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(Continued from page 195)

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TENNESSEE ADDERSTONGUE FERNS

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ENGELMANN ADDERSTONGUE

Ophioglossum Engelmanni Prantl

Ophioglossum Engelmanni is a very unfern-like plant (Fig. 216), as are all species of *Ophioglossum*. Each leaf consists of a broad and entire sterile leaflet and a stalked spike-like fertile leaflet; a combination of characteristics not present in any other Tennessee genus. Some leaves have only the sterile leaflet and are thus entirely sterile. In Tennessee, this fern is mainly or altogether a limestone fern, being found most often in the cedar glades. Leaves of *Ophioglossum Engelmanni* have large areolae formed by anastomosing veins and there are in these areolae many smaller areolae formed by the anastomoses of the smaller veins (Fig. 215, *B*). The leaf blade is apiculate. These characters are sufficient to separate this plant from *Ophioglossum vulgatum* for this last plant does not have smaller areolae within the large areolae nor does it have an apiculate sterile leaf blade.

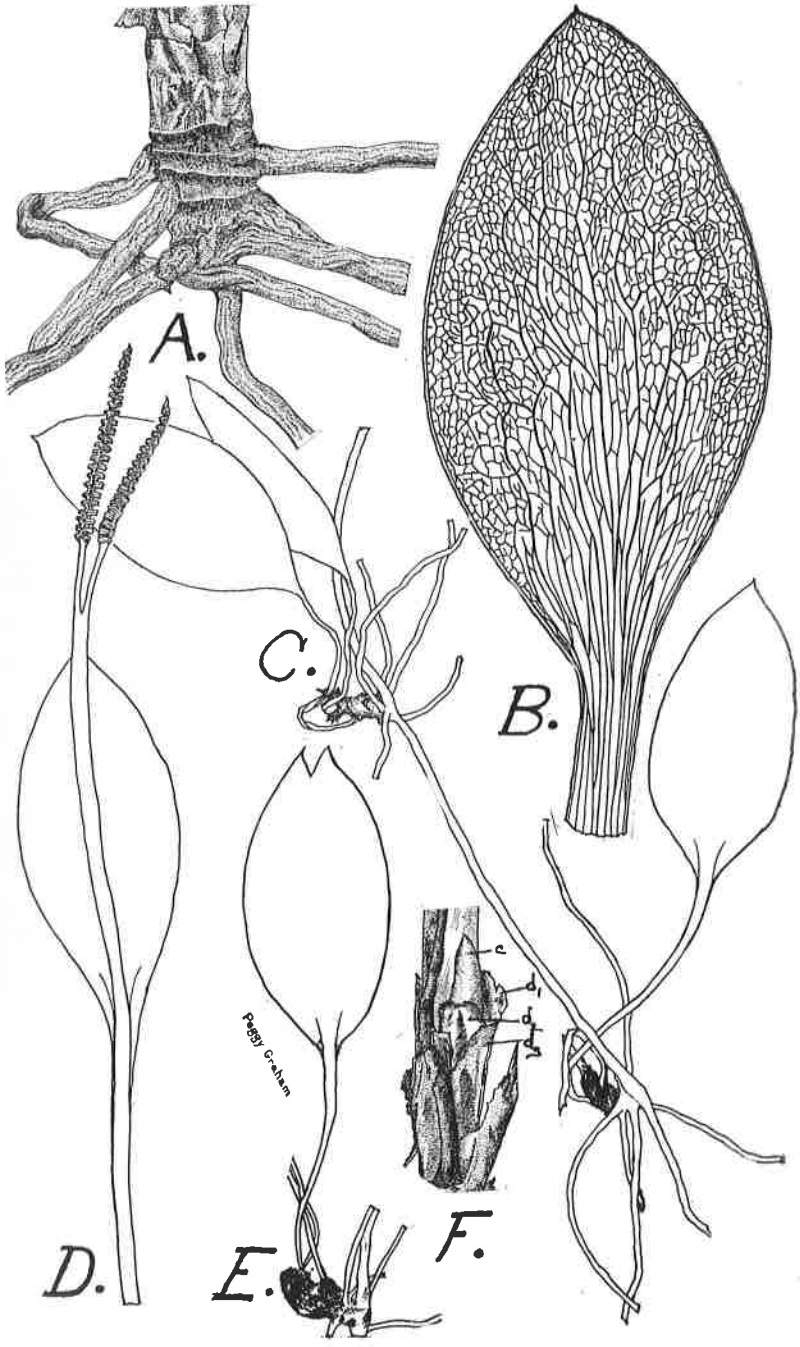
The adderstongue ferns are regarded by some fern students as so called because of the supposed resemblance of the acuminate apices of their fertile spikes to the tongues of adders. The word, *Ophioglos-*

