THE PROTHALLIA OF OPHIOGLOSSUM VULGATUM

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(WITH FOUR FIGURES)

The gametophyte of *Ophioglossum* was found first by METTENIUS in material of *O. pedunculosum* Desv. in the botanical gardens at Leipzig, in 1856. Almost 50 years later, LANG collected prothallia of *O. pendulum* in Ceylon, in the Barrawa Forest Reserve. These were found to be developed in the humus between leaf bases of an epiphytic *Polypodium*, and, as in the case of METTENIUS, were found growing spontaneously, but were not developed in cultures from the spores. Later, CAMPBELL found similar prothallia in humus collected between leaves of *Asplenium nidus* in Java. In 1906 he also collected prothallia of *O. molluccanum* at Buitenzorg. In 1904, BRUCHMANN reported the finding of gametophytes of *O. vulgatum* in nature. He worked over a considerable period of time, free days from May to October, in isolating about 70 young prothallia, besides those with sporophytes, in a particularly favorable region in the Thuringian Forest. The area concerned was a depression surrounded by ash trees and alders. The occurrence of so many specimens was attributed partly to the protection against wind currents which might carry the spores away, although the depression was subject to overflows from rains, which might remove the spores also. CAMPBELL considers the latter of importance because of the possible effect of submergence upon germination of spores. It would seem likely that this process is favored by inundation. BRUCHMANN obtained the prothallia by arduous labor, working over the soil between the mature plants. That the prothallia are not numerous is evidenced by the small return of two prothallia per working day.

The situation in which the present growth of *O. vulgatum* occurs is practically the low prairie type previously described for *Thismia americana*.[1] The plants of *Ophioglossum* occur among the

[1] PFEIFFER, NORMA E., Morphology of *Thismia americana*. BOT. GAZ. 57:122–135. *pls. 7–11*. 1914.

prairie plants. Spots have been burned, and here the plants show very distinctly, owing to a partial elimination of the grasses and other plants which ordinarily tend to obscure the smaller *Ophioglossum* plants. Where there is much shade, *Selaginella apus* and *Aneura pinguis* occur, as in the *Thismia* patch, which is close at hand. The habitat is evidently low and wet, inundated in spring. Early in July, *Riccia fluitans* in small amounts was also found, and late in July 1915, after a rather wet month, some of the field was under water. There were, however, hummocks as well as more extensive little plots not submerged. Compared with the other situation in the Chicago region where *O. vulgatum* has been found, that is, near Gary, the present station in the southeast outskirts of Chicago seems wetter. The difference noted in the time of maturity of fertile spikes in the two areas is probably related to the difference in situation. In the moister place, some spikes were still unshed on July 24, whereas the spikes were already gone in the drier, less protected Gary situation, on July 15.

