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# NOTES ON EAST TENNESSEE SCROPHULARIACEAE

(A Preliminary Report)

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The Scrophulariaceae is a large and complex family. Existing data for this family in Tennessee are scattered and inadequate. Additional data are needed in order to solve certain problems of distribution and to establish definite relationships within certain groups.

Some members of the family are of historical interest. Street (1939) lists the following members of the family which have been used for medicinal purposes: *Verbascum thapsus* L., *Linaria vulgaris* Hill, *Chelone glabra* L., *Scrophularia marilandica* L., *Digitalis purpurea* L. and *Veronicastrum virginicum* (L) Farwell. The use of these plants with the exception of *D. purpurea,* has been discontinued in modern therapy.

It is planned ultimately to include the entire state in the study, but very little work has been done to date west of the escarpment of the Cumberland Mountains. Numerous field trips have been made in the area for the purpose of studying the Scrophulariaceae in the field and collecting material for closer laboratory study. Much additional field work remains to be done. Specimens of all species collected (except *Verbascum* spp.) have been placed in the herbarium of the Academy of Natural Sciences, Philadelphia, and specimens of all species in the herbarium of Lincoln Memorial University.

The writer wishes to acknowledge with thanks the help given him by the following: The late Dr. Francis W. Pennell for checking identifications and for the loan of specimens; Dr. A. J. Sharp for permission to study the herbarium material in the University of Tennessee; Dr. Jesse M. Shaver for making available his large collection for study and for valuable suggestions.

This paper is only a preliminary report, and makes no claim of completeness as to distribution of the species. Doubtless a number of additional species will be added to the list. Habitat notes and county records for the species found to date are given below. Habitat descriptions were taken from field notes. An analysis of the ecology of the different species will be given when distributional data are more complete. Nomenclature and the arrangement of tribes, genera, and species follow Pennell (1935).

Species listed below include (1) species in the herbarium of the University of Tennessee (distinguished by UT); (2) species from the collection of Dr. J. M. Shaver (distinguished by S); (3) species listed by Pennell, 1935 (distinguished by P); (4) species listed by Street, 1939 (distinguished by St.). All county records not followed by ( ) refer to species collected by the writer.

## Family Characteristics

Mostly annual or perennial herbs. Leaves opposite, alternate or whorled. Ovary two-celled, rarely becoming one-celled (some members of the Gratioleae); stigmas two, distinct or united; stamens usually four, didynamous, sometimes two or five, the fifth sterile in some groups; anther cells dehisce throughout; sepals distinct or slightly united at base; a pair of opposite bractlets sometimes present upon the pedicels; corolla zygomorphic to nearly regular actinomorphic. Flowers perfect; inflorescence racemose, axillary or paniculate. Dehiscence of capsule septicidal or loculicidal.

### Tribe I. Gratioleae

Pennell regarded the Gratioleae as the most primitive of existing Scrophulariaceae. This conclusion was based upon the distinctness of the stigmas, the simple reticulate coat of the seeds, the racemose inflorescence, septicidal dehiscence of the capsule, campanulately zygomorphic corollas and distinct sepals.

*Pagesia* Raf. This genus is distinguished by unequal sepals, pubescense of corolla within on posterior side and bractlets located at the base of the pedicels. A characteristic not shown by other members of the Gratioleae is the tendency of the plants to blacken in drying (Pennell, 1935).

*Pagesia acuminata* Walt. *typica* Pennell. This is the only representative of the genus known to occur in East Tennessee, and only two records seem to exist for it: Decatur, Meigs (UT), collected by Sharp and Underwood and listed as *Mecardonia acuminata* Walt.; Rockwood, Roane County (P).

*Gratiola* (Bauhin) L. Corolla white, yellow or purplish, zygomorphic with stiff hairs on the posterior side near the distal end; slightly upturned at the apex.

*Gratiola viscidula* Pennell *typica* Pennell. Corolla white or purplish. Found along streams from Delaware to northern Georgia and Eastern Tennessee. County records: Wolf Creek, Cocke (P); near Chattanooga, Hamilton (UT); (collected by Weatherby).

*Gratiola floridana* Nutt. Corolla white or slightly pink, yellowish at base of posterior lobes with fine longitudinal purple lines. Flowering in April and May. Occurs in wet woods on the Coastal Plain, central Georgia to southern Mississippi; extending to southern Appalachians in Alabama, Georgia, and Tennessee. County record: Chickamauga Park, Hamilton (UT). This specimen was not annotated by Pennell.

*Gratiola neglecta* Torrey. Wet soil, pond margins, ditches and other places where water has stood. Common over most of northeastern United States from Massachusetts west to Wisconsin, southward through the Appalachians to Northern Alabama (Pennell, 1935). County records: Wolf Creek, Cocke (P); Knoxville, Knox (P); eleven miles east of Ocoee, Polk (S).

*Gratiola virginiana* L. Corolla white with longitudinal purple lines within. Occurs along streams, New Jersey to Iowa, Florida and Texas. County records: Newport, Cocke (P); Signal Mountain, Hamilton (P); eleven miles east of Ocoee, Polk (S).

*Mimulus* L. A genus of about eighty species, mostly American. Leaves opposite, serrate, petioled or sessile. Flowers zygomorphic. Corolla violet or violet-purple. The nearly uniform calyx lobes shorter than the tube. Only two species are known to occur in East Tennessee, *M. ringens* L. and *M. alatus* Ait.

*Mimulus ringens* L. Leaf blades petioled, lanceolate to ovate-lanceolate, 5-12 cm. long. Corolla 25-30 mm. long, pale violet, throat with purple-red spots anteriorly, and proximately two yellow areas mottled with brownish patches (Small, 1933). A white-flowered form (f. *peckii* House) is of rare occurrence (Pennell, 1935). County records: Blount (UT); Cumberland Gap, Claiborne; Abram's Falls, Blount (UT); Wolf Creek, Cocke (UT); Buffalo Spring, Grainger, (UT); Shady Valley, Johnson (S); Knoxville,

Knox; (P); Bald River Falls, Monroe (S); Reliance, Polk (P); Elkmont, Sevier (P).

