THE ALLIES OF SELAGINELLA RUPESTRIS IN THE SOUTHEASTERN UNITED STATES.

By G. P. Van Eseltine.

INTRODUCTION.

The *rupestris* group of the genus Selaginella, in so far as it is represented in North America, has attracted the attention of several botanists, only two of whom, however, have attempted to analyze the group as a whole. Underwood published,[1] in 1898, a paper on "*Selaginella rupestris* and its allies," in which he called attention to the rich variety of forms, described 6 new species, and redescribed *S. rupestris* (L.) Spring, the type of the group, together with *S. tortipila* A. Br. Two years later Dr. Georg Hieronymus, of Berlin, published[2] a large number of new species of Selaginella, including 13 from North America previously involved in *S. rupestris*. In 1901, the same author gave a synopsis of the whole group,[3] which, though very carefully prepared, was based unfortunately on a comparatively small number of specimens. With the exception of the redescription of *S. cinerascens* by A. A. Eaton, and a short paper by Doctor Underwood, describing 2 new species from the southeastern United States, there have been no further contributions to the knowledge of *S. rupestris* and its allies in North America.

It is apparent, however, from the diversity of the abundant material in American herbaria, that there are involved a number of additional species. The present series of papers, undertaken at the suggestion of Mr. William R. Maxon, is intended to survey the whole group of *Selaginella rupestris*, to amplify the older descriptions where it seems necessary, to describe such new species as appear, and to correlate all descriptions with as large an amount of material as practicable. In pursuance of the last-mentioned aim, the author has been greatly aided by the curators of the Gray Herbarium, and of the herbaria of the New York Botanical Garden and the Missouri Botanical Garden, who have generously lent for examination all

[1] Bull. Torrey Club **25**: 125. 1898.
[2] Hedwigia **39**: 290–320. 1900.
[3] Engl. & Prantl, Pflanzenfam. 1[4]: 621–717. 1901.

the material in their keeping which comes within the scope of this paper.

The present instalment deals with the representatives of this group occurring in the Gulf Coastal Plain of the United States and the territory immediately adjacent to the northeast.

MORPHOLOGICAL NOTES.

In general appearance the plants of this group somewhat resemble small dwarfed forms of the club mosses (*Lycopodium* spp.). They are more or less cespitose in habit with erect, ascending, or repent, many-branched shoots covered with 6 to 13 rows of small sessile leaves.

The shoots or main stems are usually 5 to 25 mm. long (much longer in a few species); the primary branches are somewhat shorter than the shoots, but not otherwise different; the secondary branches generally average half as long as the primary branches; and the ultimate branchlets are merely short spurs, slightly enlarged at the tip and only a few millimeters in length. The branching appears to be dichotomous, but Campbell[1] states that it is really monopodial.

The rhizophores are leafless, stemlike structures, which arise exogenously from the stems and produce many capillary endogenous roots. They arise more numerously from the base of the shoots, but usually occur sparsely throughout their whole length.

The leaves, which are all alike, are small and sessile, and are usually provided with a suture (groove) in a median line on the dorsal side, cilia on the margins (also often on the edges of the dorsal suture), and a seta (awn) at the apex, although some of these characters are lacking in part of the species. As to length there is some diversity on the same plant, though other leaf characters are fairly constant. Descriptions of leaves throughout this paper refer to those of the primary shoots. The length of leaves is measured on the ventral side, from the point of attachment to the apex of the leaf proper, excluding the seta. It should be noted that cilia and setæ are in all cases more or less deciduous.

The spikes (fruiting branches) are terminal and usually more or less 4-angled. The sporophylls are similar to the ordinary leaves but wider and often provided with short lobes or auricles at the base. The measurements for sporophylls are taken from those in the middle of the spike.

Each sporophyll bears either a megasporangium or a microsporangium. The position of these on the spike varies somewhat. On the erect or ascending plants the megasporangia usually occupy the lower rows of sporophylls, while the microsporangia occupy the upper and by far the larger number of sporophylls. In the repent or

[1] Mosses and ferns 522. 1905.

prostrate plants the megasporangia often occur only on the ventral side of the spike, while the microsporangia occur on the dorsal side.

The megasporangia, normally containing 4 megaspores, are irregularly spherical, bulging considerably over each megaspore. The megaspores are nearly spherical, but are slightly pyramidal on the commissural face, i. e., the side of contact with the other megaspores. This face usually bears 3 commissural ridges spreading at approximately equal angles from each other, beginning at the apex of the commissural side and extending to the base of the flattened portion. The ends of these ridges are sometimes connected by a raised ring. The surface may be either plain, somewhat rugose, tuberculate, or reticulate, wholly or in part. These irregularities on the surface of the megaspores are of considerable value in classification. It often happens that one megaspore of the tetrad develops at the expense of the other three, which are then much dwarfed. The stated size of megaspores in the following descriptions is that of an average normal megaspore.

The microsporangia are reniform, and contain several hundred microspores. These present much the same general appearance as the megaspores, but are exceedingly minute.

The writer's heartiest thanks are due to Miss Kathryn Steinle, of the Western High School, Washington, D. C., for the drawings of leaves, sporophylls, and megaspores.

DESCRIPTIONS OF SPECIES.

KEY TO THE SPECIES.

Megaspores smooth, at least on the outer face.
- Stems (including leaves) up to 1 mm. thick; leaves without cilia in the dorsal suture, bearing a cluster of cilia on the long adnate base ——— 2. *S. arenicola.*
- Stems thicker; leaves usually bearing 4 to 10 cilia in the dorsal suture, without a cluster of cilia at the base.
  - Plants 7 to 12 cm. high; megaspores merely rugose on the commissural face.
    - Leaves rather lax, glaucous green; dorsal cilia of leaves as large as the marginal ——— 3. *S. humifusa.*
    - Leaves closely appressed, darker green; dorsal cilia, when present, minute and usually confined to the basal portion of the dorsal suture ——— 4. *S. funiformis.*
  - Plants 3 to 6 cm. high; megaspores rugose-tuberculate on the commissural face ——— 5. *S. acanthonota.*

Megaspores alveolate or rugose-reticulate or rugose-tuberculate.
- Setæ tortuous; plants prostrate or ascending; megaspores rugose-tuberculate.
  - Plants prostrate, spreading; leaves 8-ranked ——— 6. *S. tortipila.*
  - Plants ascending, densely cespitose; leaves 13-ranked ——— 7. *S. sherwoodii.*

Setæ straight; megaspores alveolate or rugose-reticulate.
Plants erect; stems up to 1 mm. thick; megaspores rugose-reticulate ..... 1. *S. riddellii.*
Plants ascending; stems thicker; megaspores alveolate ..... 8. *S. rupestris.*

1. Selaginella riddellii Van Eseltine, sp. nov. PLATE 15. FIGURE 63.

Plants erect or ascending, cespitose, 4 to 8 cm. (occasionally 12 cm.) high; rhizophores few, 1 to 5 cm. long (averaging 2 cm.), finely and copiously short-radicose; stems (including leaves) 0.7 to 1.2 mm. thick, rigid, branched at intervals of 6 to 12 mm.; branches few (2 to 4), 2.5 to 6 cm. long, with few branchlets, these simple, strictly ascending, up to 5 mm. long; leaves apparently 6-ranked, appressed, slightly imbricate, pale green when young, ochraceous to dark brown in age, thickish, flat or slightly concave on the upper surface,

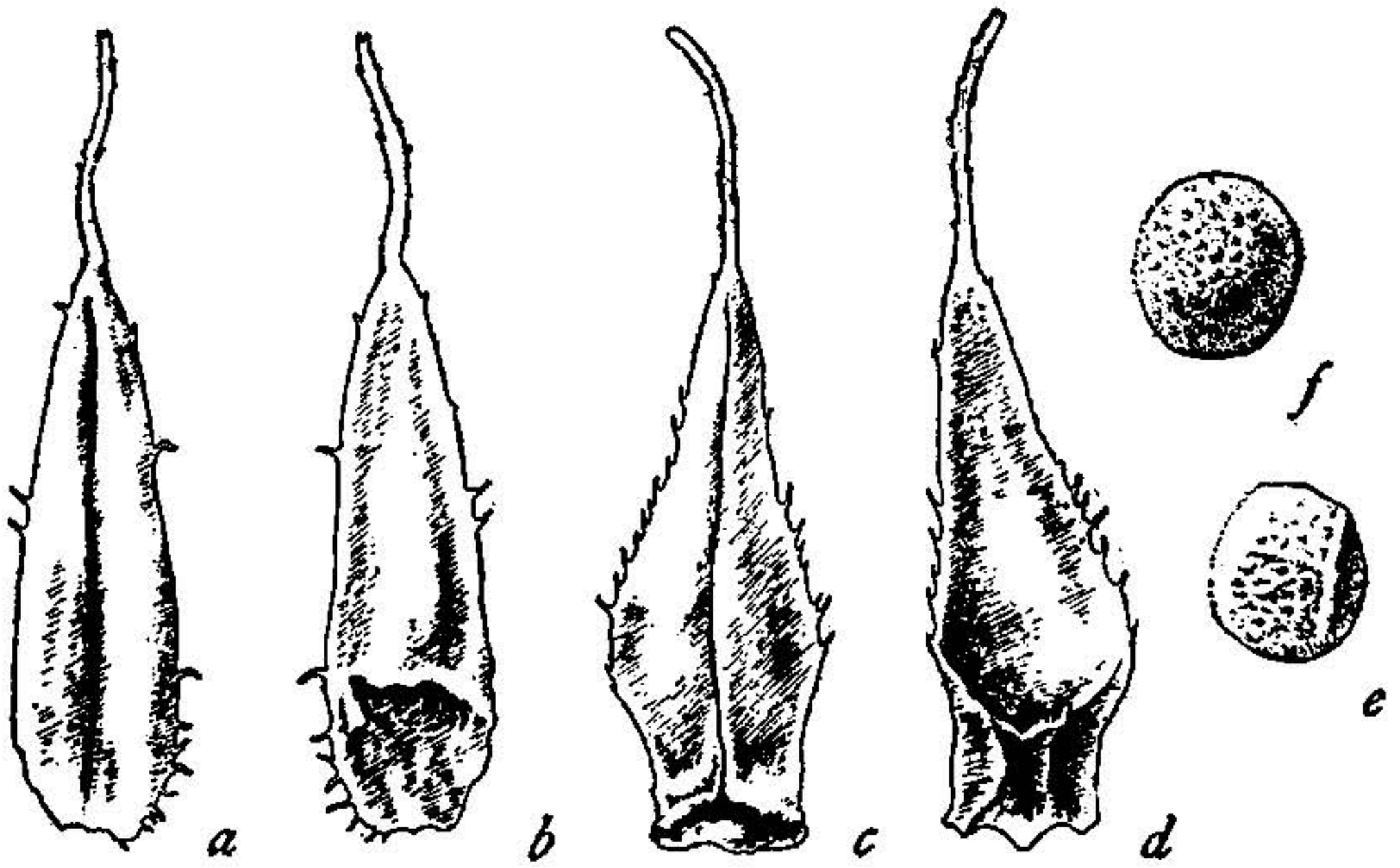

FIG. 63.—Details of *Selaginella riddellii*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From the type specimen. Scale 30.