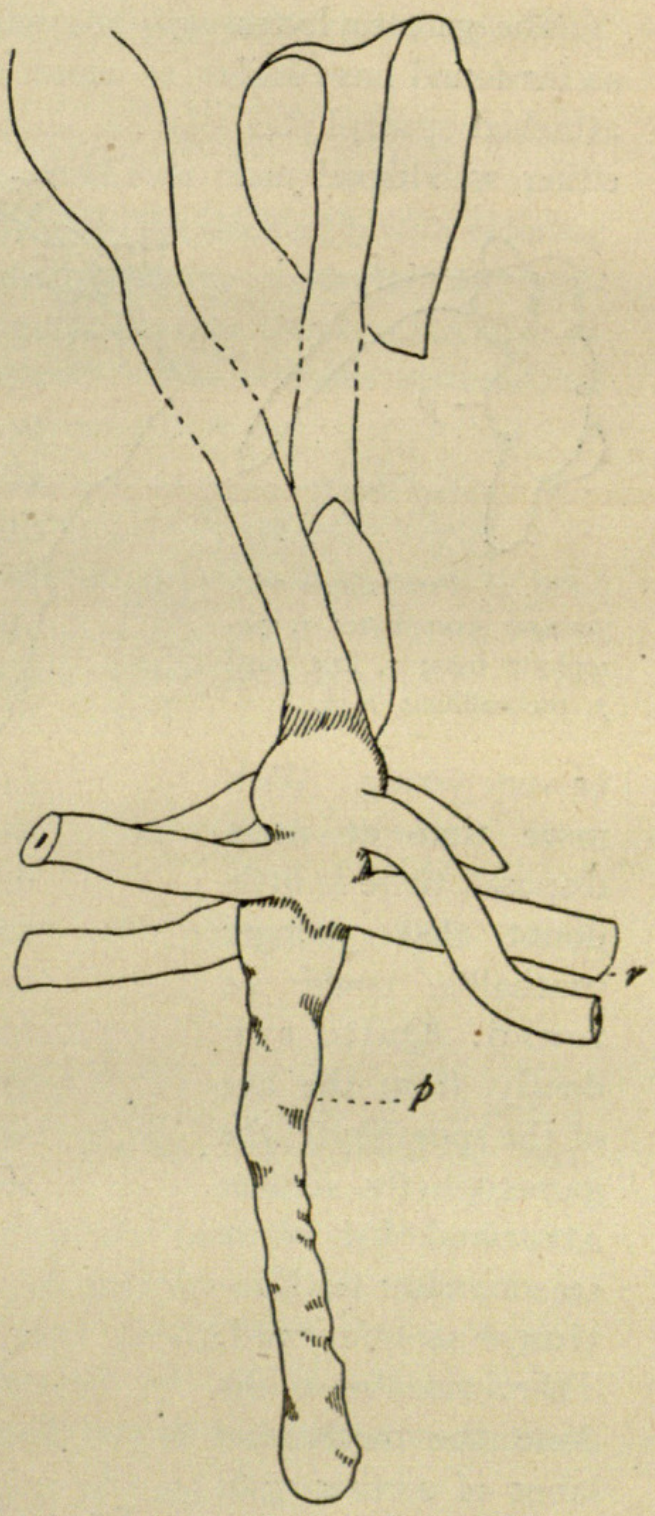

FIG. 1.—Old prothallium of *Ophioglossum vulgatum* with well developed sporophyte; *p*, prothallium; ×3½.

Working on CAMPBELL'S theory that inundation favors spore germination, one may suppose that

this difference would account for the finding of any prothallia here, whereas their occurrence in the Gary area has not been noted.

The gametophytes so far found have had attached sporophytes, either well developed

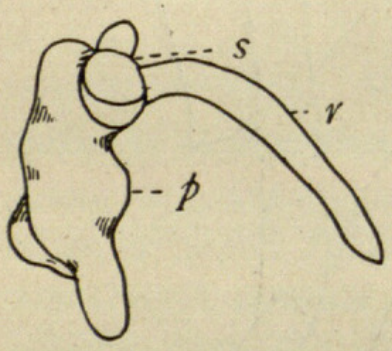

FIG. 2.—Prothallium with younger sporophyte; *s*, sporophyte base; *r*, first root; *p*, prothallium; ×3⅓.

or very young. With more time at one's disposal, there is little doubt that younger prothallia could be found. Quite evidently, from the age of the sporophyte, the gametophytes remain attached for some seasons after fertilization has occurred. There remains to be done the mechanical labor of sorting until younger and younger material is obtained.

