GA). Courtland Co.: Van Courtland, May 1893, C. L. Pollard sn (US). Erie Co.: open stony woods and pastures, in limestone soil, Harris Hill near Williamsville, 18 May 1924, F. W. Johnson sn (NY); Buffalo, H. Gillman sn (NY). Genesee Co.: rocky limestone woods, "North Woods," 9 May 1895, Leroy 31887 (ILL). Herkimer Co.: moist rocks, Thoss Island, 12 June 1902 & 4 July 1904, J. V. Haberer 301 (GH). Jefferson Co.: Watertown, 1834, A. Gray sn (NY). Monroe Co.: thin woods on sand dunes, on bluffs along Irondequoit Bay at Inspiration Point, 11 May 1930, W. A. Matthews 3023 (NCU). New York Co.: High Bridge, near New York City, G. Thurber sn (GH); Pelham Hills, 15 May 1885, D. W. Rogers sn (GH); near High Bridge, N. Y. inland, April 1887, E. E. Sterns sn (NY); Bronx Park, 22 April 1896, G. S. Nash sn (NY, PH); crevices in rocks, corner of Tulkaloe Rd. and Park View Rd., in the vicinity of Yonkers, 20 April 1934, H. A. Gleason, Jr. 1314 (DUKE). Niagara Co.: Falls of Niagara, May 1850, C. W. Short sn (PH). Onondaga Co.: Syracuse, M. E. Wright 15 (NY); Jamesville, on the limestone cliff of Green Lake, 5 May 1879, W. R. Maxon sn (NY, US); w. of Green Lake, Jamesville, F. C. Straub sn (US). Ontario Co.: rocky ravines, Canadice, 29 May 1895, E. J. Hill 331895 (ILL). Orange Co.: West Point, 11 June 1867, J. Carson sn (PH); West Point, Torrey Herbarium sn (PH); West Point, 16 April 1882, Ella Meams 96 (US); Tracy's, Hudson Highlands, 24 April

1882, Ella Meams 97 (US); along Black Rock Br. near lower res., Black Rock Forest, May 1937, R. Rosendahl 8157 (GH). Otsego Co.: shady hillside, Hastings, 23 May 1895, J. H. Barnhart 966 (NY). Queens Co.: dry woods, Jamaica, Long Island, 1 May 1863, E. J. Hill sn (ILL). Rensselaer Co.: ledges, Brunswick township, 12 May 1936, H. D. House 23415 (NY). Richmond Co.: Prince's Bay, Staten Island, 29 April 1891, G. D. Hulst sn (ILL). St. Lawrence Co.: Morristown, along rocky hillsides, 19 May 1914, O. P. Phelps 539 (GH, NY, US). Seneca Co.: Lodi Falls, town of Lodi, May 1832, N. W. Folwell 361 (GH); gravelly bank, Cayuga Lake shore, at Elm Black, Romulus, 16 May 1915, A. J. Eames 4231 (GH). Sullivan Co.: 1873, Eggert sn (MO). Tioga Co.: Apalachian, 1 May 1898, F. E. Ferms 141 (NY). Tompkins Co.: Glen Wood Rd., Ithaca, 2 May 1900, H. S. Jackson sn (DUKE); e. of lake, Ithaca, 26 May 1903, H. S. Jackson sn (DUKE); Six Mile Creek, Ithaca, 12 May 1890, W. E. Rumsey sn (WVA); rock by Fall Creek Mills, Fall Creek ravine, Ithaca, 21 May 1915, K. M. Wiegand 4232 (GH, MO); inlet valley, along r. r., Ithaca, 5 May 1942, C. Wagner & E. D. McDonald sn (US); rocks, bank of Six Mile Creek, Ithaca, 1 May 1884, F. V. Coville sn (US); Ithaca, May 1897, sn (PH); Table Rock, near Stone bridge, over Beebe, Ithaca, 29 April 1942, E. D. McDonald sn (US); Ithaca, 29 April 1885, F. V. Coville sn (US); Six Mile Creek, Ithaca, rocky ledges, 29 April 1883, O. E. Pearce sn (US); Ithaca, 10 May 1890, W. W. Rowlee sn (US); r. r. tracks s. of Morse Chain works, Ithaca, 27 April 1941, R. D. Ross sn (VPI). Ulster Co.: Highland, in moist wood, 14 May 1914, P. C. Standley 10572 (US); cliffs of Esopus Creek opposite Atwood, elev. ca. 280', 2 June 1948, S. J. Smith 3786 (GA).