slightly convex on the lower, deeply sulcate dorsally in a median line up to the rather blunt apex, linear-deltoid to linear-lanceolate from a short obdeltoid base, minutely 4 to 8-ciliate on the margins; longest leaves 1.3 mm. long; cilia up to 0.06 mm. long, green, yellowish, or hyaline; setæ up to 0.6 mm. long, on the younger leaves white, on the older leaves reddish or yellow at the base, scabrous to spinulose-roughened.

Spikes nearly quadrangular, up to 2.5 cm. long; sporophylls up to 1.5 mm. long, 0.7 to 0.8 mm. wide just above the base, slightly elongate-triangular from an auriculate base (auricles rounded-triangular), minutely 12 to 18-ciliate on the margins; setæ and cilia similar to those of the stem leaves.

Megasporangia yellowish, 0.6 mm. in diameter; megaspores 0.45 mm. in diameter, yellowish, rugose-reticulate; microspores deep orange (deep yellow by transmitted light), up to 0.046 mm. in diameter.

Type in the U. S. National Herbarium, no. 690149, collected near Prairie View, Waller County, Texas, January 3, 1911, by F. W. Thurow (no. 7).

The following specimens have been examined:

TEXAS: Burnett County, *Reverchon* 1632 (N, M, Y).[1] Hudson Mountain, Gillespie County, *Jermy* 342 (N, M). Newton County, *Holmes & Fetherolf*, January, 1903 (N). Montgomery County, *Thurow* 8 (N). Prairie View, Waller County, *Thurow*, October 26, 1915 (N). Llano, *Lindheimer* 76 (M); *Plank* (Y). Marble Falls, *Plank* (Y). Austin, *Long*, March, 1900 (Y), and February, 1901 (Y). Localities wanting, *Drummond* 352 (Y); *Riddell* 16 (Y).

DISTRIBUTION: Central and eastern Texas. probably through southern Louisiana.

The rugose-reticulate megaspores differentiate this plant from all others of the southeastern United States, while the very slender, erect shoots are in rather marked contrast with any of the other Texan and New Mexican species. *Selaginella rupincola*, with which this species might possibly be confused, is a larger plant, with longer setæ, thicker stems, and megaspores with a raised ring circumscribing the ends of the commissural ridges.

There is a brief manuscript description of this species (under Lycopodium) by Riddell in the Gray Herbarium.

EXPLANATION OF PLATE 15.—Type specimen of *Selaginella riddellii*. Natural size.

2. Selaginella arenicola Underw. Bull. Torrey Club **25**: 511. 1898.

PLATES 16, 17. FIGURE 64.

Selaginella arenaria Underw. Bull. Torrey Club **25**: 129. 1898, not Baker, 1883.

Plants erect, fasciculate, 5 to 10 cm. high, somewhat rigid; rhizophores abundant, arising only from the base of the shoots; stems (including leaves) up to 1 mm. thick, rigid, freely branched at intervals of 7 to 10 mm.; primary branches few (3 to 5), 4 to 8 cm. long, with few short branchlets, these 5 to 10 mm. long, simple, strictly ascending, incurved; leaves 6-ranked, appressed, slightly imbricate, in the younger stages glaucous green, in age becoming cinereous brown, thickish, papillose-roughened, flat above, slightly convex beneath, deeply sulcate dorsally in a median line up to the apex, linear-deltoid from a long decurrent base, minutely 7 to 14-ciliate on the margin, bearing a clump of cilia on the decurrent base; longest leaves 1.2 mm. long, about 0.3 mm. wide at the base; cilia 0.03 to 0.06 mm. long; setæ up to 0.8 mm. long, 0.03 to 0.06 mm. thick, white with yellowish base, spinulose-serrulate throughout.

Spikes terminal on the shoots and upper branches, quadrangular, 1.5 to 2 cm. long; sporophylls elongate-triangular from an auriculate base (auricles broadly rounded-triangular) acute, in the younger stages glaucous green, in age becoming pale brown, somewhat cymbiform, about 1.2 mm. long, 0.66 mm. wide at the base, 15 to 25-ciliate on the margin, deltoid.

Megasporangia in the axils of the lower sporophylls, 0.6 mm. in diameter; megaspores crustaceous, punctate on the commissural side, irregularly and minutely punctulate on the opposite side, chalk-white, 0.4 mm. in diameter; microsporangia in the axils of the upper sporophylls, flattened, reniform, the widest diameter 0.6 mm.; microspores red to orange, the widest diameter 0.036 mm.

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[1] Capitals in parentheses designate the herbarium in which the specimen examined is deposited, as follows: (N), U. S. National Herbarium; (G), Gray Herbarium of Harvard University; (Y), herbarium of the New York Botanical Garden; (M), herbarium of the Missouri Botanical Garden.

The type, in the herbarium of the New York Botanical Garden, was collected near Eustis, Lake County, Florida, January 14, 1891, by L. M. Underwood (no. 1355 in part).

Other collections of this species are:

GEORGIA: Near Bainbridge, *Curtiss* 6714 (N, G, Y). Near Pendleton Creek, about 3 miles south of Ohoopee, Tatnall County, *Harper* 1860 (N, M, Y). Near Ohoopee River, west of Reidsville, Tatnall County, *Harper* 1854 (N, G, M, Y). Near Chattahoochee River, Muscogee County, exposed granite rocks, *Harper* 1800 (N, G, M). Albany, *Tracy* 3510 (M).

FLORIDA: Near Chattahoochee, arid sandy ridges, *Curtiss* (N). About 2½ miles south of Grandin, Putnam County, high pine land near edge of scrub hammock, *Harper* 6 (N). Orange County, *Meislahn* 138 (N). Gadsden County, *Chapman* (Y). Eustis, Lake County, *Underwood* 1355a (Y). Claremont, *Williamson* (Y). Braidentown, in "marigold" and oak scrubs, on loose white sand, *Combs* (N).

DISTRIBUTION: Dry sandy ground or rock waste, central and northern Florida and southern Georgia.

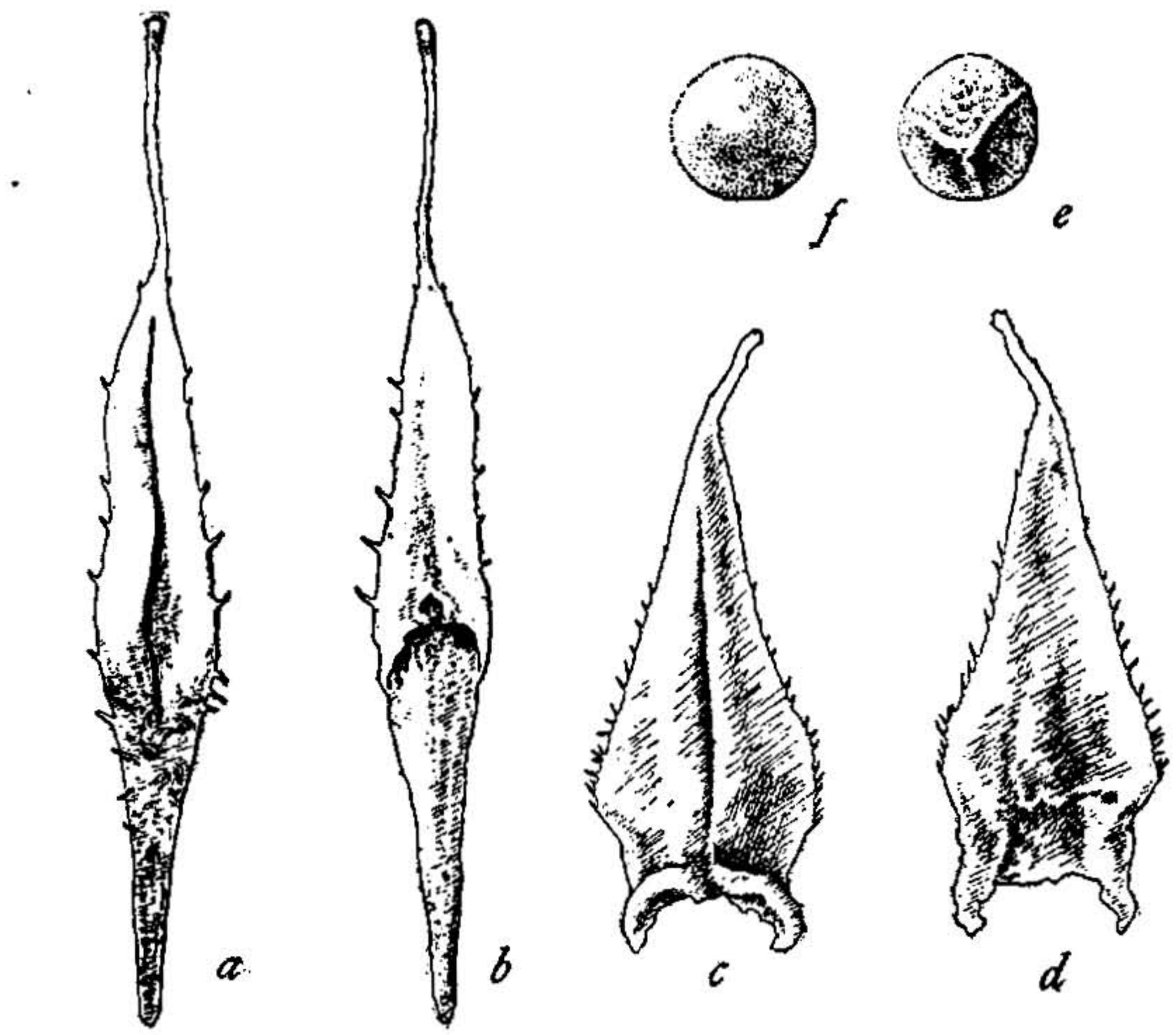


FIG. 64.—Details of *Selaginella arenicola*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From the type specimen. Scale 30.