*Mimulus alatus* Ait. Very similar to preceding species but may be distinguished from it by its petioled leaves. Occurs along streams, pond margins, and in marshes. Common in Claiborne County. A white-flowered form of rare occurrence (f. *albiflorus* House) has been described by Pennell, (1935). County records: Cades Cove, Blount (UT); Mineral Park, Bradley (P); U. S. Highway 25W, four miles north of LaFollette, Campbell; Blair's Creek, Claiborne; Buffalo Springs, Grainger (UT); four miles west of Whitesburg, Hamblen; near Eidson, Hawkins (S); Chestnut Hill, Jefferson; Shady Valley, Johnson (UT); Knoxville, Knox (P); near Fowler's Mill, three miles south of Loudon, Loudon; Brunner's Spring, Monroe; Spring City, Rhea (P); Highway 72, Roane (S); Gatlinburg, Sevier (UT).

*Lindernia* All. In the New World best developed in the Nearctic Region and chiefly in the southeastern United States. Records for only two species have been found for East Tennessee.

*Lindernia dubia* L. *typica* Pennell. Stems 0.5-2.5 dm. tall; leaf blades dentate, serrate, or nearly entire, ovate or elliptic, narrowed at base. Corolla 7-10 mm. long, pale lavender. Stream margins and swamps (Small, 1933). County records: Cades Cove, Blount (UT); Grainger (UT); Knoxville, Knox (P); Pond margin, eleven miles east of Ocoee, Polk (S).

*Lindernia dubia* L. *major* Pennell. This form is quite similar to *L. d. typica* and Pennell (1935) concludes that *typica* has arisen directly from *major*. County records: Knoxville, Knox (P); pond margin eleven miles east of Ocoee, Polk (S); Gatlinburg, Sevier (P); Unaka Springs, Unicoi (P).

*Lindernia anagallidea* (Michx.) Pennell. Corolla white or tinged with lavender, slightly deeper at bases of anterior lobes, lavender spots internally and short pale yellow hairs on anterior ridges. Flowering from July to September, (Pennell, 1935). Southern distribution as given by Pennell: throughout the Coastal Plain, extending above the Fall line on the Piedmont Upland of North Carolina and Virginia; in the Mississippi Valley extending northward through the Central Lowland from Alabama and Oklahoma to Minnesota, etc. Pennell (1935) reported this species from Jackson, Madison County but did not report it from East Tennessee. Street (1939) recorded it from Polk County (stream margin eleven miles east of Ocoee). This record extends the known range for this species. More information on the distribution of *L. anagallidea* is needed.

### Tribe II. Verbasceae

The Verbasceae were formerly thought to be a primitive link with the family Solanaceae. Pennell (1935) considers them to be derived from zygomorphic ancestry and the present rotate corolla to be a later development. For this reason he places them in a more advanced position.

*Verbascum* L. Leaves alternate; blades toothed or entire. Flowers in spikes, racemes, or panicles. Corolla rotate, slightly zygomorphic; lobes longer than the tube. Stamens five, exserted. Stigma capitate. About 250 species; natives of the Old World (Small, 1933).

*Verbascum blattaria* L. Occurs in abandoned fields, pastures, and along waysides. Common in Claiborne County. Two forms are known to exist, one with yellow corolla and the other with white corolla with a purplish base (Pennell, 1935). Form *albiflora* is common in East Tennessee. On June 15, 1953, the yellow flowered form was found in pastureland in Claiborne County. This is the only specimen of this form seen by the writer. County records: Norris, Anderson (UT); Forked Ridge Trail, Blount (UT); Cove Creek, Campbell; Harrogate, Claiborne; Rogersville, Hawkins; Kingston Pike, Knox (UT); Brunner's Spring, Monroe; Lenoir City, Loudon (UT); Gatlinburg, Sevier (UT).

*Verbascum thapsus* L. Corolla commonly yellow. A white-flowered form, forma *candicans* has been reported from New York by House (Pennell, 1935). Common in old fields, pastures, and along roadsides. This species probably occurs in every county within the area of this study. County records: Blount (UT); LaFollette, Campbell; South of Shady Valley, Carter, Cumberland Gap, Claiborne; Picnic Ground Road east of Greeneville, Greene; Whitesburg, Hamblen; Chestnut Hill, Jefferson; Knoxville, Knox (UT); Fowler's Mill, Loudon; Vonore, Monroe; Benton, Polk.

### Tribe III. Leucophylleae

The Leucophylleae are a small group. Their known distribution is confined to northern and central Mexico (Pennell, 1935).

### Tribe IV. Cheloneae

A common point of agreement with regard to members of this tribe has been the cymose type of inflorescence. Pennell (1945) was of the opinion that the Cheloneae, as it has been understood, represents a heterogeneous assemblage of genera and that relationships must be determined along lines other than the presence of flowers in cymose inflorescences. Therefore, based on characteristics of stigmas, calyces and type of dehiscence of the capsules, he has made certain changes. Notable among these changes are: the transfer of *Synapsis* and *Paulownia* to the Bignoniaceae; *Leucocarpus* and *Berendtiella* to the tribe Gratioleae.

*Chelone* L. Leaves opposite, blades toothed, acuminate. Flowers in spike-like racemes; the bracts, excepting the lower ones, sepal-like, bractlets two-lipped. Corolla purple, greenish or white, two-lipped, externally glabrous, internally lanose on the margins of the palate; tube abruptly expanded into an inflated throat (Small, 1933). The color of the corolla is so variable in some of the species that it is not a reliable criterion for identification in some cases.

*Chelone cuthbertii* Small. This species was described by Small in 1897 from a specimen collected at Highlands, North Carolina, (Pennell, 1935). According to Pennell the species is known to occur in three isolated areas: in the Blue Ridge Plateau in Southwestern North Carolina; the Salem district of Northwestern North Carolina; and on the Coastal Plain near the James River in Virginia. He suggests that such local occurrence in such diverse habitats indicates considerable antiquity. Street (1939) reported *C. cuthbertii* Small, collected by Shaver near Sassafras Ridge, Cherokee National Park, Monroe County, Tennessee, September 28, 1938. This species is inadequately known and should be given more study.