sum, means literally snake tongue. Thus both the common name and the technical name refer to some fancied resemblance to a snake's tongue.

Description. Ophioglossum Engelmanni is a low deciduous plant which usually has two leaves but sometimes has only one. Of forty-five plants examined, 23 had two leaves each, 20 had one leaf, and 2 had three leaves. The rootstock is vertical, almost cylindrical, and short, being about 5/16 to ⅜ inch long. It is about ⅛ inch in diameter, brown in color, and glabrous. Horizontal ridges, which extend only part way around the rootstock, represent the scars of old leaf petioles which have fallen off (Fig. 215, *A*). Towards the apex of the rootstock, many old petiole bases persist for some years thus forming a grayish, grayish-brown, or dark brown sheath around the more recent leaf bases and the whitish or greenish-white bud at the apex of the rootstock. This sheath, formed from old persistent petiole bases, ought not to be confused with the membranous sheath around the petiole base in *Ophioglossum vulgatum* var. *pycnostichum,* for this membranous sheath has not been noted by the author in *O. Engelmanni.* I have never noticed more than one bud per rootstock and so it seems that more than one leaf often appears from one bud. This apical bud may be between the bases of two leaves or slightly to one side. In any case, it is usually not visible until the sheath of old and new leaf bases has been parted. It is not only covered by this sheath, but there are one or two, and maybe three, large rather obtuse, whitish, and membranous scales wholly or partly enveloping the bud (Fig. 215, *F*). These scales seem to be about 5/32 to 3/16 inch long by 1/16 inch wide. In almost all cases, the vertical rootstock narrows below to join a rather large, horizontal root to which it is attached (Fig. 215, *C*). This root may extend for a considerable distance and have many individual plants attached to it. Thus most of the plants in a colony appear to arise asexually by buds from roots.

Other very similar large roots arise from the vertical rootstock. Their numbers vary from two to sixteen per rootstock in my Tennessee material with 50 percent of 47 rootstocks having from 5 to 8 such roots. Small (1938, p. 350) indicates that there may be as many as 24 roots from a single rootstock. The number seems to me to be related loosely to the age of the rootstock and the total number of leaves that had been present as represented by leaf scars, persistent leaf petioles, or present leaves; a single large root probably appearing for each leaf. I am not quite sure that this is Campbell's opinion (1913), although it appears to be. All roots are large and about the same diameter (about 1/32 inch). They seem to be free of hairs, scales, and root branches. The shortest, and perhaps the youngest, roots sometimes grow downward. However, almost all long, and presumably old, roots pass off from the rootstocks nearly horizontally. Some of the short roots have their apices bent back sharply as if to protect growing points when pushing through the soil. The roots are brown in color with lighter brown apices. In many cases the roots appear to be constricted where they join the rootstock (Fig. 215, *A*).

Fig. 215. (Opposite page.) Some details of *Ophioglossum Engelmanni. A,* Vertical rhizome with many roots, horizontal leaf scars (which are far more prominent here than is usually the case) below, and fragments of attached leaf bases above, no. 2873, X 5. Note the absence of a sheath around the rhizome on the outside of the petiole bases. *B,* Sterile leaf blade showing large areolae inclosing many smaller areolae, no. 2630A, X 2. Drawn by the aid of transmitted light. *C,* Two plants connected by a root, no 3630A, X 1. New plants commonly arise asexually from roots. *D,* Fertile leaf with the elliptical sterile blade in the background and two fertile spikes, no. 4515, X 1. Usually only one spike is present. The two-ranked sporangia here have opened and shed their spores leaving toothed-like notches on each side of the spike. *E,* A sterile leaf which is slightly forked apically, no. 3630, X 1. *F,* Upper end of a rhizome showing *c,* the bud at the base of the leaves partly enclosed by three scales, d_1, d_2, d_3, no. 2420, X 5.


