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Selaginella rupestris and its Allies.

BY LUCIEN MARCUS UNDERWOOD.

The variations of the species of *Selaginella* with many-ranked leaves have long been a puzzle to botanists if we may judge from the numerous herbarium and MS. names that have been given to various members of the group. Two clearly marked species from North America have been separated from the tangle already ; besides these there remain the boreal *S. selaginoides* on which Beauvois founded the genus, and which needs no consideration here, and the widely varying forms that for the past forty years have found an unsatisfactory resting place under *S. rupestris*. For many years it has been evident that we have in this group several species as well marked as those which have been segregated already. In 1889 one of these species was found growing at Pasadena, California, and when in 1891 another was seen growing erect in sand fields in central Florida, the polymorphous nature of the group was even more forcibly impressed on us, and with it the impossibility of maintaining such divergent forms under a single species. Recognizing the fact that without abundance of material at hand and especially without consulting the largest collections not only of America but also of Europe, the description of new species would be a hazardous matter, we have hesitated until the great mass of material, especially at Kew, could be satisfactorily examined, meanwhile continuing to refer the various forms provisionally as variations of *S. rupestris*. We are now convinced that it is more logical as well as more scientific to designate these clearly marked forms by specific names. Even now, however, we are obliged to leave several well marked forms undescribed for lack of sufficient material and shall call attention to them briefly, in the hope that our field collectors in the west, in the southwest and in Mexico may give them better attention. The larger number of the species proposed below are comparatively local in their distribution ; most of them are confined to the region west of the Mississippi.

I. SELAGINELLA RUPESTRIS (L.) Spring.

It may be something of a surprise to many to learn that the original or type locality of this somewhat widely distributed species is in the eastern United States, and it is here where it appears to be subject to comparatively slight variation. Since the original *Lycopodium rupestre* of Linnaeus had a distribution extending to Siberia, it is possible that this species, like many others, was a composite, but as Linnaeus after his usual brief diagnosis cited the excellent figure of Dillenius,* which the latter had characterized as the sharp square-spiked rock lycopod from Virginia and Pennsylvania, it is clear that whatever the status of the Asiatic plant, the plant of the eastern United States must bear the specific name assigned to it by Linnaeus.

Spring in his revision of the species † recognized two extremely generalized varieties neither of which clearly represents any plant in particular. His var. *a borealis* included the more rigid contracted forms which he attributed to the northern regions of Asia and America, while his var. *β tropica* included the more slender elongate forms from warmer latitudes. It is interesting to note in this connection that the most elongate member of the group, attaining, according to Professor D. C. Eaton, ‡ a length of six feet, is found on the Pacific coast from Oregon to southern Alaska.

Milde§ distinguishes ten varieties, but as only one of them was American, and that from Mexico, his arrangement does not specially concern us at this time.

Baker still later || united all the forms under a single species with a note in which he mentions *S. tortipila* as "a dwarf form" and cites two herbarium names of Nuttall. Singularly enough he recognizes *S. Oregana* D. C. Eaton as distinct, although the specimens of that species at Kew are all mixed up with the various forms of *S. rupestris*, often on the same sheets, and the cover for *S. Oregana* appears to be vacant. But this unceremonious massing of widely different species under the same cover is not uncommon in the Kew collection.

* *Historia Muscorum*, *pl. 63. f. 11.*

† *Monographie de la Famille des Lycopodiacees*, seconde partie, 57. 1848.

‡ *Bot. Cal.* 2: 350. 1880.

§ *Fil. Europ. et Atlant.*, 262, 263. 1867.

|| *Handbook of Fern Allies*, 35. 1887.

The species as here limited may be characterized as follows:

Stems creeping, 5–10 cm. long, more or less flexuous, the apices ascending, subsecund, abundantly emitting roots throughout their entire length; primary branches mostly short with 3–6 shorter secondary ones: leaves closely imbricate, about 8-ranked, spreading at the apex of sterile stems, narrowly lanceolate, 0.3–0.38 mm. wide, deeply channeled dorsally, ending in a subflexuous spinulose white awn nearly 1 mm. long; margins each with 6–9 slender cilia: spikes sharply quadrangular, 1–1.5 cm. long, about 1 mm. in diameter; bracts similar in texture to the leaves but broader at the base, with a shorter and stouter terminal awn and usually with more cilia on the margin.

On rocks, New England and Ontario, southward throughout the Appalachian region, westward to Missouri, Colorado, Idaho, Wyoming, California and British Columbia, extending to 7000 feet altitude.

Specimens collected by Kearney in eastern Tennessee have the leaves more lax, and more spreading branches, due, perhaps, to growth in moister places. Specimens growing in mountain exposures, particularly in the far West show shorter more incurved sterile branches and assume generally a more compact form of growth doubtless for better conserving their supply of moisture, but in all other characters do not differ essentially from the more typical eastern form. It will be a fortunate day when field collectors take more time to study in the field the environment of the plants they collect.