*Chelone lyoni* Pursh. Leaf blades 10-20 cm. long, ovate, serrate, acuminate, slender petioles. Corolla 20-30 mm. long, reddish purple, the anterior lip with dark yellow beard, sterile filament white or pinkish-tipped. Springheads, along streams, and in open rich woods. County records: Cades Cove, Blount (P); Lemon Gap, State Highway 107, east of Newport, Cocke, (S); Roan Mountain Station, Carter (P); Chestnut Hill, Jefferson; near Cherokee Orchard (elev. 2,500 ft.) Sevier (UT); also Mt. LeConte at 6,000 ft.; State Highway 412, five miles east of Bristol, Sullivan, Ernstville, Unicoi; Embreeville, Washington.

*Chelone obliqua* L. Pennell (1935) divides this species into three subspecies; *C. o. typica, C. o. speciosa* and *C. o. erwiniae*. He gives no record for the species in East Tennessee. There are two records of this species in the University of Tennessee herbarium from West Tennessee: Benton County and Jackson, Madison County. It is very difficult to distinguish herbarium material of *C. o. erwiniae* from *Chelone glabra* L. *typica* Pennell. According to Small (1933) in *C. o. erwiniae* the corolla is a pale dull purple, the sterile filament usually green-tipped and leaf blades decidedly paler beneath.

*Chelone glabra* L. is a very complex species. Pennell (1935) placed seven subspecies within this species. Three of these, *C. g. typica, C. g. elatior* and *C. g. chlorantha* have been reported from East Tennessee.

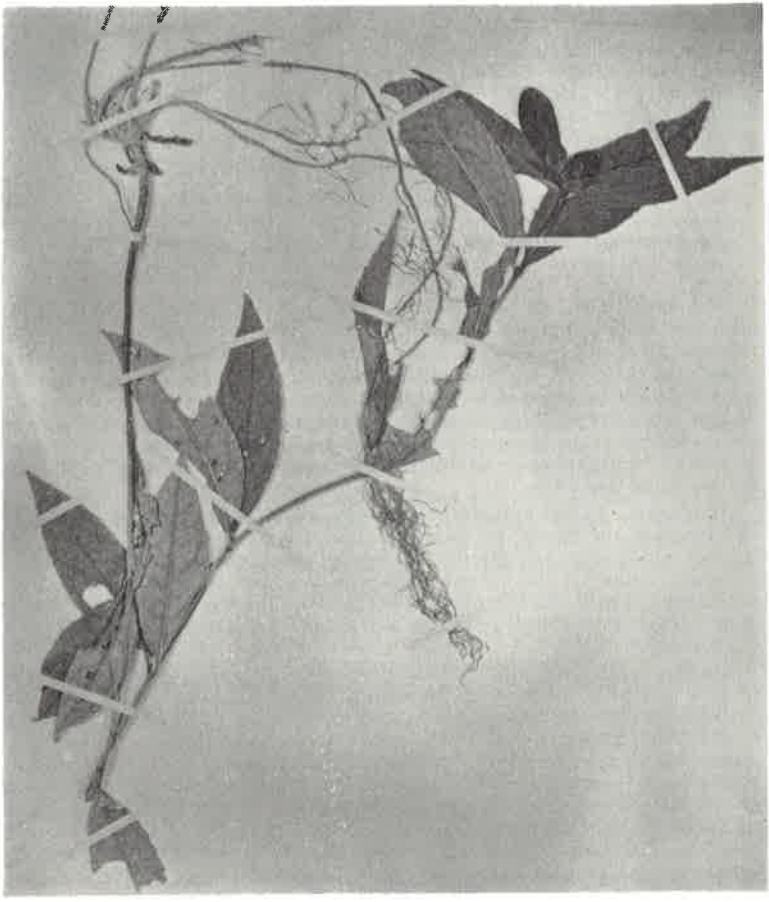

Fig. 1. Typical *specimen* of *Chelone glabra typica*.

*Chelone glabra* L. *typica* Pennell. Leaf blades lanceolate to elliptic-lanceolate or linear-lanceolate, serrate, acuminate. Corolla 25-35 mm. long, externally white, internally dull purple at distal end on upper lip (very variable in this respect). Pennell supplied the author with what he regarded as a typical specimen, a photograph of this specimen is shown in figure 1. Occurs along streams, around springheads and in rich moist woods. This is the most widespread of the subspecies. Distribution: New England and Piedmont Physiographic Province from Maine to Maryland and inland to New York to southern Ontario and the St. Lawrence Valley; northward to Chaleur Bay, New Brunswick and Nova Scotia, etc.; westward to Ohio and along the shores of the Great Lakes, on the upper Mississippi River from Minnesota to Illinois; southeastwardly occurring on the Coastal Plain from Massachusetts to Virginia, through the Piedmont and Appalachian Provinces to Central Alabama (Pennell, 1936). Thorne (1949) reported it from the Gulf Coastal Plain of Georgia.

It is sometimes difficult to distinguish *C. g typica* from *C. g elatior* in the field, and much more difficult when working with herbarium material. An

attempt is being made to discover characteristics which may be used to distinguish these subspecies using herbarium material. This work is discussed below.

County records for *Chelone glabra* L. *typica* Pennell: Mineral Park, Bradley (P); Wolf Creek, Cocke (P); Greystone School, Picnic Ground Road, Greene; east of Rogersville, Hawkins; mountains east of Shady Valley, Johnson; Knoxville, Knox (P); Tellico Junction, McMinn (P); Little Piney Creek, Rhea (UT).

*Chelone glabra* L. *elatior* Pennell. In 1928, Pennell and Wherry, after an extensive trip through the Ohio Valley and the southern Appalachians, gave *elatior* specific rank, *Chelone montana* (Raf.) Pennell and Wherry, and it is included under this name in Small's Manual of the Southeastern Flora (1933). Pennell later (1935) reduced it to *Chelone glabra* var. *elatior*, thus giving it equal rank with *C. g.* var. linifolia, a post-glacial variety. In a written communication to the writer in 1944, Dr. Pennell expressed the opinion that further field work might justify giving this plant specific rank. With typical specimens *Chelone glabra elatior* may be distinguished from *C. g. typica*, which it closely resembles, by the fact that the corolla is distally reddish purple, while the corolla of *C. g. typica* is white externally and a very pale purplish internally at the distal end. However, there are so many intergrading forms that the separation of the two varieties on the basis of corolla color is sometimes difficult.