A.
B.
C.
D.
E.
F.
c
d1
d2
d3
Peggy Graham

One or two, rarely more, vertical or nearly vertical leaves arise from the apex of the rootstock. Usually these leaves are fertile but occasionally one or even all leaves will be sterile. Of 45 plants examined, 28 had all their leaves fertile, 14 had all of their leaves sterile, and 3 had both sterile and

Fig. 216. *Ophioglossum Engelmanni* growing in the cedar glades of Middle Tennessee.

fertile leaves. The leaf stalk in sterile plants and the common stalk in fertile plants are here called petioles and the fertile stalk a petiolule without any intention of supporting a particular theory of their origin. The petioles of both sterile and fertile leaves seem very similar: they are green in color when young, and glabrous. With age, they become straminеous to dark brown with

the exception of the basal part which may be white or yellowish or brown like the rest of the petiole. Sometimes two veins appear to be present in the petiole near the base. Farther up these veins branch and rebranch into a group of veins some of which anastomose to form very long and narrow

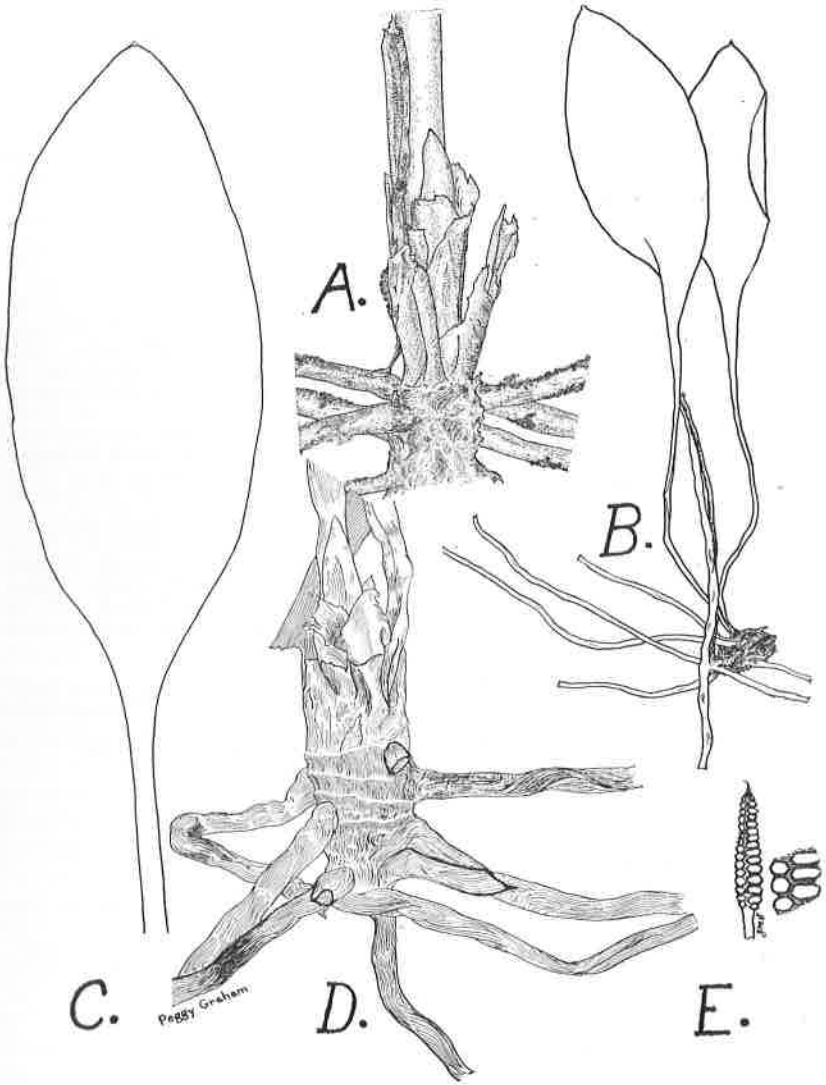


Fig. 217. *Ophioglossum Engelmanni*. *A*, Apex of a rhizome showing a leaf petiole, fragments of old leaf petioles, roots, and the conical bud, no. 2420, X 5. *B*, Representative sterile plant with two leaves, many roots, including the root—here vertically arranged—from which the plant grew, no. 2630, X 1. *C*, A very large leaf, no. 2422, X 1. *D*, Rhizome, roots, petiole bases, conical bud, and prominent leaf scars, no. 2873, X 5. *E*, Fertile spike with unopened sporangia, *Svenson* no. 10249, X 1, to left. A few enlarged sporangia to the right.

areolae before passing into the leaf blade (Fig. 215, *B*). However, some of the smaller veins end free. In general, the sterile blades of fertile leaves seem larger than the blades of entirely sterile leaves. To check on this impression, 43 sterile blades from fertile leaves and 25 sterile blades from sterile leaves were measured as to length and width in inches and these results secured:

Type of	*Sterile blade from fertile leaf*		*Sterile blade from sterile leaf*	
Measurement	Length	Width	Length	Width
Average	1⅝	⅝	1⅜	⅝
Maximum	3⅝	1¼	1⅞	15/16
Minimum	⅞	¼	1	⅜

