On the leaves of *Zostera marina*, which abounds throughout the sounds *Melobesia pustulata* and probably other species are very common.

Altogether between twenty-five and thirty species were found, the most interesting feature of the flora being perhaps the occurrence here, at what must be nearly their northern limit, of the tropical or subtropical forms Codium, Dictyota, and Padina.—DUNCAN S. JOHNSON, *Johns Hopkins University*.

NOTES ON THE VALIDITY OF ASPLENIUM EBENOIDES AS A SPECIES.[1]

A RECENT visit, in company with Mr. Charles L. Pollard, to the somewhat famous locality for this fern at Havana, Hale county, Alabama, has led me to review what has been written upon the question of its hybridity, and to offer here a few comments, both upon its occurrence in Alabama and regarding its status as a species.

The theory of the hybridity of *Asplenium ebenoides* originated with Berkeley,[2] when, in publishing Scott's manuscript name in 1866, he expressed an opinion that the fern might well be a hybrid between *Asplenium ebeneum* and *Camptosorus rhizophyllus*. No considerable amount has since been written, but, considering the scattering references available, I think it may fairly be said that the weight of authority has been in support of Berkeley's proposition. Professor Coulter, in mentioning the discovery (1882) of new stations for this "suspicious species," remarked[3] that the "burden of testimony all seems to be in favor of that idea." Both Mr. Redfield[4] and Professor Eaton[5] regarded the fern as a probable hybrid; while the most concise favorable comment is that of Mr. George E. Davenport,[6] who cites it as "probably the best example of a fern hybrid that we have, the infrequency of its occurrence, the presence always of *Camptosorus* and *Asplenium ebeneum*, and the few plants found in the recorded stations, all going to favor the hypothesis of hybridization." In 1896 Professor Underwood, having visited the Havana locality, made the statements,[7]

[1] Published by permission of the Secretary of the Smithsonian Institution.

[2] Journ. Roy. Hort. Soc. 87. *pl. 2, fig. 1.* 1866.

[3] BOT. GAZ. **7**: 37. 1882.

[4] Proc. Acad. Nat. Sci., Phila. Dec. 1874.

[5] Ferns of N. Am. **1**: 26.

[6] BOT. GAZ. **19**: 492 *et seq.* 1894.

[7] BOT. GAZ. **22**: 410. 1896.

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that "the display of the species at Havana clearly demonstrates that it is not a hybrid at all," that the fern appeared "to be multiplying, as many young plants were seen in the crevices," and that "this myth of hybridity may be put aside, for *Asplenium ebenoides* is as clearly defined a species as we possess in the genus Asplenium, and has no near relatives outside of its own genus." It seems to me that the conclusion adopted by Professor Underwood does not follow necessarily from the facts observed, and is perhaps less logical than the assumption, on the other hand, that the fern is a hybrid because always found under what may be termed "suspicious circumstances."

In the particularly rugged conglomerate gorge where *A. ebenoides* grows at Havana, it is indeed abundant; plants in all stages of growth abound, from the prothallus to the independent small plant and those ranging to the maximum of ten or eleven inches. *Asplenium platyneuron* (*A. ebeneum*) is common in the near vicinity, but Camptosorus is not in great evidence, in fact, was not seen either by Mr. Pollard or myself (who made no especial search for it), though it had previously been found here in small quantity. Now, if it be agreed, as Professor Underwood assumes, that a test of this fern's hybridity consists in its inability to reproduce through its spores, most assuredly *A. ebenoides* may not be classed as a hybrid; for the presence of prothalli and young plants in such numbers precludes the possibility of their having arisen in any other way, such as by a wholesale crossing of the suspected parents. The chances of frequent crossing are indeed small, since the Camptosorus is present in such limited quantity; while the groups of young plants are too far distant from mature ones to suppose that they arose from proliferous buds; besides the prothalli would arise only from spores.

The question naturally arises, then, as to whether the fact of the fern's fertility effectually disposes of the supposition of its hybridity. May it not be a *fertile* hybrid? The only really well-authenticated instances of hybridization between species, of which I am aware, are those of *Phyllitis scolopendrium* (*Scolopendrium vulgare*) with *Ceterach officinarum*, *Polypodium vulgare elegantissimum* with *Phlebodium aureum*, and *Polystichum aculeatum* with *Polystichum angulare*. In the first case[8] the cross was effected by Lowe. Three fronds were sent by him to Mr. C. T. Druery, who has explained carefully[9] their intermediate

[8] DRUERY: Gardener's Chronicle Sept. 1895.