It is likewise difficult to separate the two varieties on the basis of leaf size and shape, due to intergrading forms. Small (1933) describes the leaves of the two varieties as follows: *C. g. typica;* leaf blades 7-15 cm. long, lanceolate to elliptic-lanceolate, slightly to moderately serrate, acuminate, at base cuneately narrowed. *C. g. elatior* (*C. montana* of Small); leaf blades 9-18 cm. long, sharply serrate, long-acuminate, at base cuneately narrowed. There are many variations and intergrading forms. Some of these are illustrated in figure 2.

Stomata frequency and the size of guard cells have been found to be valuable criteria in the separation of closely related species and lower categories (Babcock and Stebbins, 1937) and (Sax, K. and H. J. Sax, 1937). In this study, stomata frequency and size of guard cells have been determined for a number of specimens of *C. g. typica* and *C. g elatior*. This work is incomplete, but the method used and the results to date are included here because the data appear to show a definite trend.

The collodion peel method was used (Sax, K. and H. J. Sax, 1937). A small drop of collodion was spread over the lower epidermis of the basal part of the lowest cauline leaf (no basal leaves present in *Chelone*) with a small camel's hair brush. When the edges of the collodion began to separate from the leaf, the peel was removed and immediately cemented to a glass slide. Stomata counts were made at 440X. The count for each specimen was based on an average of five records from various parts of the peel. The counts were converted into number of stomata per sq. mm. of leaf surface. Counts from four specimens of *C. g. typica* gave an average of 5997 per sq. mm. and counts from sixteen specimens of *C. g. elatior* gave an average of 470 per sq. mm. In similar work on *malus*, Sax and Sax (1937) concluded that the higher counts indicated a tetraploid chromosome number. Conclusions will not be made relative to *C. g. elatior* until more data are available.

The size of the guard cells was measured by means of a standardized ocular micrometer and a microscope equipped with mechanical stage. The present data indicate no statistically significant difference between the two varieties in this respect.

During the course of this study, two forms of *C. g. elatior* were found to occur in East Tennessee. One form has dark green leaves and the distal end of the corolla colored purple for one-fourth to one-third its length; the other form has pale green leaves and the corolla a somewhat deeper

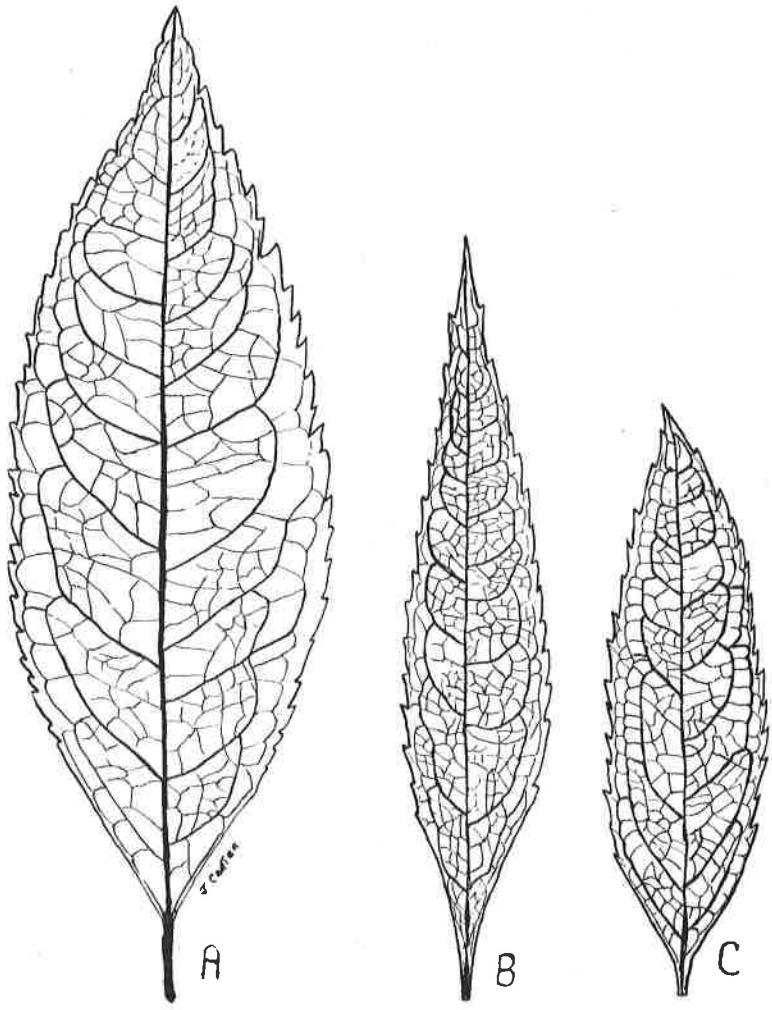


Fig. 2. Leaves from two varieties of *Chelone glabra*. A. and C, leaves from different specimens of *C. g. elatior* X I: B, leaf of *C. g. typica* X I.

purple for about two-thirds of its length (Frick, 1946). Field notes show that each form was collected in both shady and exposed habitats. The possible effect of soil differences has not been studied.

The frequency and size of stomata were determined for sixteen specimens of the two forms by the method described above. The results were plotted in a scatter diagram (Fig. 3). This method has been used by Erickson (1941) and Anderson (1949) to show variability within closely related groups. Reference to figure 3 shows that there is a greater degree of variability in frequency of stomata than in size and that frequency is probably of value in the separation of the two forms.

County records for *Chelone glabra elatior*: Cades Cove, Blount (P); four miles east of LaFollette, State Highway 65, Campbell; Powell River, five miles south of Harrogate, Claiborne; six miles south of Sneedville, Hancock; near Fowler's Mill, Loudon; Tellico River, six miles above Tellico Plains, Monroe; Archville, Polk (P); Spring City, Rhea (P); four miles east of Maynardville, Union; Gatlinburg, Sevier (P).