The fertile leaflet is a spike with the sporangia arranged in rows, one row on each margin (Fig. 215, *D*). It is therefore two ranked. The spike is at the end of a petiolule. To get some idea of the length of this petiolule, thirty-nine stalks were measured. They ranged from ¼ inch (*Svenson* no. 10249, *A*) to 3 inches (*Svenson* no. 10249, *D*) in length with an average length of about 1⅜ inches. Thirty-seven fertile spikes were measured and the average length was found to be about ⅝ inch with the extremes 1½ inches (no. 2422) and 5/16 inch (*Svenson* no. 10249, *A*). Fifty percent of 29 spikes had from 14 to 22 pairs of sporangia. Often the number of sporangia in one row may be one or two more or less than in the other row. With the exception of two long spikes from two very large plants which had 38 and 44 pairs of sporangia, respectively, the extremes were 12 pairs and 30 pairs of sporangia per spike.

The spike is glabrous, linear-elliptic, and tapers gradually at each end. Apically there is a sterile acuminate apex. There is a row of sessile sporangia coalesced end to end on each side of the brownish, two-ranked spike (Fig. 217, *E*). The larger sporangia are about 1/32 inch wide and are much wider than long. Towards each end of the spike, the sporangia get smaller and have fewer spores. Some of these smaller sporangia may be entirely sterile. There is no annulus. The sporangia dehisce by a median, transverse split, forming two valves and liberating masses of light yellow or sometimes whitish spores. The spores mature in spring or early summer and the plant soon dies to the ground and disintegrates above the soil. Roots and rootstock are perennial, and the bud for next year's leaves is present.

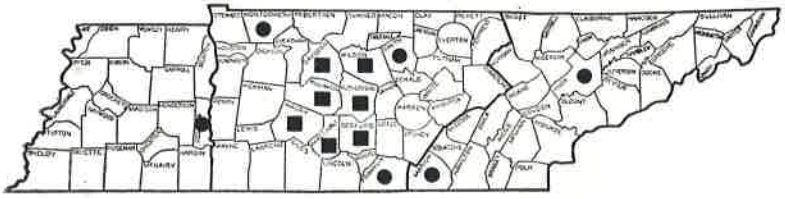


Fig. 218. The county distribution of *Ophioglossum Engelmanni* in Tennessee. The collections of Shaver are indicated by solid squares, those of others by solid circles as follows: Decatur County (Endsley, J. R., northwest of Clifton—my no. 2420); Franklin County (*Svenson* no. 10249); Knox County (Anderson, 1931); Marion and Montgomery counties (Univ. of Tenn. herbarium); Smith County (collected for me at Rome by Don Caplenor).

The distribution of this fern in Tennessee, in so far as it is known to the author, is given by counties in the map (Fig. 218). Its distribution in the country at large is given by Broun (1938, p. 122) as from ". . . central Florida to . . . Virginia, . . . Ohio, and Arizona. . . ."

