

Fertile Sporophytes of *Botrychium virginianum* Attached to Gametophytes¹

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While making a floristic survey of the pteridophytes of the Highlands, North Carolina area (Macon County) with Dr. Warren H. Wagner, Jr., I discovered a population of *Botrychium virginianum* containing many small but fertile specimens. An apparently similar population has been described for the Mountain Lake (Giles County) area in Virginia (Wagner, 1963, pp. 130–131.) Investigation of the Macon County plants showed a considerable percentage of the plants attached to large gametophytes. Whereas juvenile plants typically are found attached to a gametophyte (Bierhorst, 1958), the plants found near Highlands showed a wide range of developmental stages. Many were fully fertile with small leaves 3–5 cm broad (*Fig. 1*). These juvenile specimens have had the name *B. virginianum* var. *gracile* (Pursh) Lawson applied to them, but are not worthy of taxonomic recognition (Weatherby, 1935). Precociously fertile sporophytes may be due to abundant nutrition supplied by long-lived gametophytes.

Gametophytes of most ferns usually die after the sporophyte has become self-sufficient. This is not strictly the case in the eusporangiate genus *Botrychium* where gametophytes have been reported still attached to sporophytes at least two years old (Foster, 1964) and up to eight years old (Jeffrey, 1896–97, pp. 271–272). Campbell (1911, p. 18) mentions that fertile *B. virginianum* sporophytes with attached gametophytes were found by Jeffrey, but similar plants are not mentioned by later workers.

Bierhorst (1958) believes that a relatively small number of gametophytes persist after giving rise to a sporophyte. He states that in areas where sporophytes of all ages are present it is not the older sporophytes with attached gametophyte which predominate,

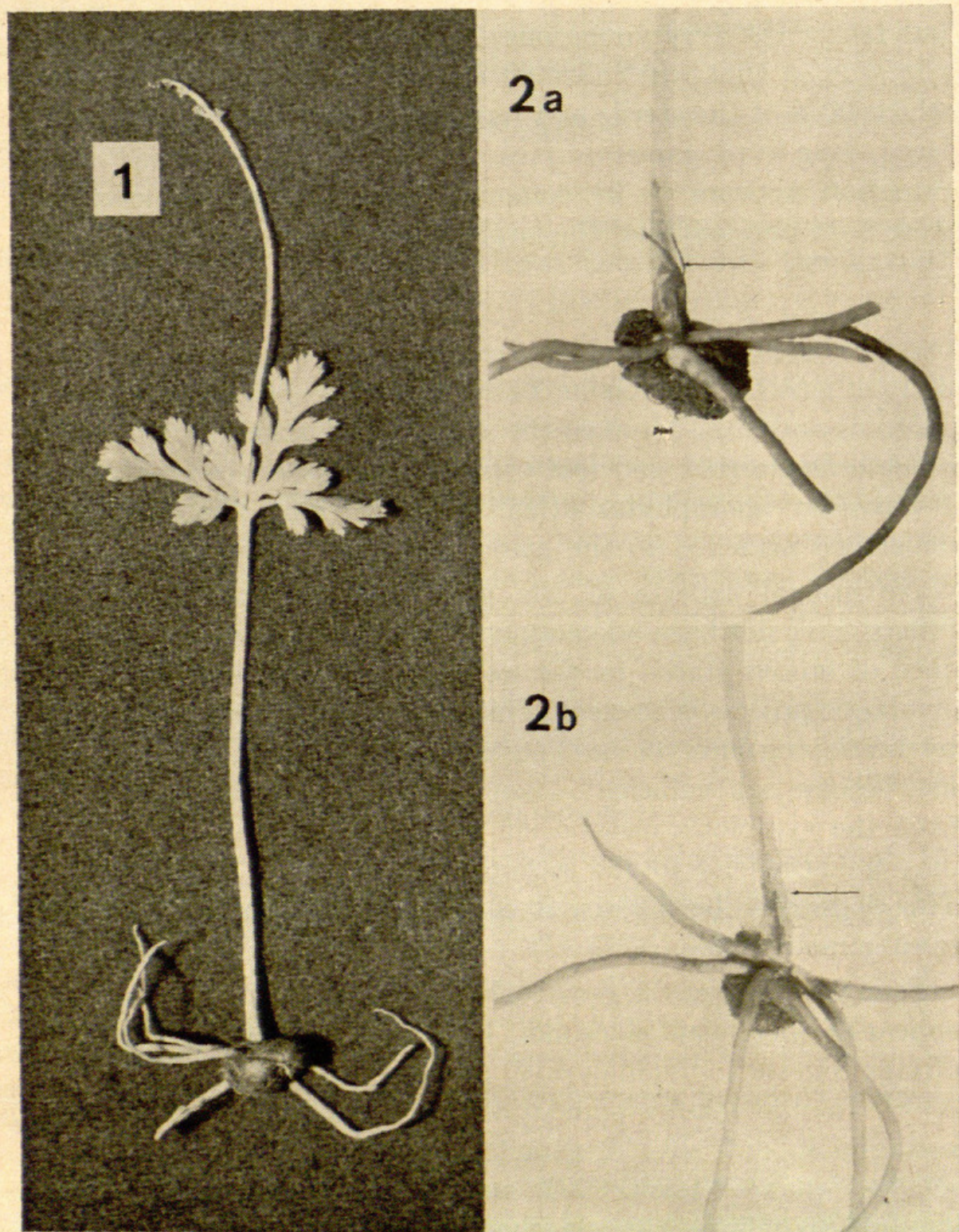
¹ This research was supported by NSF grant GB-2496 to the Highlands Biological Station. Voucher specimens (*Wagner 69100*) are on deposit in the herbaria of the University of Michigan and Duke University.