*Penstemon*. Herbs with one to several erect stems arising from a short rootstock. Cauline leaves opposite, blades entire or toothed, upper leaves sessile. Flowers paniculate, bractlets absent. Corolla two-lipped, the tube expanded into an inflated throat, lobes shorter than the tube, corolla mostly

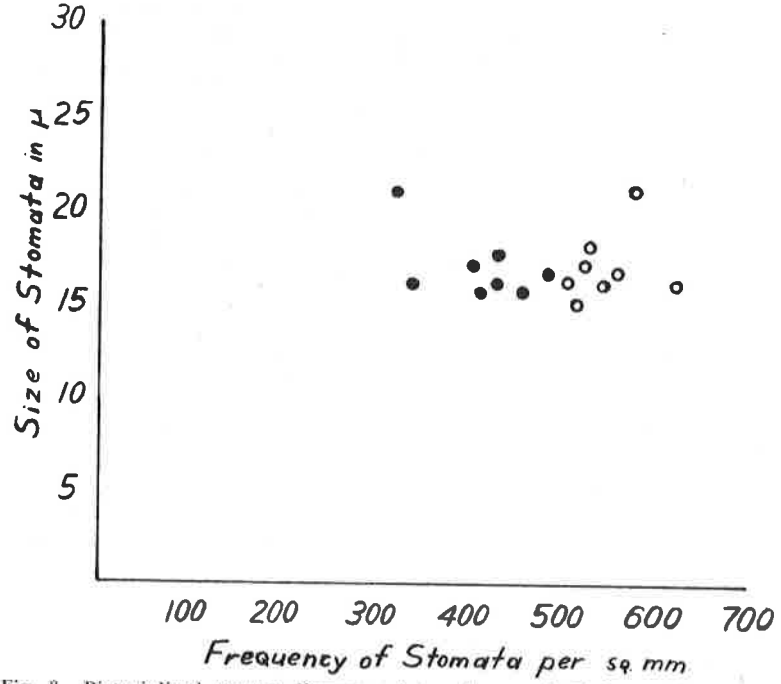


Fig. 3. Pictorialized scatter diagram of two forms of *Chelone glabra* var. *elatior*, showing size and frequency of stomata. Open circles: form with light green leaves; dots: form with dark green leaves.

purple or white. Fertile stamens four, posterior sterile filament with yellow hairs. Capsule ovoid, septicidal. Seeds numerous. Nine species of *Penstemon* are known to occur in East Tennessee. Of these *P. canescens* Britton *typicus* Pennell and *P. brevisepalus* Pennell appear to be the most common.

*Penstemon digitalis* Nutt. One record for this species, Decatur, Meigs County, is in the herbarium of the University of Tennessee. The writer found the species growing along a ridge south of Cumberland Gap, Claiborne County.

*Penstemon alluviorum* Pennell. Occurs in low open ground, clayey to somewhat sandy, often alluvial, but occasionally on low hillsides. The only record: Kinzel Springs, Blount (St.).

*Penstemon calycosus* Small. This species is quite variable as to size of corolla, width of leaves and degree of hairiness of leaves and stems. A de-

tailed study of these variations is planned. County records: flood plain of Clinch River, U. S. Highway 25 E. to Claiborne; U. S. Highway 25 E, two miles west of Thornhill, Grainger; Chattanooga, Hamilton (P).

A specimen of *P. Calycosus* (UT) collected from a Knoxville garden by Hatfield in 1934 was from a plant transplanted from Cannon County.

*Penstemon laevigatus* Solander. County records: Clinton, Anderson (P); Kinzel Springs, Blount (S); Dandridge, Jefferson (P); Dead Horse Lake, Knox (UT); Chickamauga Park, Hamilton (UT).

*Penstemon Smallii* Heller. Corolla externally purple, the tube much darker than the corolla lobes; internally pale purple with violet lines. Occurs on rocky slopes and river bluffs. County records: Wolfe Creek, Cocke (P); Lea Lakes, Grainger (UT); collected by Weatherby, Lookout Mountain, Hamilton (P); Lenoir City, Loudon (UT); river bluff, two miles south of Knoxville, Knox; eleven miles east of Ocoee, Polk (S).

*Penstemon canescens* Britton *typicus* Pennell. Common throughout East Tennessee. Corolla pale purple externally, white internally on anterior side with fine deep purple lines; cauline leaves elliptic-lanceolate, irregularly serrate; stem pubescent. (Small, 1933).

A specimen (identified by Pennell as *P. canescens*) was collected from a railroad embankment near Cumberland Gap which differs in some respects from the above description. The corolla of this specimen (author's no. 363) was of an orchid color (a shade of pink rather than purple). The lower cauline leaves obovate with winged petioles; the upper part of the stem sparingly hirsute. Further study of this specimen is planned.

One of Shaver's specimens (no. 8304) has this comment on the sheet, "lower bracts as large as leaves as in *P. Smallii,* but flowers are too small." Measurements showed the length of corolla tube to vary from 6-13 mm. The leaves rather sharply serrate, triangular-ovate (similar to *Smallii*); 1.8-2.2 cm. wide and 9-9.5 cm. long. The corolla length of *P. Smallii* (Small, 1933) is 28-35 mm. and of *P. canescens* 22-32 mm. There was very little difference in the color of the corolla in the two species in specimens examined, except that some specimens of *P. canescens* were white or very pale purple within and the *P. Smallii* were of a somewhat deeper purple within.

Shaver's specimen does not fit completely the description of Pennell's *P. canescens brittonorum* which appears to lie between *P. canescens typicus* and *P. Smallii*. Therefore, Shaver's specimen seems to be a form not previously mentioned in the literature. Information as to the distribution of this form would aid in assigning it a definite rank. County records: Norris, Anderson (UT); roadside, six miles south of Maryville, State Highway 33, Blount; roadside, Arthur, Claiborne; Del Rio, Cocke (P); Lookout Mountain, Hamilton (P); Mooresburg, Hawkins (P); Marsh, U. S. 70, eight miles east of Sevier County line, Jefferson (S); Hills back of Cherokee farms, Knox (UT); Lenoir City, Loudon (UT); roadside, five miles west of Madisonville, Monroe; rock bluff along creek, 11.3 miles east of Ocoee, Polk (S); five miles east of Rockwood, Roane (UT); Smoky Mountains National Park, Sevier (UT); four miles southwest of Erwin, Unicoi (P).

