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WITH THREE PLATES

BY

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POLYPODIUM PODOCARPUM Maxon

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(WITH THREE PLATES)

Toward the last of February, 1911, in the course of fieldwork connected with the Smithsonian Biological Survey of the Panama Canal Zone, I accompanied Mr. Henry Pittier from the Canal Zone, where our work had been carried on up to that time, to Chiriqui, the westernmost province of Panama, and spent nearly all of March in collecting plants—mainly ferns and lower cryptogams—in the mountains north of David, the principal city of the province. As indicating in a general way the character of this region, the following notes may be of value, inasmuch as other new ferns will be described later, in advance of a proposed paper dealing with the fern flora of Panama as a whole.

Our base of operations was the small town of El Boquete, which lies at an altitude of about 1,100 meters upon the immediate southern base of the extensive east-and-west range of mountains here forming the Continental Divide, and is reached from David by means of a rather indifferent ox-road of nearly 35 miles. The contrast between the gentle slopes of the open and nearly treeless wind-swept savannah region, through which the trail extends practically its whole length, and the territory from which the Rio Caldera issues abruptly at the foot of the mountains, is most pronounced. Ferns, which have been almost wholly wanting below, here become a conspicuous part of the vegetation. From El Boquete a few trails lead in various directions to the upper slopes of the heavily forested mountains and under tolerably good weather conditions afford fair opportunity for collecting. In less favorable weather, however, the term "rain forest" here acquires a new and truer significance; conditions of such intense and apparently perpetual humidity I have never seen in other parts of tropical America as here in the Cordillera of Chiriqui.

The most extended trips taken from El Boquete were one of four days to the summit of Chiriqui Volcano, which lies just south of the Cordillera and wholly in the dry zone; another to the twin peaks Cerro de la Horqueta, at the summit of the Cordillera; and a

third expedition (the most interesting of all to a collector of ferns) along a comparatively recent path, known from the name of the surveyor as "Holcomb's trail," which, though never wholly completed, was designed to cross the Divide to the northern (Atlantic) coast. It was upon this last trip that the peculiar species here to be described was collected. The first day's route lay wholly along the Rio Caldera, "Camp I" being some ten or twelve miles from El Boquete and in the midst of wet virgin forest at an altitude of about 1,625 meters. The second day's route proceeded through an even more humid forest above the Rio Caldera over a laboriously constructed trail, which is rapidly becoming obliterated, to the summit of the Divide at a point previously determined as about 1,925 meters above sea-level. "Camp II," which lies a short distance farther on and below, upon the Atlantic side, was not visited from lack of time. My collections for this day, which were very large, consisted entirely of material gathered between "Camp I" and the Divide. Among the many noteworthy pteridophyta collected, several of them new, none approaches in interest the species here to be described.

The first specimen of this peculiar species was secured at perhaps 1,750 meters elevation, on the trail referred to, above "Camp I," and from there all the way to the summit an occasional plant or tuft of plants would be found upon the smooth trunks of palms or other forest trees, usually at a distance of from two to six meters from the ground. The fact that the plant, though nowhere abundant, was sufficiently widespread to be encountered over an area of several miles, may safely be taken to indicate that the peculiar position of the sori, though apparently unique within the genus, is nevertheless normal for the species. The elongation of the pinnæ and their repeated division in a great majority of the fronds is discussed later, following the description. The species may be known as:

POLYPODIUM PODOCARPUM Maxon, new species

Plants epiphytic, the fronds pendent, usually numerous, closely fasciculate, 25 to 55 cm. long, subpinnate, the pinnæ sometimes simple, but mostly several to many times divaricately branched, both lamina and pinnæ of slow indeterminate growth. Rhizome prostrate or decumbent, rather slender and short, up to 4 cm. long, 4 to 6 mm. in diameter, the older portion clothed with the imbricated bases of numerous dead fronds, the crown bearing a few nearly concealed lanceolate, plicate, cucullate or subtubulose, entire, bright brown scales 3 to 5 mm. long; stipes stoutish, greenish from a dull

brown base, or discolored throughout, 1 to 6 cm. long or nearly wanting, flattened, very narrowly alate above (gradually passing into the narrowly winged rachis), rather densely pilose with very slender, fragile, spreading, rufous hairs 2 to 3.5 mm. long; lamina 20 to 50 cm. long, of varying form and indeterminate growth, readily abortive at the apex, the pinnæ simple and usually elongate, or greatly extended and freely branched near or beyond their middle, the numerous slender branches commonly forming a subdichotomy; pinnæ spreading or slightly ascending, adnate, joined uniformly by a narrow wing about 1 mm. broad, decurrent, the simple ones linear-caudate, 4 to 14 cm. long, 3 to 5 mm. broad and entire if sterile, if fertile distantly and obliquely serrate-pectinate to dentate, 5 to 9 mm. broad including the teeth or lobes, these 1 to 3 mm. long, rounded and soriferous at the apex; veins free, very oblique, the sterile ones 1- to 3-forked, the fertile ones forked, the sorus borne at the clavate apex of the greatly elongated anterior branch, very close to the margin; sori large, hemispherical, or by their position nearly globose, the sporangia arising from the lower surface but crowding outward in the plane of the lamina, the sorus thus appearing nearly or quite terminal upon the lobe; leaf tissue of young plants firmly membrano-herbaceous, the veins apparent by transmitted light, of mature plants thicker and spongiose, the veins seen with difficulty; both surfaces of the lamina (including the greenish rachis and nearly concealed midveins) covered throughout with short, distant, dark, gland-like hairs.