but rather the very young ones. The Highlands population of *B. virginianum* that was collected in July, 1969, contained plants in which 60% of the sterile and fertile sporophytes were attached to large, long-lived gametophytes. In this population gametophyte retention appears to be common. The attached gametophytes were 3–14 mm long and the largest were attached to fertile sporophytes (*Fig. 2*).

Very large gametophytes could supply abundant nutrients to first-year sporophytes, which then could grow larger than average and perhaps become fertile. The largest sporophytes had three to six roots and often retained the shriveled bases of previous leaves. Since a single root and leaf typically are produced annually by *Botrychium* sporophytes, this indicates that the sporophyte developed attached to the gametophyte for a number of years.

Nutritional aspects of the gametophyte and its symbiotic fungus have not been adequately investigated. However, the presence of stored starch in the gametophyte is evidence that the symbiotic process is efficient. This food reserve is presumably used by developing embryos and young sporelings before the sporophyte has become self sufficient. Conceivably the stored material and even the symbiotic metabolism of the gametophyte and fungus may be beneficial to the sporophyte throughout its life history. This appears to be the case in some *Botrychium* plants with long-lived gametophytes.

Factors which cause gametophyte retention are unknown but appear to be frequent since most collections of *Botrychium* gametophytes contain individuals with attached sporophytes (Bierhorst, 1958). In many large populations of *Botrychium* there is much variation in leaf size. A gametophyte is often attached to the smallest plants (leaves 1–2 cm broad). Occasionally several hundred sporelings with attached gametophytes can be collected in an area of a few square feet. Careful sifting and washing of the soil over a fine mesh screen may yield gametophytes in all stages of development. Pteridologists interested in securing gametophytes of *Botrychium* species for study or teaching material need only look for the smallest sporophytes in or near large popu-



FERTILE *BOTRYCHUM VIRGINIANUM* SPOROPHYTES WITH ATTACHED GAMETOPHYTES. FIG. 1. HABIT OF PLANT, $\times 0.8$. FIGS. 2A, B. GAMETOPHYTES ATTACHED TO SPOROPHYTES WITH MULTIPLE ROOTS AND DEAD LEAF BASES (ARROW), CA. $\times 1$.

lations. Careful search of the surrounding soil may then yield an entire ontogenetic series of the subterranean gametophytes.

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A Peculiar Species of Grammitis

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Polypodium mathewsii Kunze ex Mett. was described from Peruvian specimens collected by Mathews; the locality was not specified but was given by Hooker (Sp. Fil. **5**: 20. 1864) as Chachapoyas, and the numbers as *Mathews 1811* and *3281*. However, it is evident that Mathews collected this species at least three times, all at Chachapoyas, for the specimen in the British Museum is no. 1837. The holotype in Kunze's herbarium has been destroyed. A specimen of one of these numbers in the Mettenius herbarium in Berlin should be designated as lectotype, if one exists, other-



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