Warren Co.: rocks, French Mt., 17 May 1893, S. H. Burnham sn (US); Silver Bay, Lake George, 29 May - 20 June 1901, J. F. Kemp sn (NY); Pack Forest, 5 mi. n. of Warrensburg, 19 May 1950, W. S. Riley sn (DUKE). Washington Co.: moist woods on limestone, Pilot Knob, Lake George, 3 June 1943, H. D. House 28362 (GH); rocky woods, n. bank of Halfway Brook, e. of Tripoli, s. of Fort Ann, 12 May 1905, S. H. Burnham sn (GH). Westchester Co.: Hartsdale, 19 May 1905, T. W. Edmondson 8245 (NY); Hartsdale, 17 May 1908, T. W. Edmondson 4157 (NY); Hartsdale, 19 May 1907, T. W. Edmondson 8666 (NY); Armonk, 19 April 1925, Harriet Spear sn (DUKE).

CONNECTICUT. Fairfield Co.: roadside, Sugar Hollow, Danberry, April 1887, J. H. Barnhart 3 (NY); Fairfield and Turnbull, partially shaded rocks, 18 April & 23 May 1897, E. H. Eames sn (GH). Hartford Co.: rocky woods, Southington, 25 May 1897, C. H. Bissell 272 & 813 (MO); dry rock ledge, Southington, 8 May 1899, C. H. Bissell 2 (GH); rocky woods, Southington, 25 April & 5 June 1897, C. H. Bissell 74 (NY). Litchfield Co.: on ledge, Kent, 3 May 1908, H. Mosher sn (GH). New Haven Co.: rocky places, No. Guilford, 5 May & 20 May 1906, G. H. Bartlett sn (GH); New Haven, 6 May 1876, J. B. Hatcher sn (NY); Savin Rock, near New Haven, 23 May 1884, W. E. Safford 48 (US); New Haven, 31 May 1884, W. E. Safford 115 (US); Mill Rock, New Haven, 18 May 1885, W. E. Safford 321 (US). Tolland Co.: Storrs, March 1907, W. W. Ohlweiler sn (MO). Windham Co.: Killingly, 7 May 1939, W. V. Brown & J. O. Young sn (DUKE, MO).

RHODE ISLAND. Providence Co.: on wet rocks in light woods, Lincoln Woods, Pawtucket, 6 June 1938, W. V. Brown sn (DUKE); Cumberland,

15 May 1904, E. F. Williams sn (GH); Providence, April 1878, W. W. Bailey sn (DUKE); moist ledges of rocky wooded bluffs, near Pawtucket Res., Cumberland, 26 May 1946, E. J. Palmer 17492 (ILL); Morris Bay, Providence, 6 May 1902, J. Franklin Collins sn (GH).

MASSACHUSETTS. Berkshire Co.: woods above Kitchen Brook, Cheshire, 26 May 1916, J. R. Churchill 446 (MO); Mt. Greylock, 16 June 1901, E. F. Williams sn (GH); Mt. Warner, April 1870, G. C. Woolson sn (ILL). Essex Co.: on garnet slate rock, between White's and Perkin's Hills, 12 May 1898, J. H. Sears sn (GH); Marblehead Neck, 30 May 1888, A. B. Seymour & A. C. Seymour sn (DUKE). Franklin Co.: Buckland, 30 April 1900, F. F. Forbes sn (GH); Mount Herman, 1891, sn (WVA); s. side ravine, Mt. Toby, Sunderland, 14 May 1923, F. C. Seymour sn (DUKE). Hampden Co.: dry ledge, Holland, 20 May 1916, C. H. Knowlton sn (PH). Hampshire Co.: side-hill, Orient near Amherst, 4 May ?, E. S. Draper sn (TENN); near Adams Pond, Amherst, 5 May 1886, sn (ILL); dry hillside, Amherst, 10 May 1914, W. C. Dickson sn (DUKE). Middlesex Co.: Newtonville, 22 May 1875, W. C. Lane sn (GH); Pine Grove, Newton, 8 May 1894, G. Gilbert sn (GH); dry rocky banks, Lexington, 8 May 1902, M. A. Day & M. L. Fernald 91 (DUKE, GA, GH, NY, PH, US); rocks, Pearl St., Reading, 23 April 1909, G. G. Kennedy sn (GH); Watatic Mt., Ashby, 10 May 1896, Sydney Harrison sn (GH); Waverly, 2 June 1896, sn (GH); Westford, E. F. Fletcher sn (GH); Ashland, 6 June 1885, T. M. sn (NY); McLean Hill, Waverley, 1 May 1908, F. C. Seymour sn (DUKE). Norfolk Co.: Brookline, 25 May 1911, F. F. Forbes sn (GH); rocky woodland, Wellesley, 4 May 1918, L. W. Riddle sn (GH); Milton, 21 May 1893, J. R. Churchill sn (GH); Wellesley, 3 May