On the type sheet of *S. arenicola* in the herbarium of the New York Botanical Garden there are 10 pieces of Selaginella. Six of these are obviously one species, probably portions of the same plant, and the other four are portions of a plant or plants entirely distinct in several respects. These differences are taken up at length following the description of the second species represented.

It is the plant with more slender stems and with leaves bearing no cilia in the dorsal suture that must be taken as the type of *S. arenicola*, since Underwood, in his description, emphasizes the fact that the plant is "slender" and makes no mention of the dorsal cilia, while he subsequently used the presence of these as a distinguishing mark of *S. acanthonota*. Of the other two specimens cited by Underwood in his descriptions of the species, one (Gadsden County, Florida, *Chapman*, in 1840) is true *S. arenicola;* and the other (collected in the vicinity of Eustis, Lake County, Florida, July 16–31, 1894, by Nash, no. 1449) belongs to the other species.

Selaginella arenicola is readily distinguished from any other species by its nearly smooth megaspores, long adnate leaf base, and extremely slender stems. Harper's no. 1860 is peculiar in having a somewhat laxer habit and more spreading leaves than most collections of this species.

EXPLANATION OF PLATES 16, 17.—*Selaginella arenicola*. Pl. 16, the type specimen; Pl. 17, specimen collected near Grandin, Putnam County, Florida, *Harper* 6, U. S. Nat. Herb. no. 513489. Both natural size.

3. Selaginella humifusa Van Eseltine, sp. nov. PLATE 18. FIGURE 65.

Plants ascending, densely cespitose, 5 to 7 cm. high; rhizophores abundant, arising only from the base of the shoots; stems (including leaves) up to 2 mm. thick, rather lax, freely repeatedly branching at intervals of 3 to 6 mm.; primary branches abundant, 3 to 6 cm. long, with abundant short branchlets 5 to 20 mm. long, these with still smaller branchlets; ultimate branchlets up to 5 mm. long, simple, divaricate; leaves 8 to 10-ranked, imbricate, slightly appressed, in the younger stages pale green, in age becoming cinereous brown, thickish, chartaceous, minutely papillose-roughened, flat above, slightly convex beneath, sulcate dorsally in a median line up to the apex, narrowly deltoid from a short obdeltoid base, minutely 8 to 12-ciliate on the margins, bearing 5

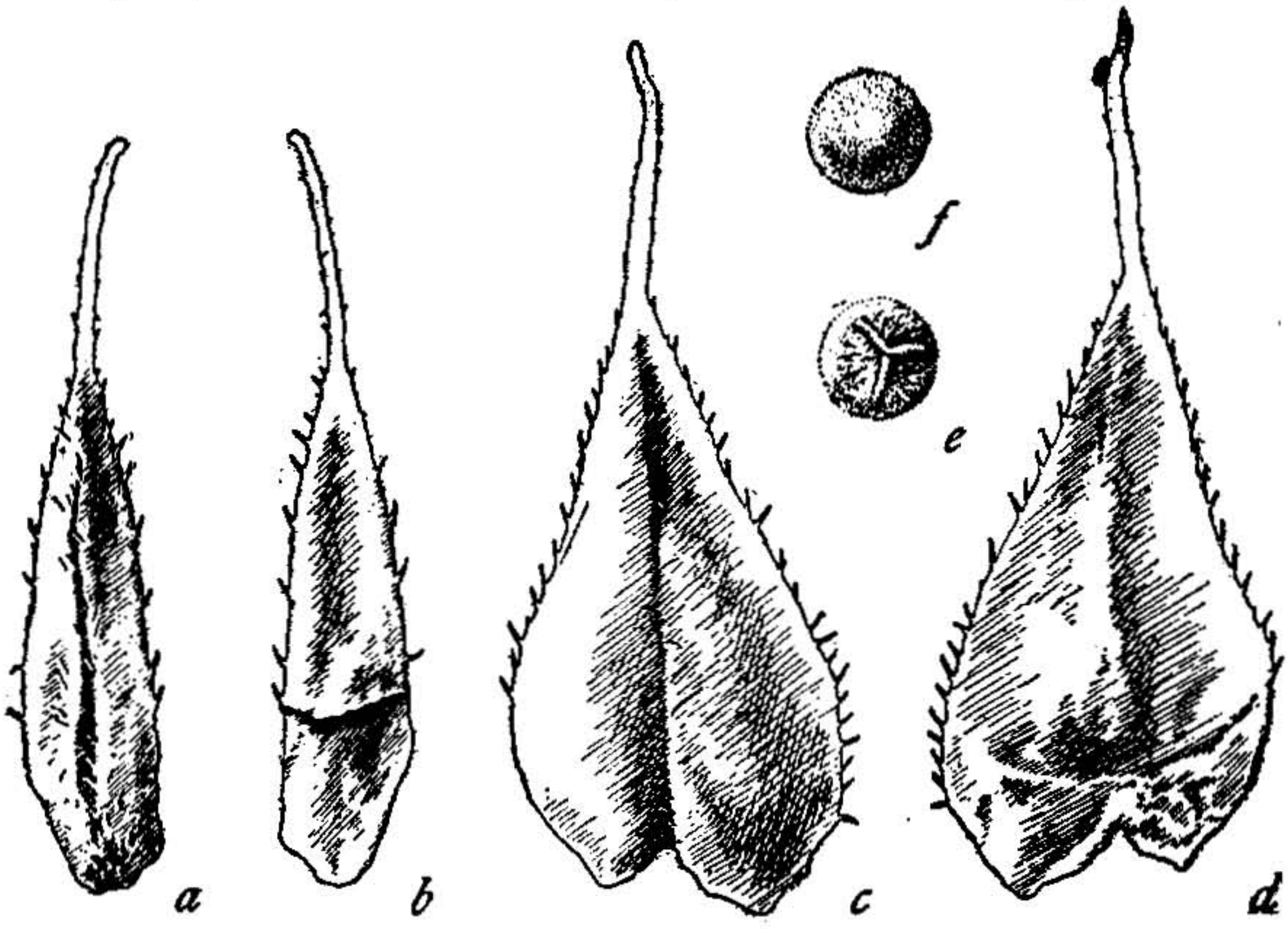


FIG. 65.—Details of *Selaginella humifusa*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From the type specimen. Scale 30.

to 10 cilia on the edges of the dorsal suture; longest leaves 1.5 mm. long, 0.3 mm. wide at the base; cilia 0.045 to 0.076 mm. long; setæ deciduous, up to 1 mm. long, 0.034 to 0.068 mm. thick, white, spinulose-roughened.

Spikes terminal, nearly quadrangular, up to 2 cm. long, 1 mm. thick; sporophylls 1.75 mm. long, 1 mm. wide, deltoid, auriculate at base, narrowly sulcate dorsally in a median line up to the ciliate setigerous apex, 15 to 25-ciliate on the margins, occasionally very minutely ciliate on the base, with 4 to 10 cilia on the edges of the dorsal suture; setæ and cilia similar to those of stem leaves; auricles rounded-deltoid, 0.2 mm. wide.

Megasporangia reddish yellow, 0.7 mm. in widest diameter; megaspores crustaceous, whitish, more or less minutely punctate, rougher on the commissural side, 0.3 to 0.35 mm. in diameter; microsporangia 0.6 mm. in widest diameter, reniform, orange or brownish orange; microspores abundant, bright orange, 0.03 mm. in diameter.

Type in the U. S. National Herbarium, no. 228293, collected in the vicinity of Eustis, Lake County, Florida, July 16–31, 1894, by George V. Nash (no. 1449).

Other collections of this species are:

FLORIDA: Dry sandy soil, Lake County, *Nash* 1449 (G, M, Y). Sanford, Orange County, September, 1900, *Rapp* (N). Sandy pine woods, Alapattah, Dade County, *Eaton* (N, G).

DISTRIBUTION: Central and southern Florida.

Selaginella humifusa, which is the species confused by Underwood with his *S. arenicola*, differs markedly from that species in several respects. Whereas the leaves of each are of nearly the same length on the inner surface from the point of attachment to the tip, the long basal portion of the leaves of *S. arenicola* makes them appear on the outer face or dorsal side from half as long again to twice as long as those of *S. humifusa*. The basal portion of the leaves of *S. humifusa* may or may not have a few very minute cilia upon it, but this portion of the leaves of *S. arenicola* usually has a distinct clump of cilia quite as long as the marginal ones. *Selaginella humifusa* has cilia along the edges of the dorsal suture, and *S. arenicola* never has them. It must be borne in mind, however, that these cilia are, like the marginal ones and the setæ, more or less deciduous, and are not to be found on every leaf. The leaves of *S. humifusa* are apparently 8 to 10-ranked and those of *S. arenicola* apparently never more than 6-ranked. The latter species is less loosely tufted than the former, as also much more slender.