Type in the U. S. National Herbarium, no. 676092, collected from a tree trunk in the humid forest of the upper Caldera watershed, between "Camp I" and the Divide, Holcomb's trail, above El Boquete, province of Chiriqui, Panama, altitude 1,750 to 1,925 meters, March 23, 1911, by William R. Maxon (no. 5640).

The specimen designated as the type is but one of several mounted plants (numbers 5640 and 5656) showing the extremes of leaf form within the species. It is shown at exactly one-half natural size in Plate 1 and may be taken to indicate the "normal" form of the mature frond. Plate 2 represents at the same scale a plant of no. 5656 in which the tendency toward repeated dichotomy of the pinnæ has found ample expression. Plate 3, at about two-fifths natural size, shows a plant of no. 5640 approaching maturity and possessing an unusually large number of fronds, most of which have escaped injury at the apex while young and have in consequence attained a fair length.

A reasonable explanation of the remarkable leaf form developed by many individual fronds is, I believe, found in the following hypothesis, which has been substantiated by a careful examination of the series of specimens. It is that, notwithstanding the indeterminate growth of the lamina and of the pinnæ at their apices, the fronds would, if fully protected from injury by natural causes (such as injury by wind or by the falling of water-filled parasites from the heavily laden branches above), develop in a nearly symmetrical form. (See Plate 1, in which the frond had apparently attained a fair size before the apical portion was lost. There is no abortive tip; the whole apical portion has been broken off.) Plate 2 would appear to controvert this supposition somewhat; but an examination of the specimen itself shows the apex of this frond to be dead and discolored, and the other five or six fronds to have been broken off short and to have "forced" the activities of the entire plant to seek an outlet through a single channel, namely, the further development of the pinnæ of the one remaining frond, each (if uninjured) with its nearly dormant or slowly unrolling minute terminal bud. The alternative would have been the development or pushing out of new fronds, a feature which is, possibly, seasonal.

Further evidence is offered by a great number of mutilated fronds, and in particular (among the mounted specimens) by one not here figured (U. S. Nat. Herbarium, no. 676090) which has the stipe short and stout, the rachis 7 cm. long, the lamina there broken off sharply by natural injury and wanting, the pinnæ missing on one side of the basal remnant, and those on the other side several times dichotomous and produced to a length of 18 cm. A frond of another plant has several pinnæ similarly developed to a length of from 18 to 24 cm.

Instances of indeterminate growth in *Polyopodium* are, I think, not very common, but the following readily occur: (1) That of *P. jamesonioides* Fée¹, a species described from Colombia (*Schlim* 399), recently collected by me on Chiriqui Volcano at an altitude of about 3,000 meters (no. 5340), in which the slender simply pinnate fronds are obviously of indefinite evolution, the apex being invariably terminated by a crosier-like nascent bud; (2) that of *P. heteromorphum* Hook. and Grev., which with its dichotomous fronds is well known in several forms; (3) and that of the West Indian *P. curvatum* Sw. (of which *P. inaequale* Fée² is an exact

¹ Fée, 7me Mém. Foug. 59. pl. 21. f. 4. 1857.

² Fée, 11me Mém. Foug. 47. pl. 12. f. 3. 1866.

synonym), in which a close examination shows the apices of perfect fronds to be not truly determinate, but rather, as in *P. podocarpum*, to remain in a nascent state long after the older parts of the frond have reached maturity.

As to the cause of the development of the dichotomous form of the pinnæ in fronds of *P. podocarpum*, in preference to the simple elongation of its pinnæ by the same method of indefinite evolution, no especial explanation need be sought, inasmuch as instances of repeated subdivision of apical growth in ferns are exceedingly common. But it may be mentioned that in the whole series of this species not one of the fronds is subdivided at its apex, and in only one is the rachis forked, the simple division in this instance having been caused by an injury. The repeated subdivision of the fronds occurs invariably in the pinnæ. This is only partially accounted for by the greater likelihood of injury to the apex of the frond.

With respect to relationship, *Polypodium podocarpum* is clearly allied to *P. curvatum*, its nearest relatives being perhaps the Andine species *P. pilipes* Hook.¹ and *P. pozuzoense* Baker,² the former from Peru, the latter from Ecuador. But these are species with deeply pectinate-pinnatifid pinnæ, and the former, at least, has simple veins. Both differ from *P. podocarpum* very conspicuously in the position of their sori, which are not placed apically upon special teeth or lobes. The position of the sori in *P. podocarpum*, indeed, demands especial notice, for it is not only apparently new for the genus *Polypodium* (*Eupolypodium*), but seems to reverse the usual observed fact that fertility is commonly accompanied by a loss of foliar tissue. The contrary is here true; the pinnæ are entire where sterile, and toothed or lobed only where soriferous; there are no sterile lobes on the fertile fronds. Moreover, the apical position of the sori is so pronounced a feature as to suggest strongly the recognition of this species as a distinct generic type. Without a more critical study of its closest allies this hardly appears desirable; but it is difficult to escape the conviction that, as proven similarly by Mr. Christensen in the case of *Dryopteris*, the genus *Polypodium* (restricted to *Eupolypodium*) is susceptible of division into several well-defined sections, which will be more than "groups of closely related species," in that they may be recognized by definite characters afforded by a study of their minute morphology and their method of growth.

¹ Hook. Ic. Pl. *pl.* 221. 1840.

² Hook. Ic. Pl. *pl.* 1672. 1886.



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