1889, S. H. Harlow sn (NY); Blue Hill Reservoir, Milton, 20 April 1910, G. G. Kennedy sn (GH); on rocks, Stoughton, 1 May 1909, S. F. Blake sn (ILL). Suffolk Co.: Dorchester, 30 May 1882, J. R. Churchill sn (MO); Jamaica Plains, 1 May 1873, C. E. Faxon sn (GH); West Roxbury, 13 May 1898, J. M. Greenman 2950 (MO); road s. side of Bupey place, W. Roxbury, 4 May 1834, W. Boott sn (GH). Worcester Co.: in grass, moist roadside, Mt. Wachusett, Princeton, 26 May 1944, B. M. Gates sn (DUKE).

MAINE. Cumberland Co.: Falmouth, J. Blake sn (PH). Hancock Co.: Sorrento, on dry rock, no soil, 10 August 1889, G. G. Kennedy sn (GH); rocky ground, Seal Harbor, Mt. Desert, 27 June 1890, J. H. Redfield 16492 (MO); rocky bank, Vasselboro, 2 May 1902, E. B. Chamberlain sn (GH). Penobscot Co.: moist rocks, Orono, May 1890, F. P. Briggs sn (NY); Orono, May 1893, F. P. Briggs sn (NY); wet rocks, Bangor, 8 May 1905, O. W. Knight sn (ILL). York Co.: North Berwick, May 1892, J. C. Parlin sn (GH); on cliff by Saco River, Saco, May 1904, J. C. Parlin sn (NCU); Kennebunkport, 7 May 1920, Amy M. Pier sn (DUKE).

NEW HAMPSHIRE. Carroll Co.: Flat Top Mt., elev. 2000', Sandwich, 17 June 1894, J. H. Sears sn (GH). Cheshire Co.: steep rocky hillside, Hinsdale, 15 May 1919, C. F. Batchelder sn (MO); Gap Mt., Troy, 30 May 1899, E. F. Williams 1 (GH); stony pasture near Mountain House, Jaffery, 29 May 1897, E. L. Rand & B. L. Robinson 110 (GH); Keene, E. J. C. Gilbert sn (NY); wooded roadside, bank, Walpole, 12 June 1912, sn (TENN); wooded bank, Walpole, 21 May 1913, C. F. Batchelder sn (NY). Coos Co.: rocky summit of Craig, 1420', thin soil, Shelburne, 28 May 1919, W. Deane sn (GH). Grafton Co.: Hanover, 5 May 1883, C. H. Hitchcock sn (GH, NY).

Hillsboro Co.: under the edges of juniper bushes, hillside, Merrimack, 4 June 1917, C. F. Batchelder sn (US); Merrimack, open ground, 7 May 1918, C. F. Batchelder sn (PH). Merrimack Co.: Concord, 1891, S. F. Sanborn 1177 (ILL). Sullivan Co.: dry ledges, Clarmont, 17 May 1918, C. H. Knowlton sn (PH).