This species differs from its closest ally, *S. funiformis*, in the following characters: The leaves are thinner and flatter, not so closely appressed, and (in drying) of a much lighter green color. The dorsal cilia are large and rather abundant in *S. humifusa* and exceedingly minute or absent in *S. funiformis*. The spores of the latter are much rougher than those of *S. humifusa*. The stiff, cordlike appearance of *S. funiformis* furnishes a rather obvious distinguishing character, as opposed to the softer and more lax appearance of *S. humifusa*.

EXPLANATION OF PLATE 18.—Type specimen of *Selaginella humifusa*. Natural size.

4. Selaginella funiformis Van Eseltine, Proc. Biol. Soc. Washington **30**: 161. 1917. PLATE 19. FIGURE 66.

Plants erect, cespitose, rigid, up to 12 cm. high; rhizophores abundant at the base of shoots, sparse along the older portions of the stem; stems (including leaves) up to 1.2 mm. thick, rigid, sparsely branched at intervals of 7 to 10 mm., primary branches few, 5 to 8 cm. long, these bearing few secondary branches (up to 20 mm. long); ultimate branchlets occurring throughout, up to 5 mm. long, simple, closely ascending; leaves 8 to 12-ranked, very closely appressed, imbricate, in the younger stages olive-green, in age becoming dull brown, thick-

ish, chartaceous, slightly concave above, convex beneath, narrowly sulcate dorsally in a median line up to the acute apex, narrowly deltoid from a short broadly obdeltoid base, 6 to 10-ciliate on the margins, occasionally minutely 4 to 8-ciliate along the edges of the dorsal suture; longest leaves 1.25 mm. long, 0.4 mm. wide at the base; cilia 0.03 to 0.06 mm. long; setæ white with a reddish base, scabrous, up to 1 mm. long.

Spikes nearly quadrangular, up to 15 mm. long, 1 mm. thick; sporophylls 1.5 mm. long, 0.8 mm. wide at the base, narrowly sulcate dorsally in a median line up to the acute apex, auriculate, minutely 10 to 20-ciliate on the margin, occasionally 4 to 8-ciliate on the edges of the dorsal suture near the base; auricles broadly obdeltoid, ciliate; cilia more minute and setæ slightly shorter than on the stem leaves.

Megasporangia yellowish, 0.6 mm. in widest diameter; megaspores rugose on the commissural side, nearly smooth on the opposite side, 0.3 mm. in diameter; microsporangia 0.6 mm. in widest diameter, reniform, orange or brownish; microspores abundant, bright orange, 0.03 mm. in diameter.

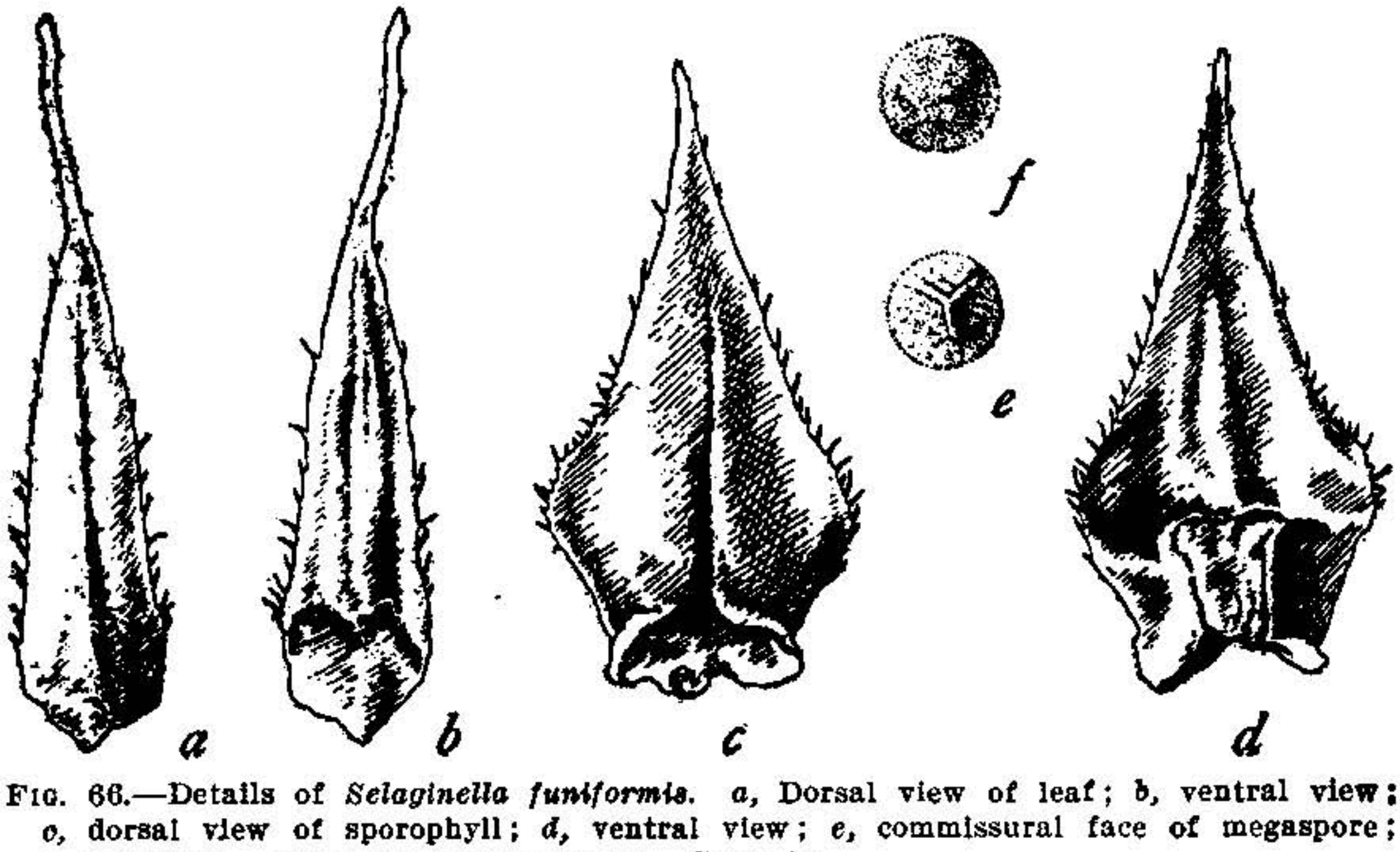


FIG. 66.—Details of *Selaginella funiformis*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From the type specimen. Scale 30.

Type in the U. S. National Herbarium, no. 723895, collected on hillocks of loose sand in shade of scrubby oaks near Carrabelle, Florida, March 15, 1898, by Charles Mohr.

The following specimens have been examined:

FLORIDA: Carrabelle, *Mohr*, March 10, 1898 (N), and March 14, 1898 (N); "*Chapman*" (Biltmore distribution, no. 3432b) (N, G, Y); "*Chapman*" (without number) (M). Indian River, *Palmer* (M, G). Palatka, *Hasbrouck* (N). Fort Lauderdale, *Small & Carter* 1013 (G, Y); *Small, Carter & Small* 3349 (Y); *Small & Wilson* 1762 (Y). Clearwater, *Huger* (Y).

DISTRIBUTION: Sand dunes and barrens, throughout Florida.

This species is closely allied to *S. humifusa*, but differs in the points noted under that species. Its next closest ally, *S. arenicola*, differs in the long-adnate base of the leaf, smoother megaspores, fewer ranks of leaves, and correspondingly smaller stems. The extremely closely appressed leaves give the stem an appearance not unlike that of stiff cord.

EXPLANATION OF PLATE 19.—Type specimen of *Selaginella funiformis*. Natural size.

5. Selaginella acanthonota Underw. Torreya 2: 172. 1902.

PLATE 20. FIGURE 67.

Selaginella rupestris acanthonota Clute. Fern Allies 142, 264. 1905.

Plants cespitose, ascending, up to 5 cm. high; rhizophores abundant throughout; stems (including leaves) up to 2 mm. thick, somewhat rigid, densely repeatedly branched at intervals of 3 to 7 mm.; primary branches 3 to 5 cm. long, similar to shoots; ultimate branchlets up to 7 mm. long, simple, closely ascending; leaves 8 to 10-ranked, imbricate slightly over half their length, appressed, in the younger stages pale green, in age becoming reddish brown, thickish, chartaceous, flat above, slightly convex beneath, sulcate dorsally in a median line up to the apex, 8 to 12-ciliate on the margins, 4 to 8-ciliate along the edges of the dorsal suture, narrowly deltoid from a short obdeltoid base; longest leaves 1.6 mm. long, 0.4 mm. wide at the base; cilia 0.042 to 0.051 mm. long; setæ deciduous, up to 1 mm. long, 0.034 to 0.068 mm. thick, white with reddish base, minutely spinulose.