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COMMON ADDERSTONGUE

Ophioglossum vulgatum L. var. **pycnostichum** Fern.

The common adderstongue resembles very much Engelmann adderstongue, differing from it in the characters already mentioned under Engelmann adderstongue. The two chief differences are the apiculate apex to the sterile blade and the numerous small areolae formed by anastomosing veinlets within the large areolae; both of these characters being present in Engelmann adderstongue, and both being absent in the common adderstongue. The only variety of the common adderstongue which I have seen from Tennessee is variety *pycnostichum.* However, the northern variety *pseudopodium* (Blake) Farw. has been reported from as far south as Virginia and North Carolina, and therefore may at some time in the future be found in Tennessee, although I think it extremely unlikely. Variety *pseudopodium* has no membranous sheath around the bud and the base of the leaf petiole. There usually is a very definite relatively long membranous sheath around the base of the leaf petiole (Fig. 220, *D*) and the bud (Fig. 220, *F*) in variety *pycnostichum.* Both of these varieties may or may not have an additional external sheath composed of old persistent petiole bases. This may be the sheath which Clausen (1942) regarded as unimportant taxonomically. Mature unopened sporangia are globose or subglobose in variety *pseudopodium;* they are mostly transversely elongated in variety *pycnostichum* (Fig. 220, *A*).

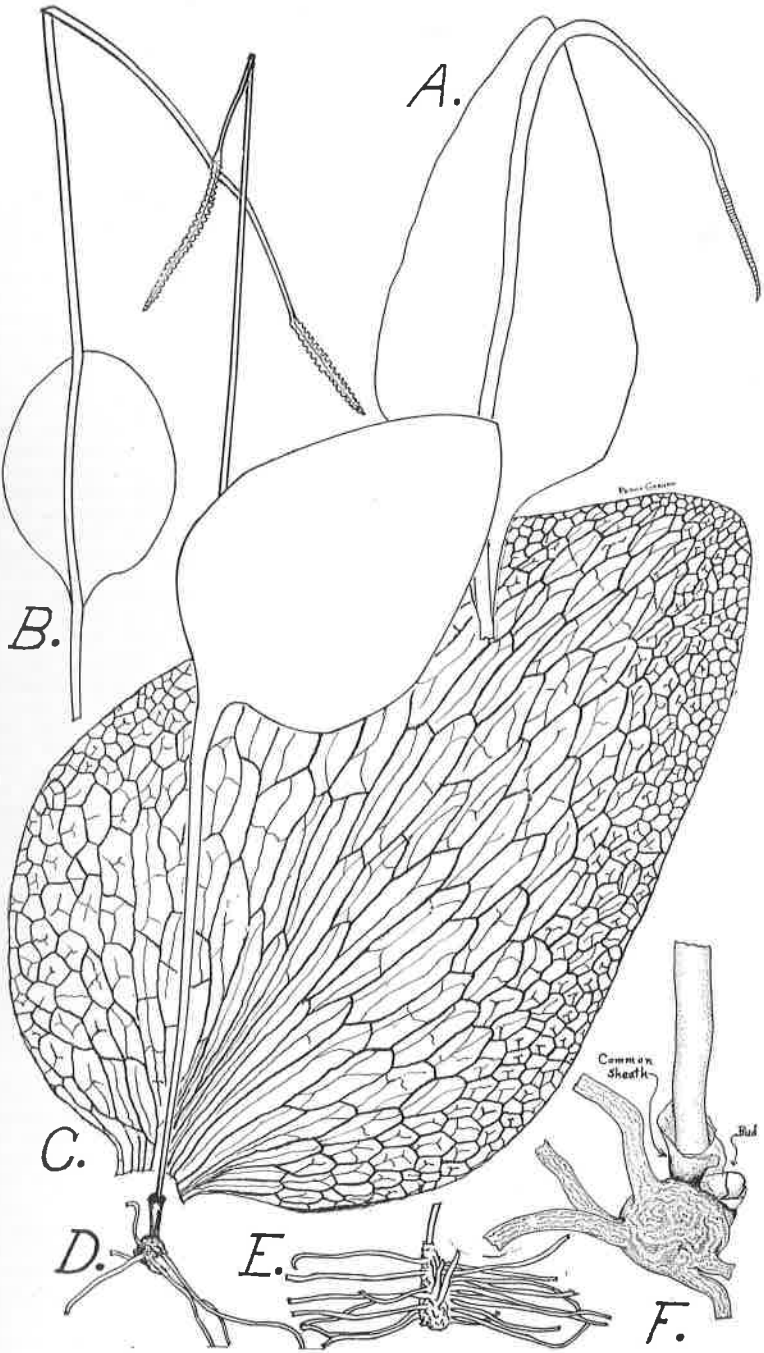
Description. Variety *pycnostichum* is the variety of *Ophioglossum vulgatum* L. described here. In Tennessee, it is a low-growing, deciduous plant which occurs in colonies, probably because plants arise from the roots of old plants.