VERMONT. Addison Co.: Shoreham, 15 May 1898, E. Brainerd sn (GH). Bennington Co.: ledge, North Rownal, 9 May 1902, J. R. Churchill sn (MO). Lamoille Co.: dry ledges, Eden, 9 June 1918, C. H. Knowlton sn (PH); Johnson, 5 May 1895, A. J. Grout sn (NY); Johnson, 24 May 1895, A. J. Grout sn (NY); Johnson, 7 May 1894, A. J. Grout sn (US). Orange Co.: rich, woods, Williamstone, 8 June 1917, C. H. Knowlton sn (PH). Orleans Co.: Willoughby Lake, 30 May 1909, J. R. Churchill sn (MO). Rutland Co.: limestone ledges, Proctor, April - May 1897, H. J. B. 197 (NY); Middletown Springs, J. H. Drushel 1447 (MO); Rutland and Castleton, 8 May - 3 June 1898, W. W. Eggleston 218 & 219 (GH, ILL, TENN, US); rocky roadside, 22 May 1909, G. G. Kennedy sn (GH); Middletown Springs, D. S. Carpenter sn (ILL). Windham Co.: on moist rocky ledges, Jamaica, 9 May 1937, H. N. Moldenke 9511 (ILL, MO, NY). Windsor Co.: cliffs, near Norwich, 5 May 1932, J. F. Reed sn (DUKE, PH); Norwich, 14 May 1888, H. E. Sargent sn (OKL).

OHIO. Fairfield Co.: Sugar Grove, 20 May 1905, H. A. Gleason sn (GH); Sugar Grove, 15 April 1916, E. C. Leonard 1188 (US). Hamilton Co.: dry woods, near Cincinnati, T. G. Lea 10-2 (PH); Highland Ave., College Hill, W. H. Aiken sn (CINC). Holmes Co.: on mossy boulder in woods, Killbuck, 9 April 1942, H. N. Moldenke 12105 (VDB). Jackson Co.:

Liberty township, 10 May 1931, L. L. Pontius & F. Bartley sn (US); common on sandstone cliffs and outcroppings in the Buck Run area, 6 May 1940, W. B. Cooke 14179 (CINC, NY). Licking Co.: rocky wooded hillsides, Newark, 6 May 1905, H. A. Gleason sn (GH). Portage Co.: dry rocks, Nelson Ledge, 25 May 1923, R. J. Webb sn (GH). Stark Co.: dans les ravins et colines, Ombrages près Canton, mai, Nicholas Riehl Herbarium 157 (MO). Washington Co.: Marietta, 7 May 1903, E. Herzer sn (GH).

INDIANA. Crawford Co.: limestone bluffs above the Ohio River, 1.1 mi. n. of Freedonia, 5 May 1940, R. C. Friesner 14290 (DUKE); common on the top and near the top of the high wooded bluffs of the Ohio River, about $\frac{1}{4}$ mi. n. of Freedonia, sandstone soil, 24 April 1927, C. C. Deam 44075 (UARK). Perry Co.: on dry clay, in shade, 10 May 1941, F. Loew 2573 (NY); frequent on the wooded bluffs of the Ohio River, about 6 mi. e. of Camelton, 24 April 1919, C. C. Deam 27099 (GH, NY); top of sandstone cliffs along rt. 66, 3.8 mi. e. of Camelton, 5 April 1941, R. C. Friesner 15054 (NY); wooded sandstone slopes, 7 mi. ne. of Camelton, 10 May 1941, T. G. Yuncker & W. Welch 10458 (GH). Spencer Co.: on limestone, along the Ohio River, at Rockport, 28 March 1910, C. C. Deam 5534 (NY).

MICHIGAN. Keweenaw Co.: thin soil on high windy spot, gneiss outcrop, Allouez, 24 June 1936, F. J. Hermann 7666 (NY, PH, US); rich soil on talus slope of bluff, in maple woods, 1 mi. n. of Mandan, 26 June 1936, F. J. Hermann 7684 (NY); ledges on open deciduous woods below the fire look-out near Central, 7 July 1934, A. S. Pearse & M. L. Fernald

3354 (GH); Isle Royale, 27 May 1873, H. Stillman sn (NY); Isle Royale, 6 June 1909, W. S. Cooper 119 (GH).

ILLINOIS. Hardin Co.: rocky ledge in a ravine at Blind Hollow, 5.5 mi. ne. of "Cave-in-Rock," 26 April 1948, G. S. Winterringer 946 (ILL).