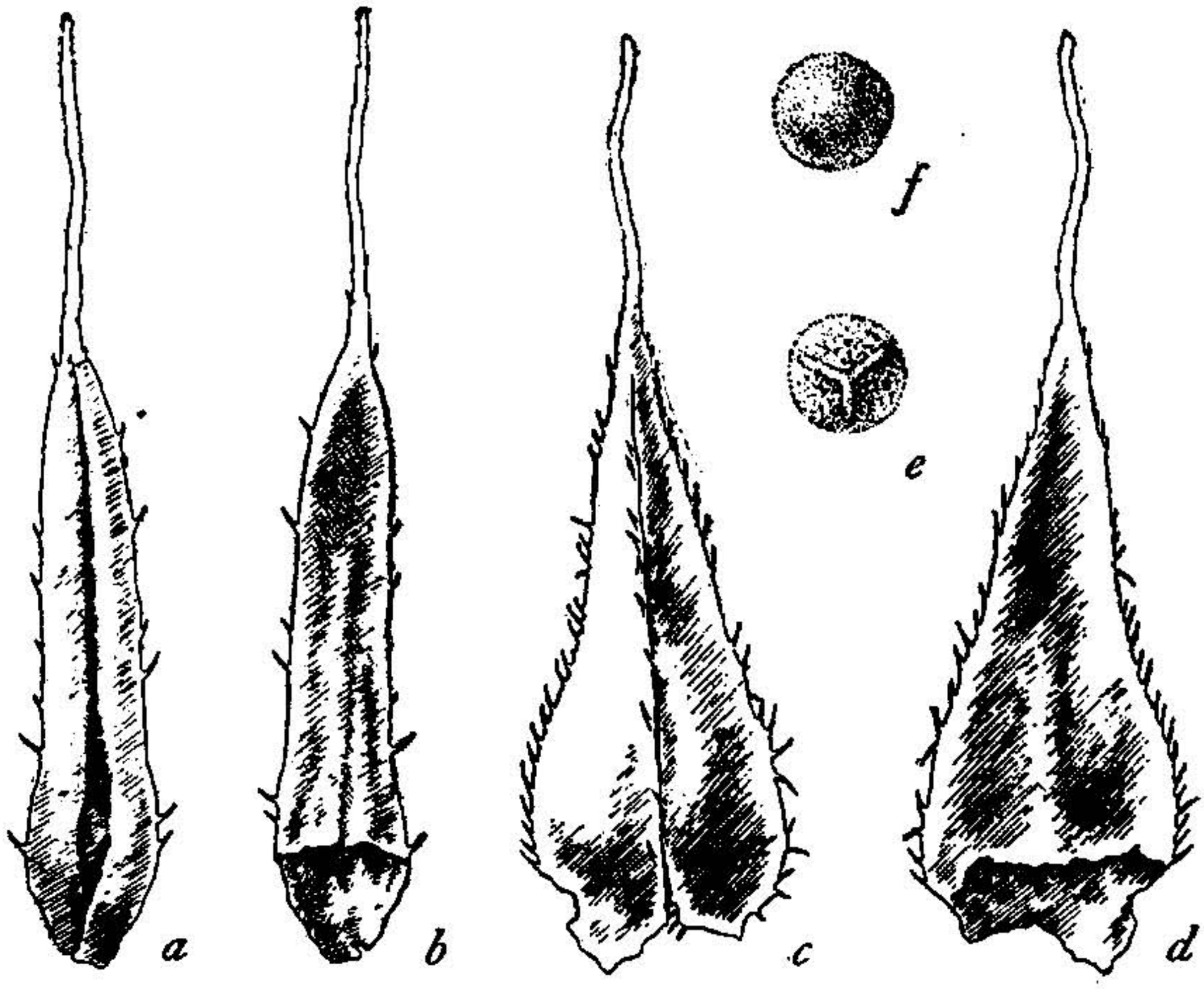


FIG. 67.—Details of *Selaginella acanthonota*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From the type specimen. Scale 30.

Spikes terminal, quadrangular, up to 3 cm. long, 1.5 to 2 mm. thick; sporophylls up to 2 mm. long, 0.8 mm. wide at the base, deltoid, 20 to 25-ciliate on the margins, minutely 10 to 15-ciliate on the edges of the dorsal suture; setæ about two-thirds as long as those of stem leaves; cilia much more minute.

Megasporangia pale yellow, 0.6 mm. in widest diameter; megaspores white, 0.28 mm. in diameter, tuberculate-rugose on the commissural side, nearly smooth on the opposite side; microsporangia 0.5 mm. in diameter, reniform, pale orange; microspores pale orange, 0.05 mm. in diameter.

The type, in the herbarium of the New York Botanical Garden, was collected by C. L. Williamson in pine barrens near Wilmington, North Carolina, July, 1892.

The following specimens have been examined:

FLORIDA: Scrub between Narcoosie and Runnymede, Osceola County, *Harper* 10 (N, M). Dry pine barrens at base of Tabletop Hill, northwest of West Apopka, Lake County, *Harper* 16 (N, G, M). Scrub about 3 miles east of Tavares, Lake County, *Harper* 17 (N, M). Palma Sola, *Tracy* 7554 (N, M, G).

GEORGIA: Sand hills of Ohoopee River near Reidsville, Tatnall County, *Harper* 1852 (N, G, M). Dry pine barrens east of Arabi, Dooly County, on rocks, *Harper* 1957 (N, G, M). Sand hills of the Little Ocmulgee River, Montgomery County, *Harper* 1987 (N, G, M). Near Harrison, on Altamaha grit, *Harper* (N, Y).

NORTH CAROLINA: East of Wilmington, in dry sand, *Bartram* (G), *Chase* (N).

DISTRIBUTION: Central Florida to North Carolina, along the Coastal Plain.

Williamson in a letter to Underwood—the letter now attached to the type sheet in the herbarium of the New York Botanical Garden—states that this species "grew in the white sand of the open sand barrens in circular clumps a foot or more in diameter, that were generally almost covered by the drifting sand." The specimen of Harper's no. 1987 (with photograph) in the Gray Herbarium shows the habit very well.

This species differs noticeably from *S. humifusa*, to which it is closely related, in its dwarfish aspect, as well as in its much more rugose spores, and its more minute dorsal cilia, those of *S. acanthonota* being extremely fine, while those of *S. humifusa* are quite as large and prominent as are the marginal ones. The dwarf habit and more strongly rugose spores also serve to distinguish it from *S. funiformis*. It is typically more lax than *S. funiformis*, but there is a very considerable variation in that respect. *Selaginella acanthonota* seems to be the most variable species in the group, exclusive, perhaps, of *S. rupestris*.

Underwood in his notes on *S. acanthonota* says that it is related to *S. rupestris*. The lack of definite reticulation on the megaspores, as well as the more stiffly ascending or semierect habit and the shorter leaves with dorsal cilia, shows it to be much more closely related to *S. humifusa* and the other southern species.

EXPLANATION OF PLATE 20.—Type specimen of *Selaginella acanthonota*. Natural size.

6. Selaginella tortipila A. Br. Ann. Sci. Nat. V. 3: 2. 1865.

PLATE 21. FIGURE 68.

Selaginella rupestris tortipila Underw. Native Ferns ed. 4, 140. 1893.

Plants prostrate, loosely fasciculate, 20 to 25 cm. long, producing rhizophores at the base of the shoots, rarely elsewhere; stems (including leaves) up to 1.25 mm. thick, flexuous, loosely repeatedly branched at intervals of 7 to 25 mm.; larger branches similar to the primary shoots; ultimate branchlets up to 20 mm. long, slightly thicker than the shoots; leaves 8-ranked, imbricate, closely appressed on the shoots and branches, more lax on the ultimate branchlets, in the younger stages pale glaucous green, in age becoming ochraceous to cinereous brown, chartaceous, thickish, slightly concave above, strongly convex beneath, narrowly sulcate dorsally nearly to the thick blunt apex, lanceolate from a long decurrent base, minutely 3 to 8-ciliate on the margins, abruptly setigerous at the apex; longest leaves 2 mm. long, 0.6 mm. wide at the base; cilia up to 0.045 mm. long, hyaline, deciduous; setæ fibriform, minutely spinulose, extremely tortuous, ochraceous to hyaline, up to 0.7 mm. long.

Spikes inconspicuous, not more than 5 mm. long; sporophylls ovate-lanceolate, cymbiform, 0.9 mm. wide above the base, minutely 6 to 12-ciliate on the margins, otherwise similar to the stem leaves.

Megasporangia 0.6 mm. in diameter, arranged on the ventral side of the spike; megaspores subrugose-tuberculate, yellow, 0.36 mm. in diameter; microsporangia arranged on the dorsal side of the spike, reniform, flattened, 0.75 mm. in diameter; microspores 0.04 mm. in diameter.

There is a duplicate of the type in the herbarium of the New York Botanical Garden: "In locis humidis montium ad Broad River, Carolina Sept. legit Rugel, July, 1841."