1a. SELAGINELLA RUPESTRIS FENDLERI var. nov.

Differs from the Eastern forms of the species in its lax, less crowded leaves which are tipped with a shorter white awn and their margins with short denticulate cilia; the spikes are flabby and flexuous, and the macrospores are more coarsely areolate.

Fendler, no. 1024, *Plantae Novo-Mexicanae*, 1847; Fort Collins, Colorado, C. F. Baker, no. 2. I would also refer to this variety a single sterile plant collected in the Organ Mountains, New Mexico, by E. O. Wooton, 1892.

2. SELAGINELLA WATSONI sp. nov.

Stems short, 4–6 cm. long, creeping, sparingly short branched, rooting throughout the entire length; leaves rather short, stout,

deeply channeled dorsally, ending abruptly in a short stout smooth mostly curved green awn, 0.25–0.35 mm. long; margins with few cilia or none, when present not exceeding 70μ in length; spikes 1.5–2.5 cm. long, sharply quadrangular, the bracts broader at base, lanceolate-ovate to ovate, with shorter and stouter awns.

Apparently confined to high altitudes of the Sierra Nevada and neighboring mountains. Cottonwood Cañon, Utah, alt. 9500 ft., S. Watson, no. 2370, in King's Expl. Exped., July, 1869; Clover Mts., Nevada, alt. 9000 ft., S. Watson, Sept., 1868. (U. S. Nat. Herb.); Cañon Pass (Sierra Nevada) alt. 8000–9000 ft., Aug., 1863 (Herb. D. C. Eaton); Alpine Co., California, alt. 8000 ft., Hansen (Herb. D. C. Eaton) also Hansen, 879 (Herb. Kew); Mt. Whitney, Tulare Co., California "1700 ft. above timber line" Coville & Funston, no. 2071, Death Valley Expedition.

3. SELAGINELLA MUTICA D. C. Eaton MS. in Herb.

"Stems creeping, rather rigid, 3'–6' long, divided and pinnately branched; leaves glaucescent, six-ranked, closely imbricated, half a line long, oblong-ovate, convex and slightly grooved on the back, obtuse and without a terminal seta, the margins ciliated with about eight spreading cilia on each side; spikes scarcely thicker than the branches, quadrangular, the bracts broader than the leaves and pointed or even obscurely mucronate."

"Collected in New Mexico by the Mexican Boundary Commission and in several places in Colorado by Thomas Meehan, Mrs. E. J. Spence, etc."

This clearly marked species I have found described as above in Professor Eaton's collection and would add the following characters partly in emendation of those noted above. The cilia on the margins of the leaves are often 12–15 on either side (even in Eaton's specimens), are long and slender, often 120μ or longer; the channels on the dorsal surfaces of the leaves are as clearly marked as in *S. rupestris*. The stems are well provided with roots throughout their whole extent.

Additional specimens in the Columbia Herbarium were collected in Colorado by Brandegee, A. G. Compton and Mrs. Livermore; also specimens from La Cuerba, New Mexico, Bigelow, 1853, Whipple's Exped. My own herbarium also contains specimens from Prescott, Arizona, J. W. Tuomey. In the U. S. Na-

tional Herbarium are additional specimens collected on the Mexican Boundary Survey.

4. SELAGINELLA ARENARIA sp. nov.

Deeply rooting in sand with fine copious roots often 15–20 cm. long; stems slender, branching, erect or ascending, densely caespitose, 5–8 cm. high, emitting copious brown wiry roots a little distance above the base; leaves closely appressed, narrowly lanceolate, 0.25 mm. wide, deeply channelled dorsally, terminated by a spinulose white awn 0.35–0.50 mm. long; margins with numerous short cilia; spikes 2–3 cm. long, slender, sharply quadrangular, the bracts broadly lanceolate, spreading at maturity with copious marginal cilia (15–20 on either side); microspores very abundant throughout the length of the spike, globose-tetrahedral, 36–39 μ in diameter, bright yellow or pale orange.

Growing in sand in open fields, Eustis, Florida, Jan., 1891, Underwood; July, 1894, Nash, no. 1449. A fragmentary specimen of the same plant is in the Chapman Herbarium and bears the note "Dry sand ridges, Gadsden Co., Florida, 1840." In addition to the remarkable habit and habitat of this species it produces a great abundance of microspores unlike the other members of the *rupestris* group.