MINNESOTA. Cook Co.: Clear Water Lake, n. shore, rocky ledges near water, Twp 65N R1 E31, 19 June 1945, A. O. Dahl 133 (GH); cliff about 1 mi. w. of the outlet to South Fowl Lake, Twp 64N R3E, 27 June 1940, F. K. Butters, E. C. Abbe & G. W. Burns 613 (GH); cleft in cliff above Pigeon River, just below outlet of South Fowl Lake, Twp 64N R3E, 2 July 1939, F. K. Butters & J. W. Moore 10827 (US); humus, slate cliff, s. of Clear Water Lake, T 65N R1E, 12 July 1932, F. K. Butters & M. J. Buell 406 (GH). Lake Co.: Two Harbors, June 1893, E. P. Shelton sn (GH, ILL, NY, TENN, US); in moss mats, se. slope, Pan Cake Island in Lake Superior, East Beaver Bay, 26 May 1945, Olga Lakela 5929 (PH). Lake of Woods Co.: on rock ledges, rocky point of Lake of the Woods, 16 May 1926, I. E. Nylander 109 (US). St. Louis Co.: in mat of moss on wet rocks along a small stream about 44th Avenue and W. Skyline Pkwy., 8 July 1939, Olga Lakela 3117 (CINC, MO, NY).

MISSOURI. Douglas Co.: upper sandstone bluffs along n. fork of White River, T 27N R11W, Sect 29, 2½ mi. e. of Holt, 24 July 1937, J. A. Steyermark 23610 (MO). Iron Co.: Ironton, 4 May 1925, C. C. Epling 6022 (MO). Jefferson Co.: sandy rocks, 14 April & 20 May 1887, H. Eggert sn (GH, MO, NY, TENN, US). Madison Co.: moist shaded sandstone, bluffs of the Little Francis River, mine Le Motte, 22 May 1926, E. J. Palmer

30285 (MO, NY, PH). Ozark Co.: sandstone rocks, around Althea Spring, in T 23N R12W, Sect. 25, at Althea, 4 April 1937, J. A. Steyermark 4695 (MO). St. Francois Co.: rock crevices, n. of Knob Lick, near St. Francis River, 22 April 1950, H. E. Ahles 2060 (ILL). St. Genevieve Co.: in open sandy soil along Levie Blue Cr., about 2 mi. nw. of Sprott, 12 April 1931, J. A. Steyermark 807 (MO); moist sandy soil in open woods, Pickle Spring, 7 mi. e. of Farmington, 21 April 1956, A. C. Koelling 35 (ILL). Shannon Co.: Powder Mill Ford, between Eminence and Ellington, 6 April 1937, J. A. Steyermark 4733 (MO). Texas Co.: on lower limestone bluff of rich nw. facing slope by "The Narrows," along West Piney Creek, T 30N R10W, Sect. 1, 3 mi. w. of Houston, 28 April 1952, J. A. Steyermark 73149 (MO). Wayne Co.: moist low slopes along St. Francis River e. of Patterson, 22 May 1935, J. A. Steyermark 17005 (MO).

ARKANSAS. Pulaski Co.: rocky banks of Arkansas River, at Little Rock, April 1837, G. Engelmann 927 (MO).

PHYLOGENETIC RELATIONSHIPS

The most interesting phase of this study, and probably the most important, is that of the relationships among the five species of Saxifraga of the area. These relationships are of two kinds: the relationship of the five species to each other, and the relationship of these five species to the other species of this complex genus.

Saxifraga micranthidifolia does not seem to exhibit a close relationship to any of the other four species found in the area encompassed by this study. It was suggested, indirectly, by Haworth (1821) that this plant was not intimately related to any of the saxifrages which he knew, for he erected a monotypic genus for it: Aulaxis. Engler (1872), in his monograph, placed S. micranthidifolia in the section BORAPHILIA along with the other four species of Saxifraga of the Southern Appalachians. Johnson (1923), when revising the North American species of Engler's section BORAPHILIA, removed S. micranthidifolia from the section BORAPHILIA and considered it to be a monotypic section AULAXIS. He mentioned that it had been confused with S. pensylvanica because they have similar vegetative characters but that the two species could be distinguished from one another by the characters of the carpels. Engler (1930), in Die Natürlichen Pflanzenfamilien, placed this species in the section BORAPHILIA, group Stellares, which also included Saxifraga michauxii and S. stellaris.