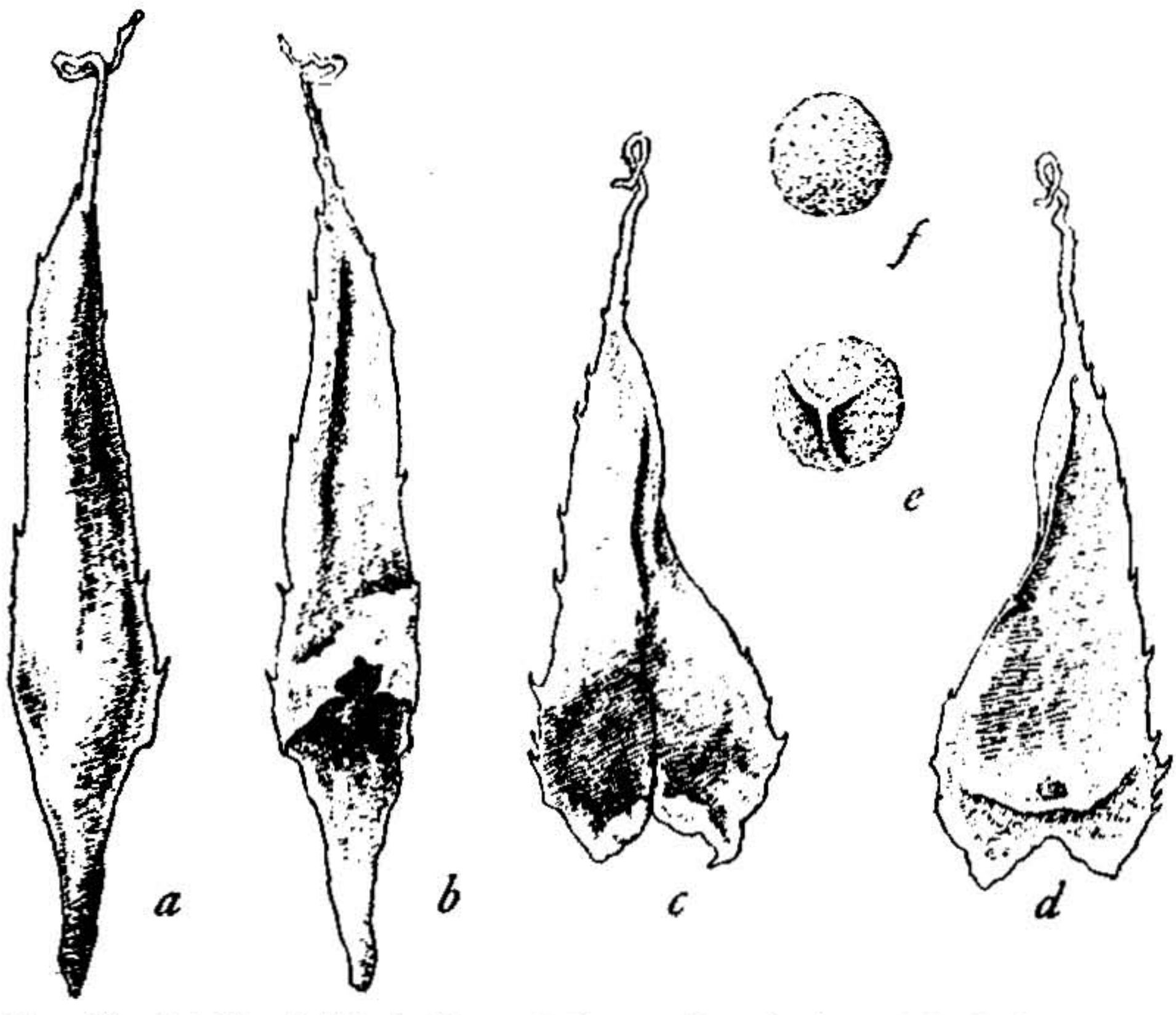


FIG. 68.—Details of *Selaginella tortipila*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From specimen collected at Caesars Head, South Carolina, August 6, 1881, by John Donnell Smith; U. S. Nat. Herb., no. 154689. Scale 30.

Other specimens examined are:

SOUTH CAROLINA: Exposed rocks, Caesars Head, Green County, alt. 1,350 meters, *Smith* (N, G, Y); *Engelmann* (M); *Redfield* (M). Table Rock, *Gray & Carey* (G). Without definite locality, *Ravenel* (G).

DISTRIBUTION: On granite (?) rocks, mountains of South Carolina.

The characters noted in the key serve as ready marks of distinction between this species and the next. The relatively thick leaves and tortuous awns effectually distinguish this plant from all other eastern species.

EXPLANATION OF PLATE 21.—*Selaginella tortipila*. Specimen collected on Caesars Head, South Carolina, Sept. 2, 1876, by Engelmann; Herb. Missouri Bot. Gard., no. 46797. Natural size.

7. Selaginella sherwoodii Underw. Torreya **2**: 172. 1902.

Selaginella rupestris sherwoodii Clute, Fern Allies 142, 264. 1905.

PLATE 22. FIGURE 69.

Plants ascending, densely cespitose, somewhat rigid, 8 to 12 cm. high, producing rhizophores only at the base of the shoots; stems (including leaves) 1.5 to 1.75 mm. thick, densely repeatedly branched at intervals of scarcely 10 mm. between the larger branches, and of scarcely 5 mm. between the ultimate branchlets; lower branches loosely ascending, similar to the shoots but shorter; ultimate branchlets simple, less than 5 mm. long, as thick as the primary shoots; leaves about 13-ranked, closely appressed, imbricate, in younger stages pale olivaceous to glaucous green, in age becoming ochraceous to dark cinereous brown, chartaceous, thickish, slightly concave above with a slight median ridge in older leaves, strongly convex beneath, either not channeled or shallowly sulcate dorsally in the lower two-thirds, narrowly elliptic-ovate from a long decurrent base, abruptly setigerous at the blunt semiterete apex, minutely ciliate

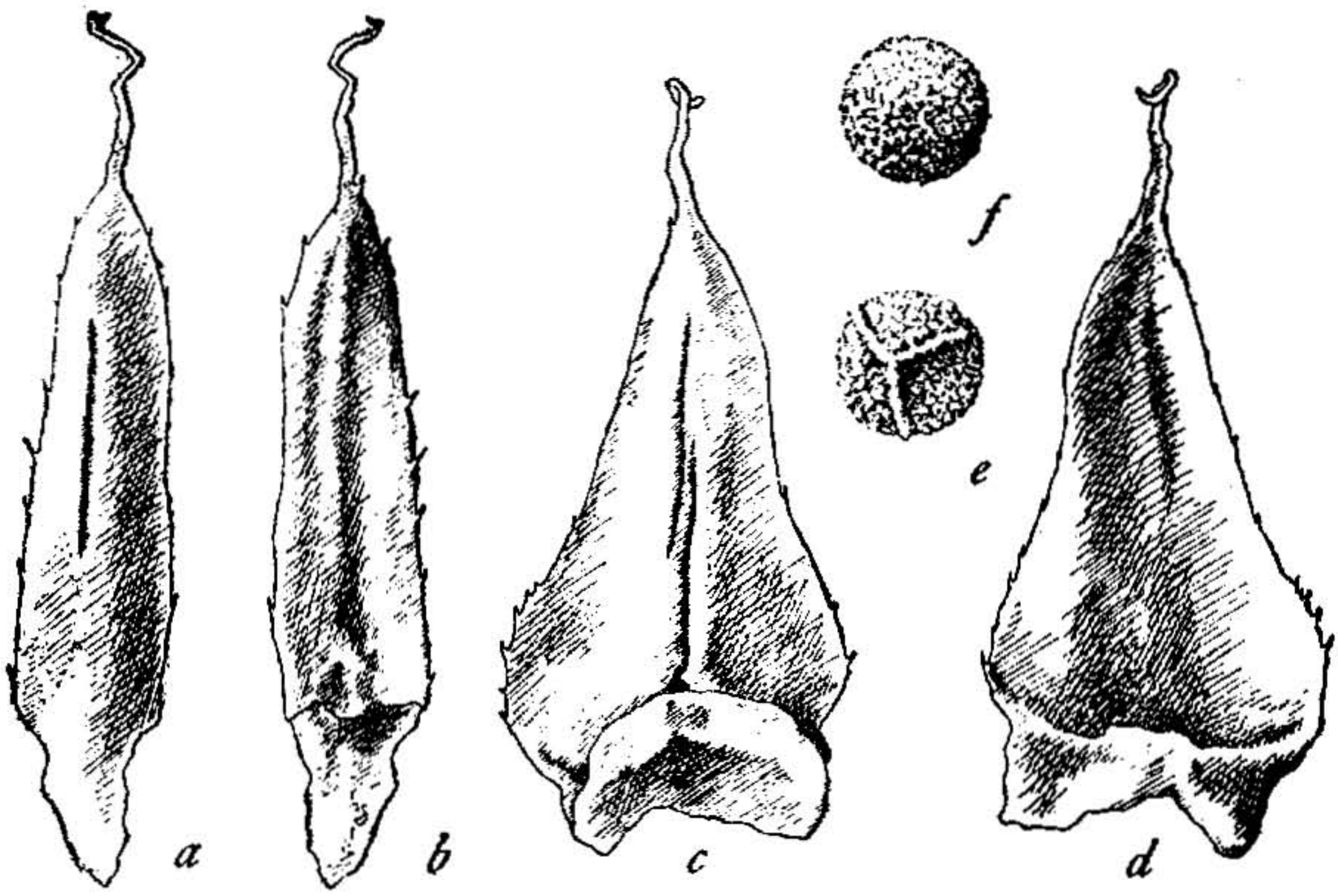


FIG. 69.—Details of *Selaginella sherwoodii*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From specimen collected on Satulah Mountain, near Highlands, North Carolina, August 30, 1882, by John Donnell Smith; U. S. Nat. Herb., no. 834949. Scale 30.

on the margins; largest leaves 1.5 mm. long, 0.35 mm. wide at the base; setæ fibriform, extremely tortuous (in dried specimens), minutely spinulose, white, up to 1 mm. long; cilia 8 to 15 on each side of the leaf, 0.03 mm. long.

Spikes terminal, inconspicuous, less than 5 mm. long; sporophylls similar to the leaves but wider at the base and more deeply sulcate.

Megasporangia arranged on the ventral side of the spike, yellowish, the widest diameter 0.6 mm.; megaspores tuberculate-rugose, yellow, 0.4 mm. in diameter; microsporangia arranged on the dorsal side of the spike, reniform, flattened, 0.6 mm. in widest diameter; microspores red to orange, 0.046 mm. in diameter.

The type, in the herbarium of the New York Botanical Garden, was collected near Highlands, Macon County, North Carolina, by W. L. Sherwood.

The following specimens have been examined:

NORTH CAROLINA: Summit of Satulah Mountain, near Highlands, Macon County, alt. 1,500 meters, on exposed rocks, *Smith* (N, M, G). Highlands, *Sherwood* in 1901 (Y), and in 1902 (Y). Hendersonville, *Huger* (Y).

DISTRIBUTION: Mountains of North Carolina.

The many-ranked leaves and densely cespitose habit of *S. sherwoodii* serve as very obvious distinguishing characters. The tortuous setæ and the tuberculate megaspores also form important distinctions.

The closely appressed, shallowly sulcate, thick leaves are so wholly unlike the longer, flatter, more lax, deeply sulcate leaves of *S. rupestris* that there is little likelihood of confusion. *Selaginella acanthonota* does not, so far as known, reach the altitude of this or the next species, but its more erect habit, its rigid setæ, and the dorso-ventral arrangement of its spores would, in any case, serve immediately to distinguish it.

EXPLANATION OF PLATE 22.—*Selaginella sherwoodii*. Specimen collected on Satulah Mountain, near Highlands, North Carolina, August 30, 1882, by John Donnell Smith; U. S. Nat. Herb., no. 834040. Natural size.

8. Selaginella rupestris (L.) Spring in Mart. Fl. Bras. 1²: 118. 1840.

FIGURE 70.

Lycopodium rupestre L. Sp. Pl. 1101. 1753.

