for 15 minutes. Solid which separated on subsequent brief chilling was removed by filtration, washed with cold ether, and dried under reduced pressure over alumina; yield 48.2 g. (44%).

The sulfonic acid was prepared by a procedure based on one of Shriner and Land (1941). Concentrated ammonium hydroxide (26 ml.) and 70.4 g. of the bisulfite addition product were heated in 400 ml. of water at 55-64° for 35 minutes, after which supernatant liquid was decanted from gum and filtered. *Alpha*-Amino-beta-benzylmercaptoethanesulfonic acid was obtained by acidification of the filtrate with 30 ml. of concentrated hydrochloric acid. After separation by filtration and drying under reduced pressure over alumina, the yield of light tan powder was 22.1 g. (34%), m.p. 120-123° (dec.). The acid (2 g.) was purified by washing by centrifugation with one 10-ml. portion of water, one of ethanol, and four of ether; yield of white powdery acid after drying, 1.4 g., m.p. 121-124° dec.

Anal. Calcd. for $C_{11}H_{15}NO_3S_2$: C, 43.70; H, 5.29; N, 5.66; S, 25.92. Found: C, 43.68; H, 5.13; N, 5.37; S, 25.56.

Literature Cited

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THE GRAPEFERNS IN TENNESSEE

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CUTLEAF GRAPEFERN

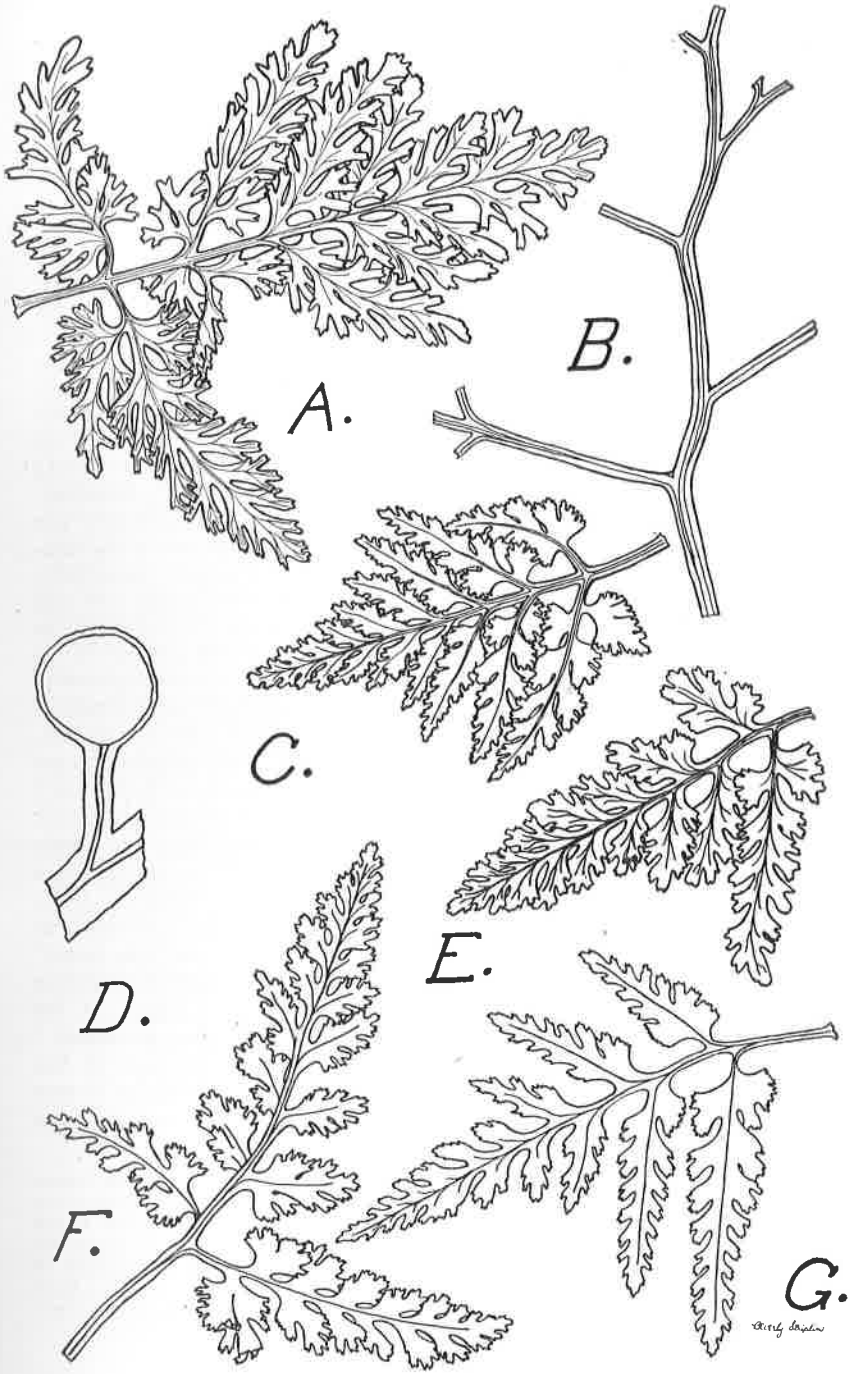
Botrychium dissectum Spreng. var. **typicum** Clausen