The rootstock is cylindrical, erect, and about ⅛ inch in diameter. Rootstocks vary in length from ⅛ inch to 11/16 inch with most rootstocks being about ¼ inch long. At least some of the longer rootstocks have their older portions partly decayed. In color the rootstocks are usually yellowish-brown. They bear small horizontal leaf scars, sometimes old frayed parts of old leaf petioles,

Fig. 219. *Ophioglossum vulgatum* var. *pycnostichum* in an oak woods on a wet hillside near Kingston Springs, Cheatham County, Tennessee, Spring, 1952. The fertile spike has already shed most of its spores.

and usually a single fertile, or, rarely sterile, leaf. There is usually, or I believe always in Tennessee plants, a yellowish-brown (or rarely gray)

Fig. 220. (Opposite page.) Details (partly diagrammatic) of *Ophioglossum vulgatum* var. *pycnostichum*. *A*, *B*, and *D* show the shape of the sterile blades and the fertile spikes bent down, X 1.0; *A*, no. 191; *B*, no. 10333; *D*, no. 2942A. Note that the sporangia in *A* have not yet opened but those in *B* and *D* have already shed their spores as indicated by the two rows of sawtoothed like margins to the terminal spike. *C*, Sterile blade showing major areoles containing branching veinlets but no complete smaller areoles surrounded on all sides by these veinlets, no. 2942A, X 2.0. *D*, *E*, and *F*, Vertical rootstocks showing the fleshy roots, the prominent sheath around the base of the petiole, and in *F*, a greatly enlarged rootstock to show the bud near the base of the petiole. The bud does not show in *D* because it is completely covered by the sheath. In *F* the common sheath has largely been dissected away to show the bud with its own sheath. *D*, no. 2942A, X 1.0; *E*, no. 10,333, X 1.0; *F*, no. 2942A, X 5.00.


A.
B.
C.
D.
E.
F.
Common sheath
Bud

cylindrical sheath attached to the apex of the rootstock and surrounding both the base of the leaf petiole and the bud. This sheath varies from ⅛ inch to ¼ inch in length and is about 1/16 inch in diameter (Fig. 220, *D*). The bud which was completely covered by this common sheath seems to have an additional yellowish-brown to yellowish-white sheath over it (Fig. 220, *F*). The bud is small and acute. It varies in color from white to flesh-colored to yellowish or brownish-white. No scales nor hairs have been found on the rootstocks or anywhere else on these plants.

From two to 25 roots (the average number being from 9 to 10) arise per rootstock and usually extend horizontally. This number was determined by the examination of 40 rootstocks. These roots are yellowish-brown to brown to dark brown, or rarely grayish, in color, and are about 1/32 to 1/25 inch in diameter. They are unbranched (Fig. 220, *E*). New plants arise from the roots somewhat distantly from old plants.

The leaf is usually single and generally fertile. Rarely, it is sterile. Occasionally two leaves arise from one rootstock. The common stalk from the rootstock to the point of origin of the sterile blade is regarded here as the petiole. It is white, whitish, or light yellowish-brown basally but this color changes to green at the top of the soil. There seems little difference between the petioles of sterile and of fertile leaves. Both kinds are glabrous, being entirely free of hairs and of scales. Measurements of 58 petioles indicate a range in length from 1¾ inches to 6¼ inches, with an average length of about 4 inches. At the distal end of the petiole is a single entire blade in sterile leaves, and a single entire blade plus a stalked fertile spike in fertile leaves. The sessile blade of the sterile leaflet of the fertile leaf and the blade of a sterile leaf seem essentially similar and so they are here considered together.