This species, while not endemic to the southeast, as are the other plants discussed, grows along the mountains well down into Georgia. Its alveolate-reticulate megaspores form a ready distinction. It shows several marked

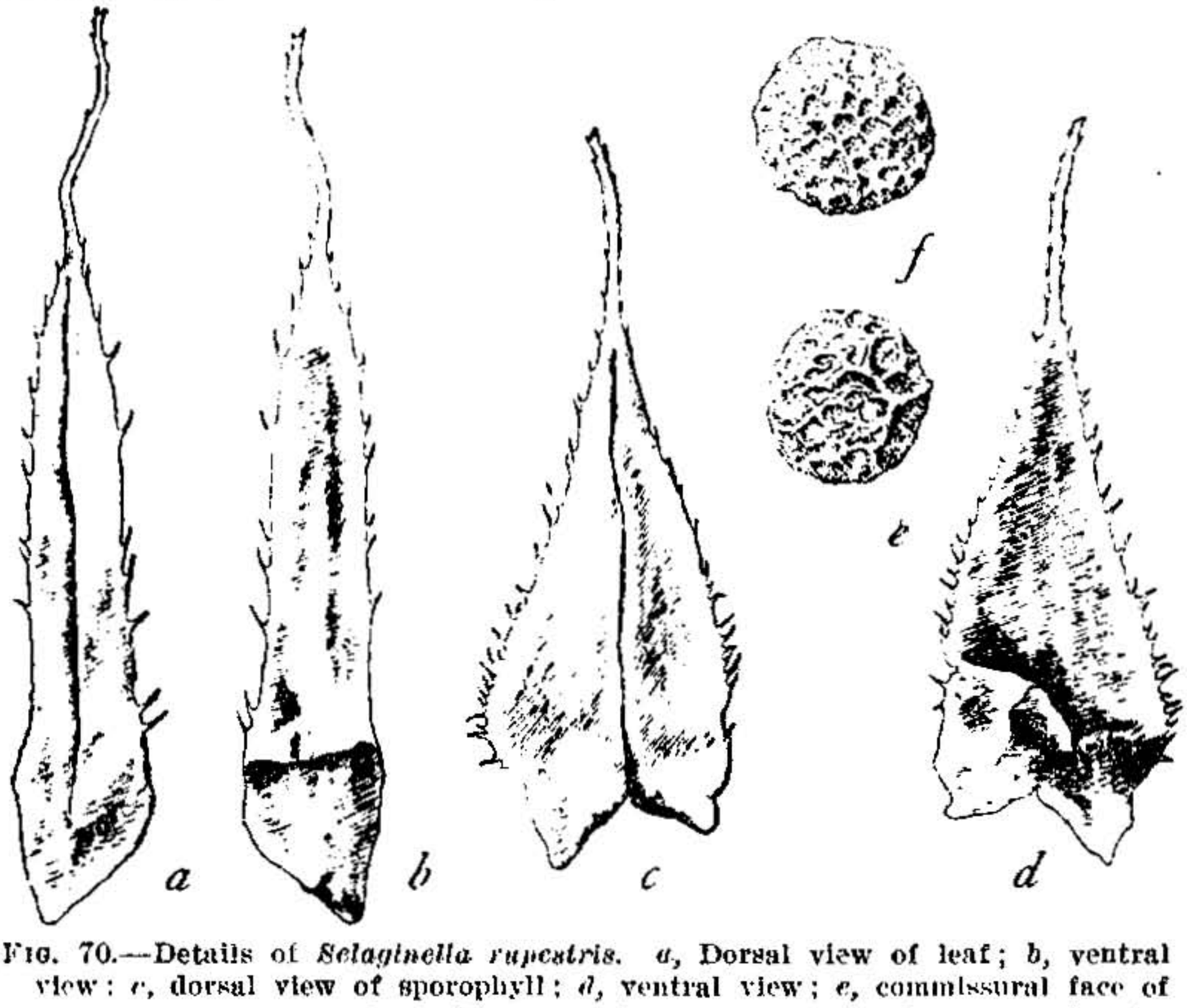
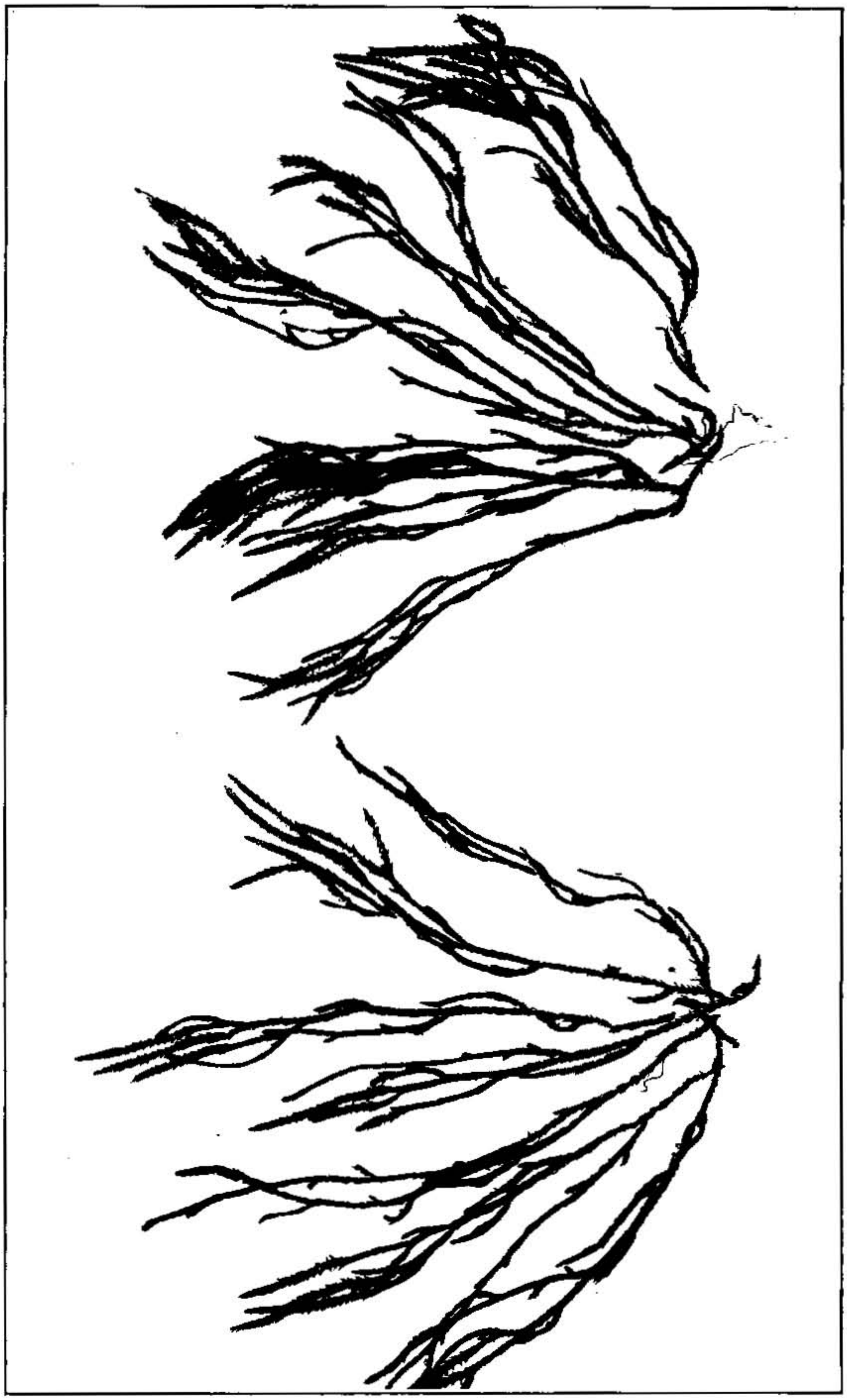


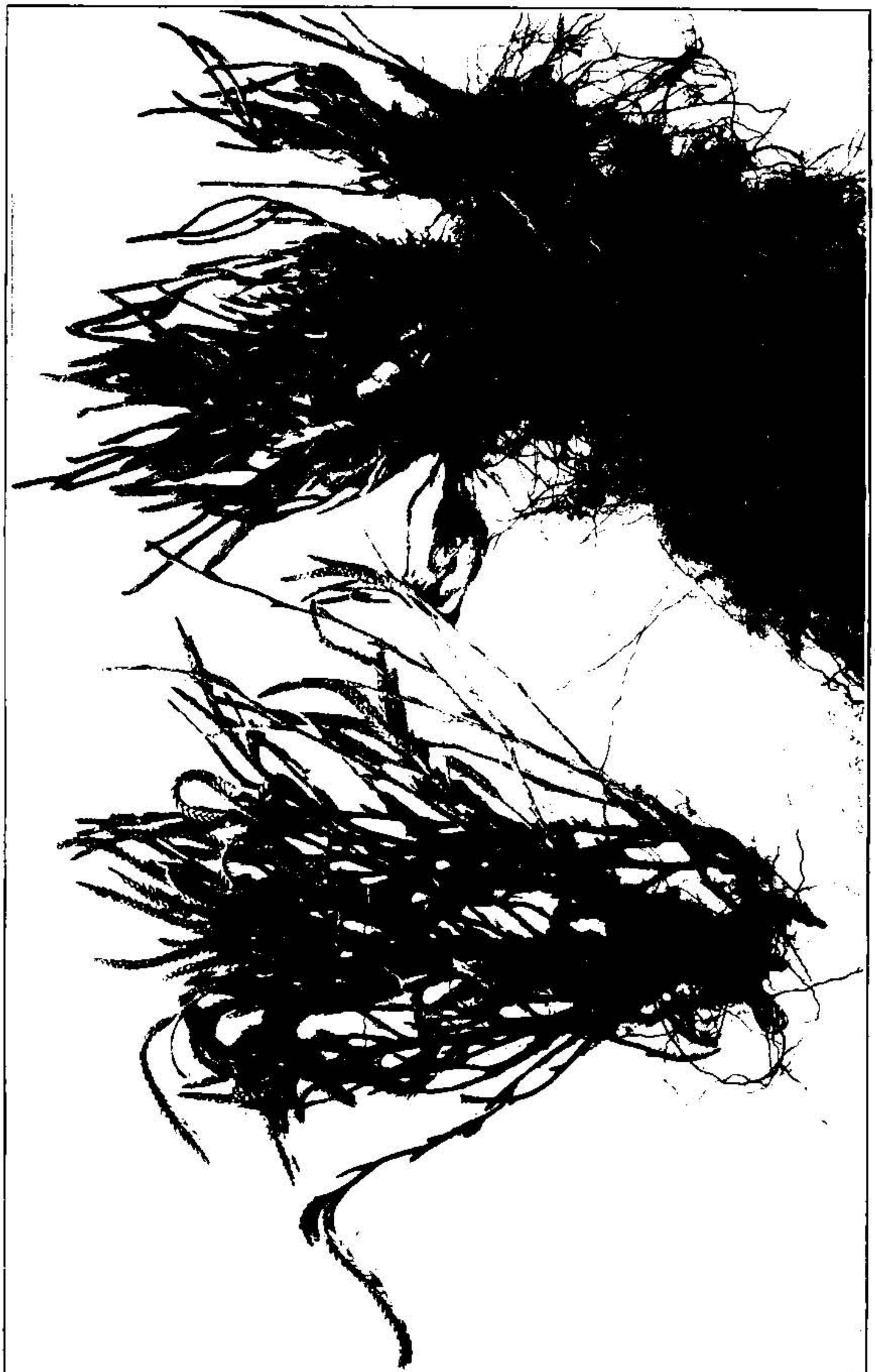
FIG. 70.—Details of *Selaginella rupestris*. *a*, Dorsal view of leaf; *b*, ventral view; *c*, dorsal view of sporophyll; *d*, ventral view; *e*, commissural face of megaspore; *f*, outer face. From specimen collected in Lancaster County, Pennsylvania, *Heller & Halbach* 706; U. S. Nat. Herb., no. 204750. Scale 30.