[9] Journ. Roy. Hort. Soc. **24**: 292. 1900.

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character, and in a recent letter briefly describes them as "scaleless fronds of true Ceterach form, but somewhat confluent at the tips, and with faced sori in pairs on the lower pinnae, but with single asplenioid sori on the upper portions." In the second case[10] the evidence is no less convincing, and the hybridity of the fern may be regarded as proven beyond question by anatomical studies, and the fact that the cross was several times repeated. In the third case[11] the cross (accomplished by Lowe) was between a cristate *angulare* and a dense form of *aculeatum*, resulting in a cruciate *aculeatum*. As to the fertility of these three hybrids: the sporangia of the first, contained in the fronds sent to Mr. Druery, were immature, so that no test of fertility could be made.[12] In the second case the spores have so far proven incapable of germination; but this sterility, Farmer suggests,[13] may be due to the circumstance of excessive vegetative development, for in the plainer fronds, reverting somewhat to the *vulgare* type, the spores are much better developed. In the third instance, I am informed by Mr. Druery, that, though producing spores freely, the plant proved barren in Mr. Lowe's hands, yet by others it has been found fertile, and a few plants have been raised which are freely fertile, and have given rise to a number of fine plants now in existence. Undoubtedly the parents of the latter hybrid are closely related, and a greater fertility might upon this account be expected; but had it proven infertile, as with the Polypodium-Phlebodium cross, it seems that even these two negative results might not properly be taken as criteria to justify the assumption that fern hybrids are sterile as a matter of course. To my mind the supposition of hybridity for *A. ebenoides* is not weakened by the discovery of its evident fertility. I am told by Mr. H. J. Webber that in the case of spermatophyte hybrids between distinct species the percentage of fertility is very much in excess of the common belief; the hundreds of sterile crosses here count for nought as an argument leading us to *expect* sterility, in the presence of an equal host of fertile ones. And so it may be in the case of fern hybrids. It appears entirely gratuitous to assume that there can be

[10] FARMER: Annals of Botany **11**: 533 *et seq.* 1897.

[11] LOWE, Fifty years fern growing. 1896. DRUERY: Journ. Roy. Hort. Soc. **24**: 292. 1900.

[12] Mr. Druery states that these fronds are still in his possession, but that the plant has probably not survived.

[13] FARMER: Annals of Botany **11**: 533 *et seq.* 1897.

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no such thing as fertile hybrids between fern species. If we grant the specific distinctness of *aculeatum* and *angulare*, the converse has now been proven. The fertility of certain varietal crosses seems well established, and it may be regarded as by no means improbable that, with the use of careful methods, the same may be unquestionably proven in the case of a good number of specific hybrids.

Regarding the relationship of *A. ebenoides* to its supposed parents, Professor Eaton remarked[14] that "while it differs from the first [Camptosorus] by its dark and shining stalk and rachis, in its free veins, and by its pinnatifid or sub-pinnate frond, it resembles it strongly in the prolonged and slender apex, and especially in the proliferous buds; and in the very respects in which it differs from this it resembles the other." These very features of resemblance appealed to Berkeley with sufficient force to induce him to advance the hybridity proposition; but Professor Underwood apparently attaches little importance to them, considering the plant closely allied to *Asplenium pinnatifidum*, in which he is supported by Professor Murrill.[15] The fern seems to me to exhibit conspicuously certain characters of both its supposed parents, not the least important of which is the more or less frequent anastomosing of the veinlets. This fact is easily noticeable in a good share of the specimens, as noted by Professor Murrill in commenting upon Professor Eaton's statement to the effect "veins are everywhere free," a character distinguishing all true Asplenia. Its propagation through proliferation at the apex, questioned by Professor Murrill, was vouched for[16] in cultivated plants as early as 1878 by Mr. Davenport, and lately Mr. William Palmer has collected fronds in Maryland in which the pinnae bear at their tips minute but well-formed young plants. A good proportion of the plants collected this summer at Havana by Mr. Pollard and myself bear young plants at the apex of the fronds, but I have yet to notice any of fair size and large enough to thrive if separated from the parent plant. I am inclined to believe that these young plants never come to an independent existence. If they are indeed abortive, the fact may be taken as tending to substantiate the claim for its intermediate position.