The leaf blade may be elliptic, elliptic-oblong, ovate, ovate-lanceolate, ovate-elliptic, ovate-orbicular, lanceolate, lanceolate-oblong, or lanceolate-elliptic. Three of these shapes of blades are illustrated in figure 220. Probably the most common shape is ovate. Many blades, however, are elliptic. Apically, the blade is almost always obtuse; basally, it is cuneate, or abruptly constricted to a narrow base and this narrow base is cuneate. The narrow base may be continued down each side of the petiole for about ½ inch as a thin ridge 1/32 inch or less high. The blade margin is entire and the blade itself seems rather thin to me. Fernald (1950) speaks of it as being thick. The large veins anastomose to make large areolae. The areolae placed medially and near the base of the blade are narrow and elongated. Most of the other areolae are broader and shorter. Veinlets arise from the veins and sometimes bend back to join the large vein from which they arose so as to make small areolae bounded on one side by a large vein. Many veinlets end free or branch into veinlets that end free. It is impossible, or very rare indeed, to find a small areola entirely bounded on all sides by veinlets (Fig. 220, *C*). All small areolae, no matter how formed, are relatively few as compared with the very numerous small areolae present within the large areolae of *Ophioglossum Engelmanni*. The blade is entirely glabrous. Forty-three blades, measured as to length, gave a range from 1¼ inches (no. 9167b, A) to 4 inches (no. 2921e, A) with an average length of about 2¼ inches. Forty-four blades were measured as to width and an average width of about one inch was secured. Width ranged from ⅝ inch to 1⅝ inches.

The fertile spike is stalked. This stalk varies from 1¼ inches to 8¼ inches in length, with an average length of about 4¼ inches. When fully mature, it is about 4-6 inches long, glabrous, dark-green near the sterile leaflet but dark brown to blackish near the spike. The spike varies considerably in length (from ⅝ to 1⅝ inches) but well-formed, mature spikes are about ⅞-1 inch long. They are long acuminate apically and somewhat narrowed basally. The sporangia are arranged in two longitudinal rows, one on each margin of the very narrow spike (Fig. 220, *B, D*). The number of sporangia in one row may be the same as in the other row of the spike but usually there is a difference of one or two sporangia. A count of the numbers of sporangia in each of 67 rows gave a range from 12 to 35, with more than one-half the sporangia in rows having from 18 to 23 sporangia per row. When mature,

these sporangia are yellowish and transversely elongated. They are about 1/16 inch wide (transversely) and 1/32 inch long. Dehiscence is by a median transverse split. The two valves thus separated curl back to free great masses of yellowish or whitish spores. Sporangia mature in late spring.

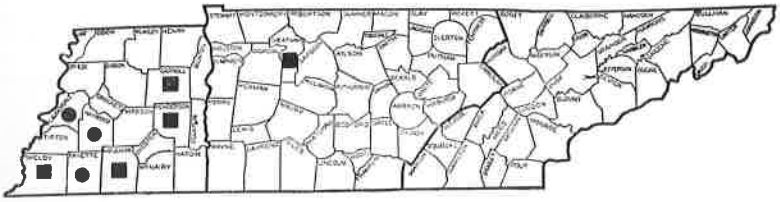


Fig. 221. Distribution of *Ophioglossum vulgatum* var. *pycnostichum* in Tennessee by counties. Shaver's records are indicated by the black square areas; those of others by black circular areas as follows: Fayette and Lauderdale counties (Univ. of Tenn. herbarium), Haywood County (Anderson, 1931, p. 67). Dr. A. J. Sharp and Herman Silva (Univ. of Tenn.) found a station in Cocke County too late to be included in the map.

The distribution of *Ophioglossum vulgatum* L. var. *pycnostichum* Fern. in Tennessee, so far as it is known to the author, is given in the map (Fig. 221). From the country at large, this variety appears to be known from Maryland, District of Columbia, to North Carolina and southern Indiana (Fernald, 1939).

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