From the work cited above, it seems apparent that little is certain in regard to the affinities of S. micranthidifolia with other species of Saxifraga known to science at this time. The present study has provided

nothing additional concerning its phyletic position.

Saxifraga michauxii, like S. micranthidifolia, appears not to be closely related to any of the other species with which it is sympatric. Its closest affinities appear to be with three species: S. ferruginea of the northwestern United States and western Canada, S. clusii of the Alps and the Pyrenees, and S. stellaris of circumpolar distribution. This species has been included in various taxa by students of the genus. Adrian Haworth (1821) put it in the genus Spatularia along with S. clusii and S. stellaris. Rafinesque (1836) established the genus Hexaphoma, in which he placed S. michauxii, S. ferruginea, and S. clusii. Small (1905), in his treatment of the North American species of Saxifraga, reinstated Haworth's genus Spatularia; however, he included not only S. michauxii but also S. ferruginea and several other related western species. Johnson (1923) erected the section ARABISA in which he included S. michauxii, S. ferruginea, S. foliolosa, S. stellaris, and S. bryophora. Engler (1930) placed S. michauxii in the section BORAPHILIA, group Stellares, along with S. micranthidifolia, S. stellaris, S. clusii, and other species.

From the observations made in this study it is felt that S. michauxii is probably closely related to S. ferruginea, from the mountains of Alaska and the northern Rockies, S. clusii, of the Pyrenees and the Alps, and S. stellaris, a circumpolar species. Miss Eva Temesy (1957) has worked on S. stellaris and its "Formenkreis." She carefully differentiated between the above named species. However, she did not mention the relationships that possibly could exist between the first three

species and Saxifraga stellaris.

It is possible to speculate about the relationships between these species in accordance with the present-day knowledge of plant migration and speciation. It can be suggested that S. stellaris was the ancestral stock that gave rise to the other taxa of this group: S. clusii in Europe, S. michauxii in the eastern United States, and S. ferruginea in the western United States and Canada. This inference is based on the fact of great morphological similarities; for example, all the species in this group have leaves of the spatulate type, irregular corollas, filiform stamens, a superior ovary and fusiform, papillose seeds. If the species with the widest distribution is the ancestral form, obviously S. stellaris is the ancestor of this group of plants. It is possible that these species could have originated during the period of Pleistocene glaciation when the parental stock of S. stellaris became isolated in various refugia (in western North America, the Southern Appalachian mountains and the Alps and Pyrenees). Saxifraga stellaris is known to be a complex species, and it has great genetic variability (Temesy 1957); thus speciation might have occurred during this period of isolation, giving rise to the three species: S. clusii, S. michauxii, and S. ferruginea.

Saxifraga careyana has been variously considered as to its affinities with the rest of the genus. Due to its late description by Asa Gray in 1841, Haworth and Rafinesque did not have the opportunity to express opinions about its position in relation to the rest of the genus. Engler (1872), however, included it in his monograph, placing it

in the section BORAPHILIA along with the other four species included in this study. Small (1905) placed S. careyana in his genus Micranthes. In Johnson's revision (1923) S. careyana is placed in the section DERMASEA. He suggested that this section could be divided into two groups: one group composed of plants that have a shallow receptacle, and the other group composed of those that have a deeper and broader receptacle. He suggested that the species in these groups are probably closely related. In the group that has a shallow receptacle, he included S. careyana along with S. caroliniana and several other species found in the mountains of the western United States and western Canada.

Engler, in 1930, in Die Natürlichen Pflanzenfamilien placed S. careyana in the group, Nivali-virginiensis, of his section BORAPHILIA which included twenty-two species, some of which are to be found in eastern Asia, eastern North America, and western North America as well as those that are circumpolar in distribution.

Saxifraga caroliniana was described in 1845 by Gray. He noted at that time that there was great similarity between S. caroliniana and S. careyana. All of the men who have worked on these two species since that time have held the opinion that there is a close relationship between them. Engler (1872) included this taxon in his section BORAPHILIA. However, he did not give it specific rank but considered it to be merely a variety of S. careyana. Small (1905) placed S. caroliniana in the genus Micranthes. Johnson (1923) placed it in the section DERMASEA. He considered that it showed a pronounced deviation from the type which he set for the section, but apparently it had insufficient differences

to be placed in another section. He suggested that it is very similar in some characters to certain western species.