Another feature in the morphology of the plant which seems especially significant is its marked asymmetry. Even in examining the great growth at Havana it is extremely difficult to discover what would

[14] Ferns of N. Am. 1 : 26.

[15] Fern Bull. 5 : 1. 1897.

[16] Bull. Torr. Bot. Club 6 : 200. 1878.

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in an ordinary species be designated as a "perfect frond." Something of this tendency is occasionally seen in *Asplenium pinnatifidum*, but in *A. ebenoides* it is at once the most noticeable and constant feature. In its ordinary mature development it is as constant in this irregularity of shape as most ferns are in their symmetry; this in itself indicates an unusual phylogeny and is a strong bit of evidence supporting its claim to hybridity. A like trait has been noted[17] by Mr. Davenport in the case of his *Dryopteris cristata* × *marginalis*, which, it may be added, Miss Slosson's recent experiments bid fair to prove a true hybrid.[18]

It may be noted further that at Havana *A. ebenoides* in its habitat resembles neither of its supposed parents, both of which require considerable humus and grow mostly upon rocks. *A. ebenoides*, however, is here strictly a mural fern, and like *A. pinnatifidum* and *Pellaea atropurpurea* grows in the narrow chinks of rock where there is a minimum of earth. It is for the most part well shaded and must derive most of its moisture from the porous conglomerate cliff, on the under side of which it grows. The cause of its abundance here is undoubtedly to be found in the especially favorable environment, and perhaps a greater fertility of spores than in the other stations. That it has not a wider distribution in the general region is no more remarkable than the limited distribution of other species, and is perhaps due to a dearth of suitable situations. But Professor Murrill's observations upon the plants found by him in six or seven different localities near Blacksburg, Virginia, show that the fern does well in light rich soil; while a recent letter from Dr. Rusby states that the plants found by him[19] near Newton, N. J., grew in an open sunny spot on a dry limestone ridge; so that after all its habitat is variable. Whenever *A. ebenoides* has been found elsewhere than at Havana it has usually, if not always, been a plant or two in a place, and these rarely in the same general region. What is there to account for this isolation? They might arise from wind-blown spores; but in this event is it not a singular coincidence that the fortunate spore happens on each occasion to settle between plants of *Asplenium platyneuron* and *Camptosorus?* Besides, the stations are mostly separated by considerable distances, one in Vermont, another in Connecticut, in New York, and so on. Thus, though it be a possible, we may hardly regard it as a probable means of origin. Is it not then somewhat plausible to suppose a local origin for the fern at

[17] Papers Pres. Bost. Meet. (1898), 10. 1899.

[18] Fernwort papers. (Ined.)

[19] Bull. Torr. Bot. Club 7: 29. 1880.

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each of its few stations by means of a natural hybridization? The rarity of its occurrence is a matter of fact; and, granting the hybridity supposition, it is evident that from the resulting plant of a single cross excessive multiplication is hardly to be expected, be the spores ever so fertile. Evidently much would depend on the environment, and it is easy to assume that the Havana station has proven most favorable, the Virginia locality rather less so, and the remaining stations barely capable of supporting their foundlings. In view of anything like conclusive evidence at the present time it is obviously impossible to settle the contention; my effort has been merely to bring together the related facts known, and to suggest again the possibility or perhaps the probability of such a solution.

It is evident, as has been both affirmed and denied, that the burden of proof rests with those who claim hybridity for the fern; it remains for the sponsors for that theory to prove their contention by actual demonstration. It can be done only by painstaking artificial crossing of the supposed parents; and I am inclined to the belief that this is possible. It is easier, admittedly, to proclaim the hybridity of the fern a myth, its abundance at Havana sufficient evidence that it is a distinct species, the scattering plants mere relics of a more general northerly distribution, and all else mere speculation; but it appears to me that the invariable presence of both supposed parents, the anomalous appearance and peculiar morphology of the fern, its usual occurrence singly and in this connection its very rarity embrace a suggestion of hybridity too patent to be ignored, and of sufficient interest to warrant careful cultural experiments.— WILLIAM R. MAXON, *U. S. National Museum, Washington, D. C.*

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