In the Gray Herbarium there is a MS. description by Riddell with meagre specimens of plants from western Louisiana and Texas which resemble the above species in habit but have spikes scarcely more than one-third as long; they may prove a distinct species, when Riddell's appropriate name should be taken up. To the same species we should refer plants of Drummond's Texas collection (Herb. Columbia and Herb. Kew), Riddell, no. 16 in Herb. Columbia and Reverchon's Texas Plants no. 1632, from Burnet county, on granite rocks, though the latter specimens show some slight variations particularly in the irregular ranking of the leaves.

5. SELAGINELLA RUPINCOLA sp. nov.

Stems suberect, somewhat flexuous, 8–12 cm. high, rooting only from near the base, pinnately branching, the secondary branches mostly very short; leaves channeled dorsally, closely imbricate, spreading only near the growing tips of the stem, glaucous or cinereous green, tapering toward the apex and ending in a

long white denticulate spine 1 mm. or more long; margins strikingly long ciliate, 15–20 on either side; spikes 1 cm. or less long, borne laterally on the branches, scarcely quadrangular, the bracts closely resembling the ordinary stem leaves so as to render the spikes scarcely distinguishable except for the axillary sporangia; macrospores dark-yellow, 0.24–0.27 mm. in diameter, strongly and deeply pitted reticulate.

On perpendicular rocks, Organ Mts., Doña Ana Co., New Mexico, alt. 6000 ft., E. O. Wooton, July 10, 1897. No. 2106 of Wright's collection, 1851–2 (Herb. Kew) belongs here, as also the erect plant of Palmer's no. 92, southwestern Chihuahua, 1885 (Herb. Kew); as represented in the Columbia herbarium, this number includes a second creeping sterile plant which belongs to a distinct species. A sterile plant in my herbarium, collected by Tuomey in the Santa Catalina Mts., Arizona, also appears to be the same species.

The macrospores of this species are only about half the diameter of those of *S. rupestris*. The plant evidently approaches what Milde had in mind in his var. *Mexicana*, but that is characterized as having "rami laxius dispositi longiores" and a "seta brevis parce denticulata," neither of which our plant possesses.

6. SELAGINELLA BIGELOVII sp. nov.

Stems slender, 10–20 cm. long, mostly ascending, flexuous, usually with short ascending primary branches; secondary branches infrequent and mostly very short; stems rooting only near the base; leaves about six-ranked, appressed-imbricate, usually with a distinct dorsal channel, narrowly lanceolate, tapering gradually into a densely spinulose white awn often 0.7 mm. long; margins with 12–15 cilia on either side which are directed forward and usually less than 50 μ long; spikes obtusely quadrangular, mostly on short lateral branches 5 mm. or less long, the bracts short, broadly ovate but otherwise like the leaves.

The original specimens collected by Bigelow (Whipple's Expedition) probably in California but without locality stated, appear to be sterile, but specimens collected by me at Pasadena, California, in January, 1889, and clearly referable to this species have a few fertile spikes from which the characters above noted are derived. The later specimens are usually more branched than those of Bigelow's original collection but are otherwise closely similar. To

this species we would also refer Parish no. 671, San Bernardino, Coville & Funston no. 101 from the same locality, and specimens collected from "San Ysabel" by H. W. Henshaw.

7. SELAGINELLA TORTIPIILA A. Br. Ann. Sc. Nat. V. 3: 2. 1865.

Stems 20–25 cm. long, more or less flexuous, with the elongate primary branches compound, rooting only near the base; leaves loosely imbricate, about six-ranked, narrowly lanceolate, scarcely channeled dorsally, ending in a contorted or irregularly coiled elongate hair point; margins with 6–12 very short cilia on either side: spikes very short (4–5 mm.) borne at the ends of ordinary branches, subquadrangular, but with loosely spreading broadly ovate-lanceolate bracts, which are dorsally channeled and bear marginal cilia and terminal hairs similar to those of the stem leaves.

Described from the type specimen, a duplicate of which, mixed with *S. rupestris*, has recently come into our possession, "In locis rupestribus humidis montium ad Broad River, Carolina, Sept. legit Rugel, July, 1841." Fragmentary specimens had hitherto been seen from Caesar's head, South Carolina, and from Sa-boola Mountain, Macon County, North Carolina, both collected by J. Donnell Smith.

This is the species which Baker describes as "a dwarf form" of *S. rupestris*, but which Milde characterizes very justly as "species pulcherrima!" The plant is much more elongate though more slender than *S. rupestris*, with which it has otherwise little in common.

8. SELAGINELLA EXTENSA sp. nov.

Stems slender, trailing, 35–40 cm. long, copiously emitting roots throughout their whole extent, with numerous primary branches 1.5–4 cm. long; leaves dark green, narrowly lanceolate with a slight dorsal channel, ending in a very short brownish or translucent point, mostly with no terminal spine: marginal cilia few, appearing like minute serrulations: spikes single or often in pairs at the ends of the primary branches, 1–2 cm. long, the bracts broadly lanceolate, ending abruptly in a point, strongly ciliate on the margins.