*Penstemon canescens brittonorum* (Pennell) Pennell. This subspecies, as described by Pennell (1935) varies slightly from *P. canescens typicus* and is a connecting link between it and *P. Smallii*. Pennell reports it from Frog Mountain, Polk County. Underwood and Sharp collected a specimen from bluffs along Emory River, Harriman, Roane Co. In this specimen the flowers were white with narrow purple streaks on top; throat gradually inflated.

*Penstemon pallidus* Small. This species has not been reported previously from East Tennessee. Pennell (1935) reported it from Maury County. The author collected this species from the margin of an abandoned field in loam soil, five miles north of Maynardville, Union County. One specimen collected by Paul Dunaway, is in the University of Tennessee herbarium. This specimen was not checked by Pennell.

*Penstemon brevisepalus* Pennell. This species is common in East Tennessee. It is similar to *P. canescens* but may be distinguished from it by the very short sepals (2-3 mm.), the sepals of *P. canescens* are from 4-7 mm. long. County records: Clinton, Anderson (P); School House Gap trail, Blount (S); four miles east of LaFollette, U. S. Highway 25 W, Campbell; roadside, Arthur, Claiborne; fifteen miles east of Newport, Cocke (S); Lea Lakes, Grainger (UT); Lookout Mountain, Hamilton (UT); roadside, Highway 33, five miles south of Vonore, Monroe; 11.3 miles east of Ocoee, Polk (S); Grand View Academy, Rhea (S); Harriman, Roane (P).

*Penstemon tubiflorus* Nutt. There is only one record for East Tennessee for this species. It was collected by Jamison in Cades Cove, Blount County.

*Scrophularia* (Bauhin) L. Only one species of this group is known for East Tennessee, *Scrophularia marilandica* L. County records: Wolf Creek, Cocke; Kyles Ford, Hawkins (UT); mountains east of Shady Valley, Johnson; Knoxville, Knox (P); Trail to Indian Grove Flats (elev. 5,000 ft.) Gatlinburg, Sevier (UT); top of Unaka Mountain, Unicoi; Nollichucky River, Washington.

### Tribe VI. Antirrhineae

Characteristics of the tribe; leaves mostly alternate; corolla in most species marked by the development of a prominent palate; it is also provided with a spur at base anteriorly; the capsule is loculicidally dehiscent, (Pennell, 1935).

*Linaria* (Bauhin) Miller. Two representatives of this genus are known to occur in East Tennessee.

*Linaria vulgaris* Hill. Pennell (1935) gives no specific record for East Tennessee. County records: in fence row, near Doe River, Carter; Fork Ridge, Claiborne; collected from roadside in very acid soil, Elkmont, Sevier (UT); old R. R. bed, State Highway 81, Embreeville, Washington (S).

*Linaria canadensis* (L) Dumont. County records: old field by French Broad River, forty-seven miles east of Newport, Cocke (S); Lookout Mountain, Hamilton (UT); Bald River Falls, Cherokee National Forest, Monroe (S).

A specimen in the University of Tennessee, collected by Churchhill and labeled *Linaria cymbalaria* is apparently *Cymbalaria muralis* Gaertner (Pennell, 1935).

### Tribe VII. Veroniceae

*Veronicastrum* (Heister) Fabricius. Only one species of this genus is indigenous to North America, *Veronicastrum virginicum* (L) Farwell. One record exists for East Tennessee: Knoxville, Knox (P).

*Veronica.* Low creeping or spreading herbs. Leaves opposite or alternate above, linear to cordate, toothed or entire. Flowers in terminal or axillary racemes or spikes. Sepals four. Corolla rotate, blue, violet or white, lobes longer than the tube. Stamens two. Capsule flattened, as wide as long, deeply loculicidal.

*Veronica serpyllifolia* L. County records: Wolf Creek, Cocke, collected by Gattinger, 1881 (UT); Cherokee Farm (UT); east of Ocoee, Polk (S); roadside, Harriman, Roane, collected by Kearney 1893 (UT); Marsh below trail to Laurel Falls, Great Smoky Mountains National Park, Sevier (S).

*Veronica peregrina L. typica* Pennell. This species is widely distributed in North America, occurring from Maine to Minnesota, south to Florida and Texas; also along the Pacific Cost from British Columbia to Oregon (Pennell, 1935). County records: near Norris, Anderson (UT); Lookout Mountain, Hamilton, collected by Weatherby (UT); Dandridge, Jefferson (P); Cherokee farm, Knox (UT).

*Veronica arvensis* L. County records: Campus, Maryville College (UT); Roan Mountain, Carter, Scribner collection (UT); Lookout Mountain, Hamilton (UT); Norris Lake forest, Union, (UT); U. T. farm (UT). In addition to above records one sheet from the Gattinger Collection is in the U. T.

herbarium. It was collected from East Tennessee, but no county record is given.

*Veronica persica* Boiret. Shaver's collection contains two sheets (Nos. 8470 and 8473) collected from Haw Knob, Monroe County. The author has been unable to locate any other records for this species in East Tennessee.

*Veronica hederaefolia* L. Collected on University of Tennesssee farm by Dr. A. J. Sharp.

*Veronica officinalis* L. County records: South of Wartburg, Anderson (UT); State Highway 63, four miles east of LaFollette, Campbell; Roan Mountain, (UT); Arthur, Claiborne; Wolf Creek, (UT); U. S. Highway 70, Jefferson (S); mountains east of Shady Valley, Johnson; Knoxville, Knox (UT); Athens, McMinn (UT); Haw Mountain, Monroe (S); Tennessee Mountains, Polk (S); Pole Ridge Creek, Rhea (UT); Harriman, Roane (UT); Indian Gap, Sevier (UT).