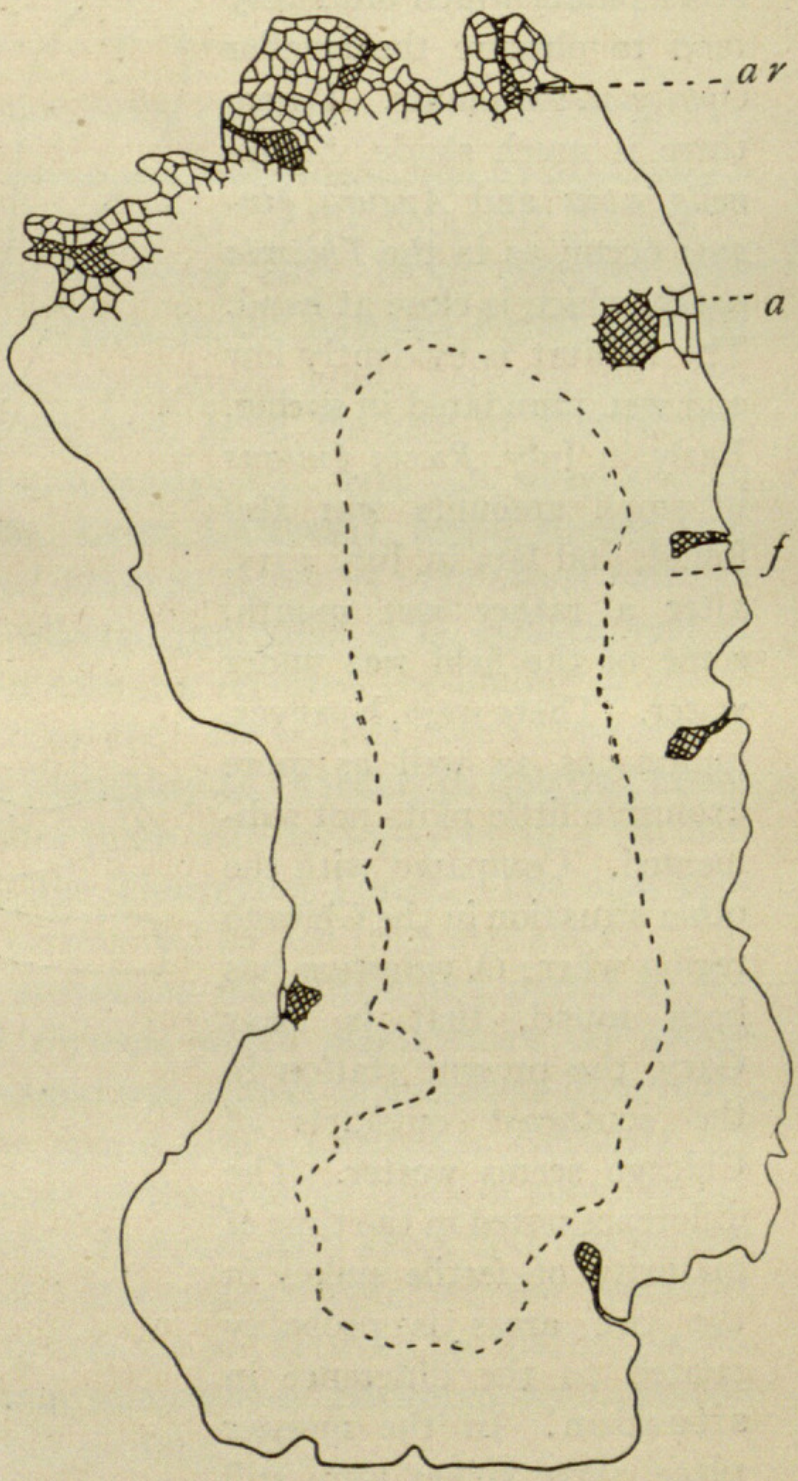

FIG. 3.—Longitudinal section of prothallium; *a*, antheridium; *ar*, archegonium; *f*, fungus-infected region; ×33.

The appearance of prothallia is entirely similar to that described by BRUCHMANN. Most of them are simple (figs. 1 and 2), although branching

occurs. In external appearance the prothallium may be distinguished readily from roots by the irregular form and uneven surface it exhibits owing to the sex organs, as compared with the straight and very smooth roots or rhizomes. The end is more or less round or even tuberous, as indicated in BRUCHMANN'S figures, as compared with the pointed root tip. Usually in specimens with well developed sporophytes, the decided brown coloring of the prothallium is another distinguishing character, although here it is often difficult to distinguish sharply between the base of the sporophyte and the gametophyte. The younger material, as well as the growing region of older gametophytes, is lighter in color, however. As compared with the horizontal position of most of the roots, the prothallium is usually oriented with its long axis nearly vertical.

FIG. 4.—Section of prothallium showing young antheridia (*a*); ×33.

Sections of a prothallium with a young sporophyte attached show the surface to be well dotted with sex organs (fig. 3), as may be seen even in bulk material by use of a hand lens. The necks of old archegonia are conspicuous, as are the positions of antheridia. Occasionally there are antheridia still unshed, as shown on a small excrescence near the upper portion, where fungal hyphae had not yet entered (fig. 4). Here it is probable that there was continued production of sex organs after fertilization. Sufficient material for working through developmental stages was not at hand, but the stages found confirm BRUCHMANN'S conclusions regarding the sex organs.

The general topography does not differ from that figured by BRUCHMANN, except that there is usually only one cortical layer free from fungi. Within this is the region, 4–6 layers of cells deep, in which the fungus is conspicuous, and then the central region, staining more lightly because of the absence of mycelium in the

cells. This region contains more or less reserve food in the form of starch grains.

There is little doubt that reproduction by vegetative spread is by far the more common method, but scattered among plants so produced are the far less numerous specimens arising after gametophyte production has occurred.

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