The last and probably the most difficult to deal with is Saxifraga virginensis. This species has long been considered to have close affinities with the circumpolar, S. nivalis. Haworth (1821) placed both of them in his genus Micranthes. In discussing the distribution of the two species, David Don (1822) questioned the identification of some of the North American plants which were collected and named Saxifraga nivalis by Pursh. He believed this species was not to be found in North America and that Pursh's plants were S. virginensis rather than S. nivalis. Engler (1872) put S. virginensis (as he did all the other species in this study) in the section BORAPHILIA without comment as to origin or affinities. Small (1905) placed it in his genus Micranthes. Johnson (1923) included it in his section DERMASEA and put it with the subgroup that possesses a deep and broad receptacle. Along with S. virginensis he also included S. nivalis and several western species. He stated that there appears to be a close affinity between S. virginensis and S. nivalis and he also noted that they had often been confused. Engler (1930) placed S. virginensis in the group, Nivali-virginensis, of the section BORAPHILIA.

Work on the flora of the south central United States has resulted in the description of three species of Saxifraga which are obviously related to S. virginensis. These are Saxifraga palmeri Bush, Saxifraga reevesi Cory, and Saxifraga texana Buckl. They appear to have been derived from S. virginensis. When an extensive study is done on

Saxifraga virginensis throughout its entire range, it probably will be found that these species are varieties, or at most, subspecies of Saxifraga virginensis.

It is apparent that the same kind of relationship may exist between Saxifraga virginensis and S. nivalis that exists between S. michauxii and S. stellaris. That is, Saxifraga virginensis may have been derived from Saxifraga nivalis, and during glaciation the Southern Appalachian area served a refugium for it. Also, the western North American elements of this group may have been derived from Saxifraga nivalis in this way.

As to the relationship between Saxifraga virginensis, Saxifraga careyana, and Saxifraga caroliniana, it has already been suggested that S. caroliniana has been derived from S. careyana and is thus closely related to it. It is felt on the basis of the results of this study that this taxon is distinct enough to be accorded specific rank.

Saxifraga caroliniana has been found to be stable in the characters of the reflexed sepals at anthesis and clavate stamen filaments, and it does not appear to intergrade with S. careyana. The morphological similarity of S. caroliniana to S. careyana and the very limited distribution of S. caroliniana suggest that perhaps it arose by mutation from Saxifraga careyana only a short time ago and has not yet been dispersed widely from its point of origin, the mountains of western North Carolina and southwestern Virginia.

It has been suggested by Rosendahl (1905) that Saxifraga michauxii, S. careyana, and S. caroliniana all developed from Saxifraga stellaris.

Morphological data, however, do not offer conclusive proof of this idea. Saxifraga careyana appears to have some characteristics of both S. virginiensis and S. michauxii in that its general habit and erect sepals are reminiscent of S. virginiensis and the stamen-filaments, carpel-shape and carpel-position and the spots on the petals are suggestive of Saxifraga michauxii. Because of the similarities listed above, it is suggested that S. careyana possibly arose as a hybrid between S. michauxii and S. virginiensis or from their ancestral stock and that subsequent hybridization resulted in the modern, rather variable, species.

In conclusion the following diagram is presented to illustrate the suggestions which have been given above (Figure 9).