*Veronica americana* (Raf.) Schautz. Only one record exists for East Tennessee: Knoxville, Knox County (P).

*Veronica anagallis-aquatica* L. County records: Near Norris, Anderson (UT); Buffalo Springs, Grainger (UT); near Eidson, Hawkins (UT); Third Creek Pike, Knox (UT). None of above were checked by Pennell.

*Veronica glandifera* Pennell. The distribution of this species as known at present, is disjunct. Pennell (1935) gives the following distinct areas: (a) Appalachian Valley from northeastern West Virginia to eastern Tennessee, (b) near head of tide water along streams entering Chesapeake Bay from the Potomac to the James River, (c) in the Piedmont province of southeastern Pennsylvania, (d) near the Ohio River in southwestern Ohio and southeastern Indiana. When the distribution of this species is more fully known it will probably prove to be contiguous. County records: Elizabethton, Carter (UT); Harrogate, Claiborne; one mile east of Clinch River, U. S. Highway 24 E., Grainger; three miles west of Whitesburg, Hamblen; Highway 70, north of Rogersville, Hawkins; House Mountain, Knox; Buffalo Creek, Johnson (P); two miles south of Loudon, Loudon; three miles west of Madisonville, Monroe; Kingston, Roane (S); small stream below Laurel Falls, Sevier (S); four miles east of Maynardville, Union.

### Tribe VIII. Buchnereae

The Buchnereae are one of the most natural groups in the Scrophulariaceae (Pennell, 1935). *Aureolaria* is regarded as the most primitive genus of the group and *Dasistoma* and *Macranthera* are regarded as derivatives. The development of annual from perennial ancestry is found within the group. *Aureolaria* is perennial in the subgenus *Euaureolaria*, but it is annual in the subgenus *Panctenis*. *Tomanthera* and *Gerardia* are annual. The primitive condition for the group seems to be the perennial habit with yellow corolla.

*Aureolaria* Raf. Leaves opposite; blades entire, toothed or pinnatifid. Flowers axillary, in spikes or racemes, bractlets none. Corolla yellow, lobes spreading, the throat nearly campanulate, somewhat inflated anteriorly. Stamens four, didynamous. Parasitic on the roots of oaks (Small, 1933).

*Aureolaria virginica* (L) Pennell. Occurs in dry open woods, mostly in sandy acid soil. County records: in sandy soil, Meadow Branch, Blount, (UT); Mineral Park, Bradley (P); Wolf Creek, Cocke, (P); woods KS&E switchback, Knox (UT); White Cliff Springs, Monroe (P); Reliance, Polk (P); roadside, four miles east of Kingston, Roane (S); Gatlinburg, Sevier (P).

*Aureolaria microcarpa* Pennell. County records: Morristown, Hamblen (P); Signal Mountain, Hamilton (P).

*Aureolaria laevigata* (Raf.) Raf. occurs in dry open woods and along streams. Common in East Tennessee; records for seventeen counties are given below.

County records: Cove Creek, Anderson (UT); Kinzel Springs, Blount (S); Mineral Park, Bradley (P); LaFollette, Campbell; roadside, Highway 91, Carter; roadside, Cumberland Gap, Claiborne; Round Mountain, Cocke (S); Thornhill, Grainger; picnic ground road, Greene; Highway 66, east of Rogersville, Hawkins; Chestnut Hill, Jefferson; Iron Mountain, Johnson (S); Cherokee Bluffs, Knox (UT); ten miles above Tellico Plains, Monroe; Reliance, Polk (P); Teague Springs, Rhea (UT); open woods, four miles east of Kingston, Roane (St.); Laurel Falls Trail, Sevier (S); Unaka Springs, Unicoi (S); White Hollow, Union (UT); Johnson City, Washington (P).

*Aureolaria flava macrantha* Pennell. Habitat much the same as the preceding species. Pennell (1935) divides *A. flava* into three geographic subspecies. Only *A. f. macrantha* has been found in East Tennessee to date. County records: Harrogate, Claiborne; State Highway 72, east of Roane County, Loudon (S); Walden's Ridge, Knox (P); U. S. Geological Field Station, above Dayton, Rhea (UT).

*Aureolaria pedicularia* L. *austromontana* Pennell. Occurs in dry open woods and along roadsides, usually in very acid soil derived from sandstone. Pennell (1935) gives no record for Tennessee. County records: Cumberland Gap, Claiborne; Highway 66, west of Rogersville, Hawkins; Sugarland Mountain, Sevier (UT); Johnson City, Washington.

*Aureolaria pectinata* (Nutt.) Pennell. County records: in dry pine woods, Forge Creek, Blount (UT); Mineral Park, Bradley (P); Chattanooga, Hamilton (P); Knoxville, Knox (UT); State Highway 72 near Roane Co., Loudon (S); near Tellico Plains, Monroe (S); State Highway 30 near Cumberland County, Rhea (S); Archville, Polk (P); Rockwood, Roane (S).

*Aureolaria pectinata eurycarpa* Pennell. County records: Maryville, Blount (P); Signal Mountain, Hamilton (P); Knoxville, Knox (P); Rockwood, Roane (P).

*Aureolaria dispersa* (Small) Pennell. County records: Walden's Ridge, Hamilton (UT); Kingston, Roane (S).

*Seymeria* Pursh. Calyx campanulate, deeply 5-cleft. Corolla tube short, not longer than the lobes, anthers oblong, approximate.

*Seymeria macrophylla* Nutt. Leaves large, the lower pinnately divided; the upper lanceolate. Corolla yellow, wooly inside; style short; capsule ovoid. County record: Walden's Ridge, Rockwood, Roane County (UT).

*Seymeria cassioides* (Walter) Blake. County records: Bradley (P); Lookout Mountain, Hamilton (P).

*Gerardia* (L) Benth. Annual or perennial herbs, many are parasitic on roots. Leaves mostly opposite, blades linear or filiform, entire, sessile. Corolla purple, usually with two yellow lines on the anterior side with purple spots between, lobes of the corolla shorter than the tube. Stamens four, included. Stigma elongate.