On rocks and trees, Las Canoas, San Luis Potosi, Mexico. Pringle, no. 3900, August 21, 1891. Specimens are also in the Meissner Herbarium, collected in Mexico by C. Müller.

The plant was distributed under the name of *Selaginella rupestris*, var. *Mexicana* but it has nothing to do with the var. *Mexicana* Milde, Fil. Europ. et Atlant. 263. 1867, and this necessitates the adoption of a new name, as it properly deserves specific rank.

9. SELAGINELLA STRUTHIOLOIDES (Presl).

Lycopodium struthioloides Presl, Rel. Haenk. 1: 82. 1830.

Selaginella Oregona D.C. Eaton; Bot. Cal. 2: 350. 1880.

This plant should be restored to its proper name under which it was well described a half century before its second christening. Hooker* years ago recognized the identity of Presl's plant with the one collected by Scouler at Observatory Inlet, the specimen of which is preserved at Kew and agrees perfectly with the plant known from the Oregon woods whence it has been collected by numerous later explorers and distributed under various names. Singularly enough, Baker,† with Scouler's plant before him, referred *Lycopodium struthioloides* Presl which was originally described from "Nootka Sund" to *L. carinatum* Desv., a true *Lycopodium* from tropical Asia! It is so simple in certain quarters to overleap all geographical barriers in the effort to mass species.

The species above characterized can be readily separated by the following synopsis:

Stems spreading or creeping.

Stems close creeping, usually less than 10 cm. long, rooting their entire length.

Leaves tapering into a conspicuous slender white awn. 1. *S. rupestris*.

Leaves ending abruptly in a minute greenish point. 2. *S. Watsoni*.

Leaves six-ranked, closely appressed, without awns or points.

3. *S. mutica*.

Stems spreading, 20-25 cm. long, rooting only at the base; spikes 4-5 mm. long leaves ending in a tortuous white hair.

7. *S. tortipila*.

Stems extensively trailing, 35 cm. to 1 meter or more long.

Stems scarcely rooting, 50-150 cm. long, lax with soft spreading leaves.

9. *S. struthioloides*.

Stems everywhere rooting, 35-40 cm. long, rigid with appressed leaves.

8. *S. extensa*.

Stems erect or ascending.

Spikes 2-3 cm. long, plants deeply rooting in sand.

4. *S. arenaria*.

Spikes 1 cm. or less long.

Leaves eight-ranked, with conspicuous long spreading cilia; spikes scarcely quadrangular.

5. *S. rupicola*.

Leaves six-ranked, slightly ciliate; spike quadrangular.

6. *S. Bigelovii*.

* Fl. Bor. Am., 2: 267. 1840.

† Handbook of Fern Allies, 17. 1887.

Besides the above species there are a number of interesting forms that are peculiar in standing strictly by themselves, having for the most part no very close alliances; the material in every case is scanty and for the greater part consists of wholly sterile plants; in order to call the attention of collectors to these forms they are briefly characterized; they are mostly found in the region extending from Texas to southern California and northern Mexico, a region already prolific in well marked species, and are particularly commended to botanists living or collecting in this portion of the country.

1. A prostrate plant with strongly secund leaves, usually showing a distinct dorso-ventral character both in color and arrangement of leaves; two forms occur, one with no hair point to the leaves and the other with a well developed hair point. To the former belong Parish, no. 1200, San Bernardino, California; Palmer, no. 455, southwestern Chihuahua, 1885; and a small plant collected by Major Emory in 1846. To the latter type belong Nealley, no. 555, Chenates, western Texas, 1889; and a plant collected by Fremont in California, 1845-7. All these forms are sterile.

2. A form with short rosette-like stem and leaves closely compacted and ending in a minute point. A mere scrap of this was collected in Inyo Co., California, by Coville and Funston, no. 628, Death Valley Expedition; a quite similar plant in Herb. Kew. is marked "*L. bryoides* Nutt." from San Diego and is presumably the plant referred to by Baker in his note under *S. rupestris*.

3. A very small creeping form with closely appressed scarcely pointed leaves and short clavate branches; a single meagre specimen collected on the Mexican Boundary Survey by Dr. Parry is in the Columbia Herbarium; a similar specimen in the Herb. Phila. Acad. Sciences is marked "*Lycopodium bryoides*" in Nuttall's own hand, while another specimen in Herb. Kew bears the mark, "*L. rupestre* β *brevipes*, Oregon, Nutt." All these sterile forms represent an interesting form and in connection with the facts above stated indicate clearly that the last word has yet to be said in regard to the members of this interesting group of species.