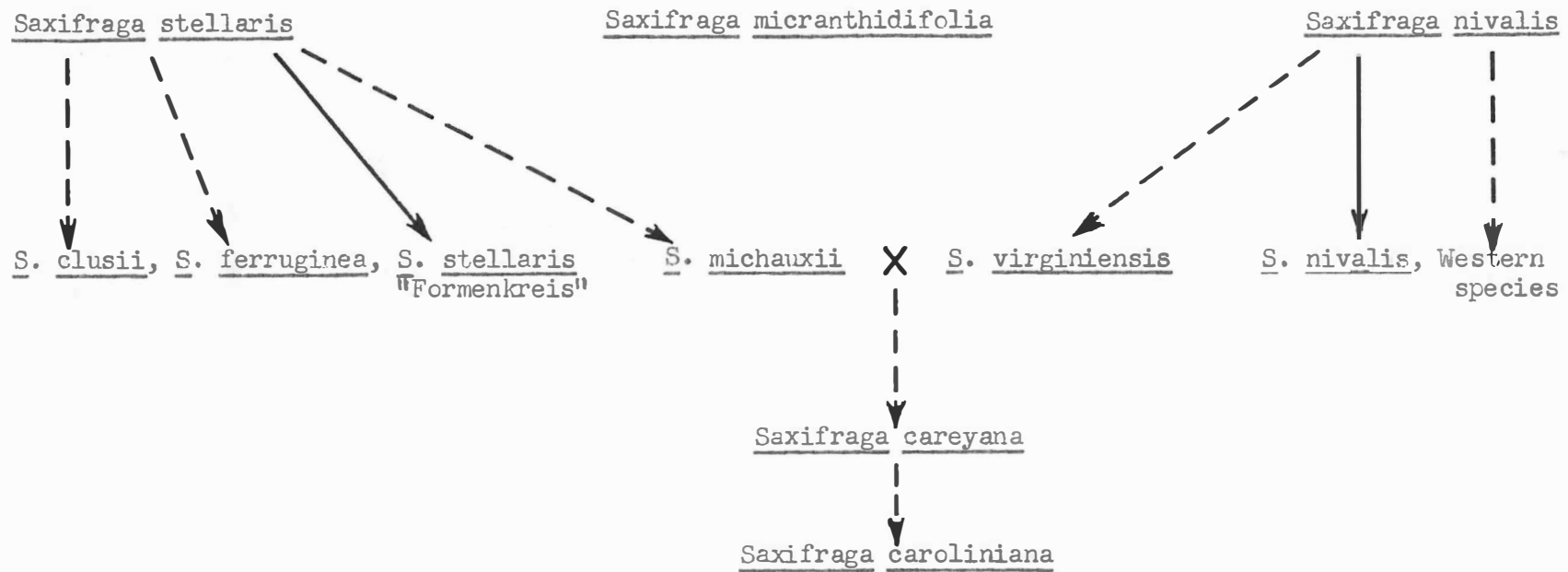


Figure 9. The Phylogenetic Relationships of the Southern Appalachian Saxifrages.

SUMMARY

1. The Southern Appalachian species of the genus Saxifraga were studied using morphological, ecological, and geographical data.

2. It has been found that the genus is represented in the area by five species: Saxifraga virginensis, Saxifraga careyana, Saxifraga caroliniana, Saxifraga michauxii, and Saxifraga micranthidifolia.

3. Saxifraga tennesseensis was found to be only a local variant of Saxifraga careyana.

4. The morphological characteristics which are of significance in distinguishing these species are pubescence-type, sepal-position, corolla-shape, shape and length of stamen-filaments, and the nature of the hypanthium.

5. Ecological and distributional data show that Saxifraga micranthidifolia always occurs in association with cold water on the edges of brooks, moss-covered rocks in brooks, or cold water seepage areas and is limited to the Blue Ridge Province. Saxifraga michauxii is limited to the Blue Ridge Province and is always associated with non-calcareous rocks in moist situations. Saxifraga careyana is found in several types of ecological niches on the Cumberland Plateau, in the Ridge and Valley Province, and in the mountains of East Tennessee, of western North Carolina, and southwestern Virginia. Saxifraga caroliniana is a restricted endemic, being found only in five counties of western North Carolina and southwestern Virginia in the Blue Ridge Province. Saxifraga virginensis is the most widely distributed. It extends from eastern Canada to northeastern United States and southward to Alabama

and Georgia and westward to Arkansas and Missouri. It occupies various environments.

6. It is suggested that Saxifraga stellaris was the ancestral stock which gave rise to Saxifraga michauxii and that Saxifraga nivalis was the ancestral stock of Saxifraga virginensis. It is thought that Saxifraga careyana possibly arose as a hybrid between Saxifraga michauxii and Saxifraga virginensis or from their ancestral stocks and that subsequent hybridizations resulted in the present rather variable species. Saxifraga caroliniana possibly arose as a mutant from Saxifraga careyana.

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