*Gerardia purpurea* L. Occurs in acid soil, pond margins, along streams and shady roadsides. Corolla pale purple with two yellow lines and numerous purple spots within on anterior side. County records: roadside, Cumberland Gap, Claiborne; Del Rio, Cocke; swamp margin, U. S. Highway 25E, Jefferson; wooded bank of Hiwassee River, Polk (UT); Rockwood, Roane (P); Gatlinburg, Sevier (P); flood plain of creek, four miles east of Maynardville, Union.

*Gerardia setacea* (Walter) Gmelin. Corolla mallow-purple, with two yellow lines and small dark purple spots within throat on anterior side (Pennell, 1935). County records: Shaver's collection contains specimens collected by him from School House Gap Trail, Great Smoky Mountains National Park, Blount County; Pennell, (1929) listed this species from Archville, Polk County, collected by Wherry and Pennell, September 14, 1927.

*Gerardia tenuifolia* (Vahl.) *typica* Pennell. Corolla light mallow-purple or paler, with two yellow lines and small dark purple spots within on

anterior side (Pennell, 1935). County records: near Norris, Anderson, (UT); Turkey Pen Ridge, sterile sandy soil, Blount, (UT); sandstone bluffs, Cumberland Gap, Claiborne; near French Broad River bridge east of Newport, Cocke; Condon Lane, Knox (UT); Buffalo Springs, Grainger, (UT); Knoxville, Knox (P); Reliance, Polk (UT); Walden's Ridge, Rhea (UT); in oak barrens, Rockwood, Roane, (UT); Sugarland Mountain, Sevier (UT).

*Gerardia gatesii* (Benth.) Pennell. Sandy-Mountain slopes, weathered gneiss. Archville, Polk County (UT). Pennell (1935) changed *Gerardia plukenetii* Eliott to *G. gatesii* (Benth.) Pennell, named for Hezekiah Gates, a physician and botanical collector of Mobile, Alabama, a hundred years ago. The above record is the most northern record for the species to date.

*Gerardia tennuifolia macrophylla* (Bentham) Blake. County records: Decatur, Meigs (P); Englewood, McMinn (P).

*Gerardia gattingeri* Small. Corolla pink, with two yellow lines and rather large dark purple spots within on anterior side (Pennell, 1935). County records: pine oak woods, east of Chattanooga by U. S. Highway 41, Hamilton (UT); Harriman, Roane (P).

*Buchnera* L. Records seem to exist for only one species of this genus in the area studied.

*Buchnera americana* L. County records: Wolf Creek, Cocke (P); Dandridge; Jefferson (P); Harriman, Roane (P).

*Pedicularis*. Perennial herbs. Leaves alternate or opposite, blades pinnately lobed. Flowers spicate. Calyx lobes four, shorter than the tube. Corolla zygomorphic, yellow or purple. Stamens four included.

*Pedicularis lanceolata* Michx. A specimen of this species, collected from swamp in Union County, near Knox-Union County line is in the herbarium of the University of Tennessee and was described by Jennison (1935). This is the only existing record for this species in Tennessee.

*Pedicularis canadensis* L. This species is very common in East Tennessee. County records: near Townsend, Blount (P); Mineral Park, Bradley (P); Roan Mountain, Carter (P); Harrogate, Claiborne; picnic ground road, Greene; Lookout Mountain, Hamilton (P); Shady Valley, Johnson; two miles north Hiwassee College, Monroe; Ducktown, Polk (P); Limestone Cove, Unicoi (P); Highway 81, Washington; Morgan Springs, Rhea (UT); Elkmont, Sevier (P); Highway 421, east of Holston River, Sullivan.

*Melampyrum* (Bauhin) L. Very little information exists for this genus in East Tennessee. Most of the existing records for this genus are located in the University of Tennessee herbarium. With a few exceptions this material has not been checked by Pennell.

*Melampyrum lineare* Desx. County records: Cades Cove, Blount (UT); Shady Valley, Johnson (UT); Elkmont, Sevier (UT); Cherokee Mountain, Washington (UT).

*Melampyrum lineare latifolium* Beauverd. County records: Panther Creek Trail, Blount (UT); Dry Rocky Ridge, Maddern's Bald (5,000 ft. elev.) Cocke, (UT); White Cliff Springs, Monroe (P); Frog Mountain, Polk (P); Sugarland Mountain, Sevier (UT) (checked by Pennell).

*Castilleja* Mutis. Most of the species of this genus which occur in North America are restricted to the western part of the continent. Only one species is known to occur in East Tennessee.

*Castilleja coccinea* (L) Sprengel. County records: open woods near Hiwassee River, U. S. Highway 11, Bradley; Roane Mountain, Carter (P); Harriman, Roane (P); Gatlinburg, Sevier (UT).

## Summary

A preliminary study of the distribution and ecology of the Scrophulariaceae in East Tennessee was made. Data were obtained by making numerous field trips over the area, from

Pennell's work (1935), from the herbarium of the University of Tennesee, from the collection of Dr. Jesse M. Shaver, and from Street's thesis (1939).

Distributional records and habitat notes are given for fifty-four species representing eighteen genera.

A number of new county records were obtained during the field work. *Penstemon pallidus* Small is reported for the first time for East Tennessee.

Methods of distinguishing between closely related species and subspecies are discussed.

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## News of Tennessee Science

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*Carson-Newman College*:

Teachers and honor pupils from fifteen schools attended the Fourth Annual High School Science Teachers meeting at Carson-Newman College Friday evening, March 4. Dr. T. P. Nash, Jr., Dean of the School of Biological Sciences in the University of Tennessee Medical Units at Memphis, spoke on opportunities in the fields of medical science and led a discussion on the proper high school and college preparation for careers in medicine. Simultaneously a program for Home Economics teachers and pupils was held by the Home Economics Department.

The American Cancer Society, on recommendation of the Committee on Growth of the National Research Councitl, has just announced a grant of $4,000 to Carson-Newman College for synthesis of compounds for use in the study of cancer chemotherapy.

The Research Corporation has made a Frederick Gardner Cottrell Grant of $1600 to Carson-Newman College for study of dipole moments of organic compounds by Dr. Albert Myers and his students.

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