The common name, Grapefern, and the technical name of the genus, *Botrychium* (from the Greek, *Botrys*—a cluster of grapes), call attention to one characteristic of the group as seen in Tennessee, namely, the globular sporangia in a spike on a fertile branch separate from the sterile branch of the leaf with both branches joining to form a very short common stalk. The fertile spike resembles greatly

a cluster of a very great number of miniature grapes. The name,

Fig. 222. *Botrychium dissectum* var. *typicum* near Gatlinburg, Sevier County, Tennessee, Sept. 4, 1935.

Fig. 223. (Opposite page.) *Botrychium dissectum* var. *typicum* details. *A*, One of the basal leaflets indicating the laciniate nature of the margins, no. 2169, X 1.00. *B*, Upper sterile stalk, rachis, and petiolules of a rather open, sterile leaf, showing the veins, no. 2286, X 1.00. *D*, Sporangium at the end of a short, flat branch, with single branch vein and a narrow frill around it, no. 2162, X 12.00. *C*, *F*, and *G*, Basal leaflets intermediate in cutting between var. *typicum* and forma *obliquum*, X 1.00. *C*, no. 2165; *F*, no. 10914; *G*, no. 10924. *E*, Basal leaflet, no. 2167, X 1.00. In all the basal leaflets illustrated in this plate, the inferior proximal pinnules are the longest.


A.
B.
C.
D.
E.
F.
G.

Cutleaf, and the species name, *dissectum,* refer to the finely cut or laciniate sterile blade present in typical plants (Fig. 222).

This fern is evergreen, develops its sporangia in the fall of the year, and has the bud for next year's leaf entirely hidden by being enclosed by the base of the common stalk or petiole; thus differing from the rattlesnake fern, *Botrychium virginianum* Sw., which is deciduous, forms its sporangia in the spring, and usually reveals the bud for next year's leaf partly exposed by the split base of the petiole. Other important identification characteristics of the cutleaf grapefern, not mentioned above, are the smooth, non-reticular, and naked sporangia which do not have indusia and which dehisce by a transverse slit.

However, there is a form of *Botrychium dissectum* Spreng. that Fernald has called forma *obliquum* (Muhl.) Fern. which ordinarily differs from *dissectum* var. *typicum* Clausen by having the divisions of the sterile blade crenate to serrate or almost entire instead of laciniate. A wide range of plants intermediate in degree of cutting between these forms may often be found (Fernald, 1921; Hopkins, 1910, 1923; Weatherby, 1935). Sometimes these intermediates are difficult to place as to form. Farwell (1923) suggests that if the ultimate divisions of the sterile blades have their margins essentially crenate-serrulate with most of the serrations about the same size and not over one millimeter in length, the fern should be regarded as *obliquum*. If the marginal indentations in part or all extend ⅓ of the way to the midrib, the fern must be *dissectum* [var. *typicum*]. In this last case, every third or fourth indentation is four times as deep as the others thus forming a segment that is incised or serrate. Graves (1935) and Gruber (1940) stressed the rectangular shape of the ultimate segments as characteristic of *dissectum* [*typicum*] and pointed out that the ultimate segments of *obliquum* are never rectangular. Clausen (1943, p. 20) seems to think that the shape of the ultimate segments as well as the depth of the cutting are variable and cannot always be depended upon to separate these forms. In this connection, it is interesting to note that two authors have used other shaped ultimate segments in their keys to "run down" *B. dissectum*: Lyness (1938, p. 17) "*b.* Ultimate segments of sterile leaf wedge-shaped," and Tryon (1940, p. 12) "50. Many of the ultimate segments lanceolate, more than twice as long as broad." The main points in this paragraph then (1) indicate some of the characters that may be used to separate var. *typicum* from forma *obliquum* and (2) suggest that some particular plants may be very difficult to determine with certainty.

Description. Botrychium dissectum Spreng. var. *typicum* is a low, erect, evergreen fern which develops its sporangia in the fall of the year. The above ground parts in a well-developed plant are a stalked, much dissected sterile leaf blade and a stalked branch bearing at its summit a cluster of numerous sporangia. These two branches unite usually at or just below the surface of the ground to form a common stalk or petiole which extends downward a short distance to join the vertical rootstock. There is only one petiole per rootstock (Fig. 224, *F*).

(To be continued)