variations in form in the northern and western portions of its range, but the form in the south seems fairly constant. A discussion of this species and its allies in the northern United States will be published in a subsequent paper. The type is from "Virginia."

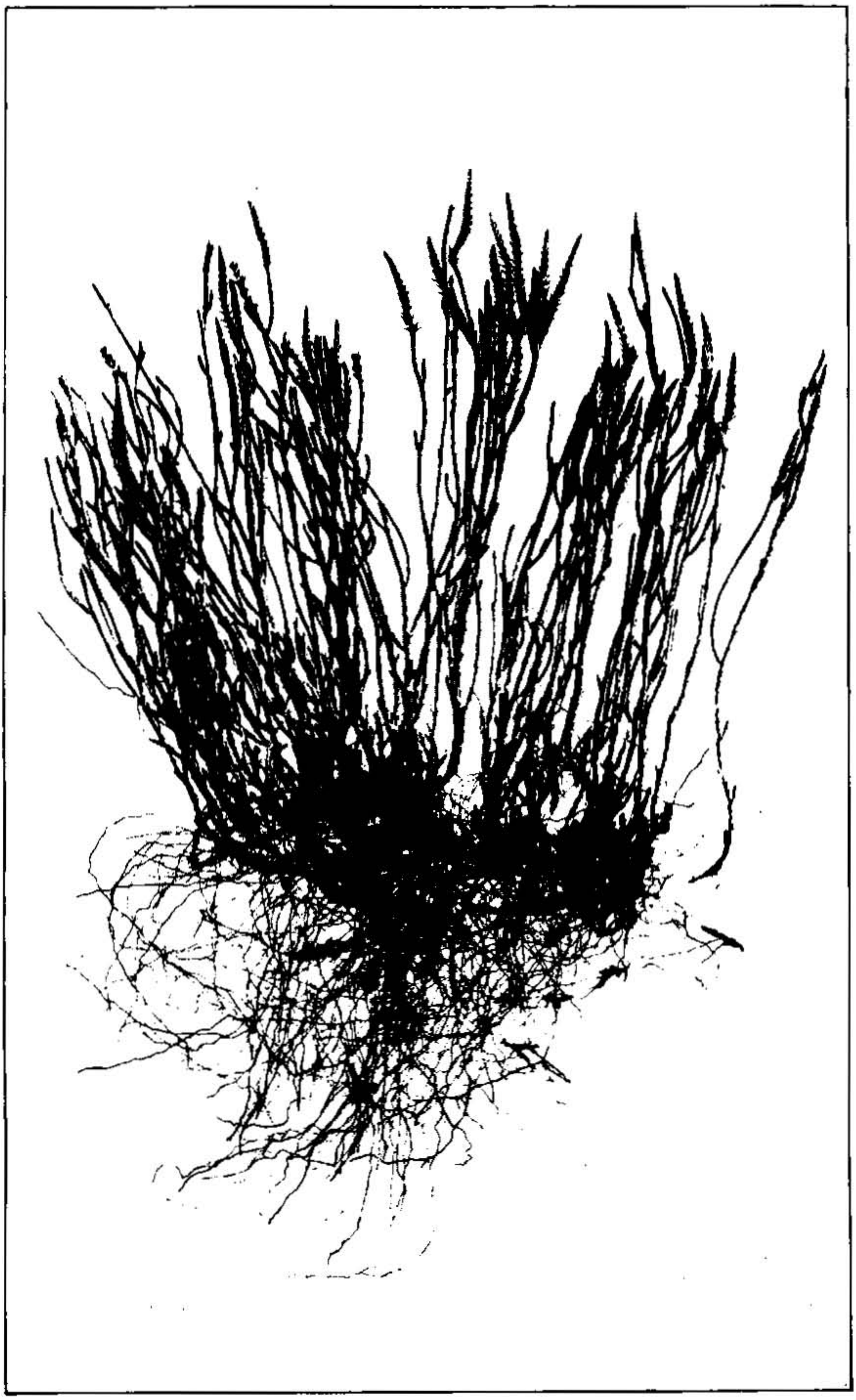


SELAGINELLA RIDDELLII VAN ESELTINE.

PLATE 16.



SELAGINELLA ARENICOLA UNDERW.



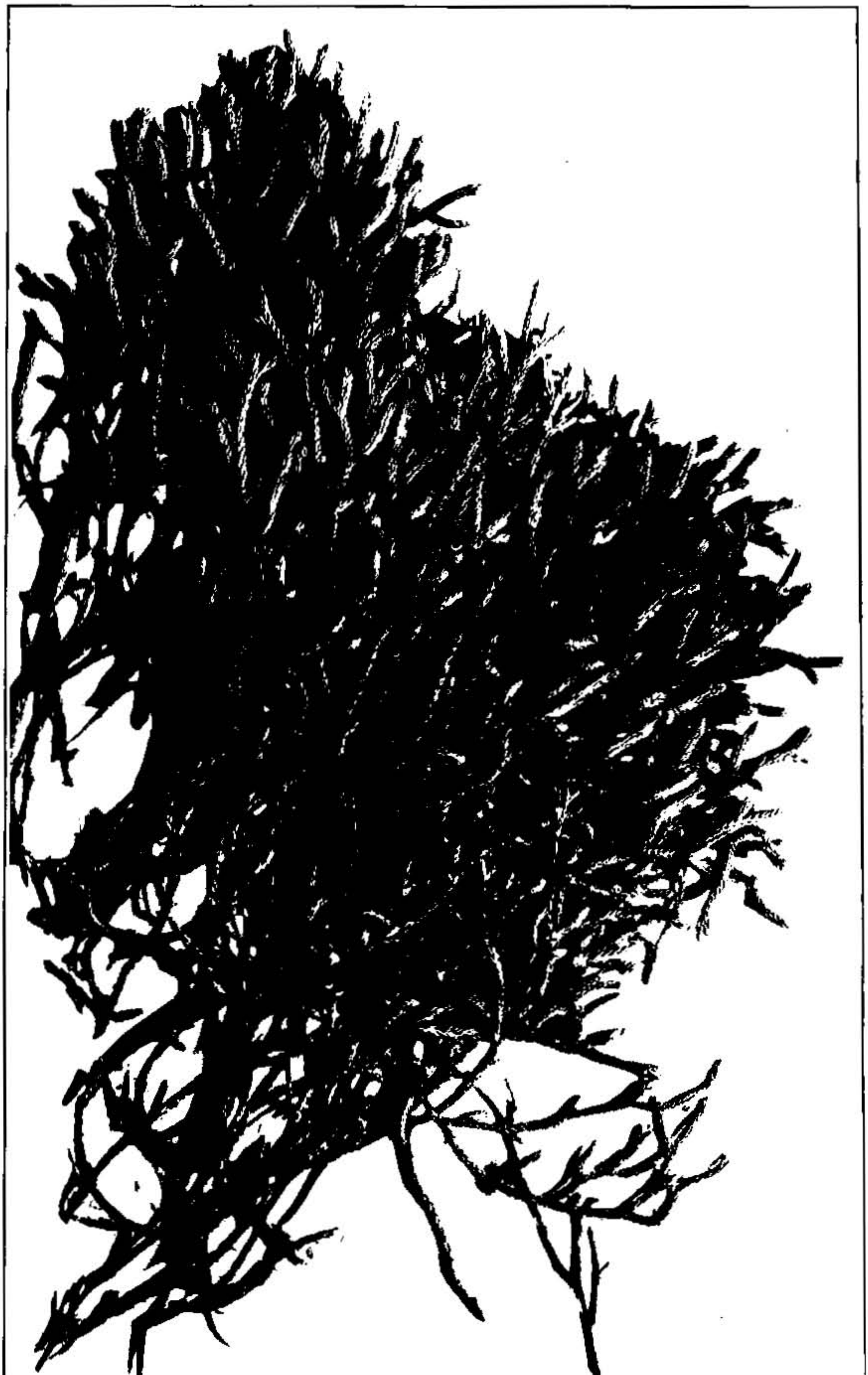
SELAGINELLA ARENICOLA UNDERW.

SELAGINELLA HUMIFUSA VAN ESELTINE.

SELAGINELLA FUNIFORMIS VAN ESELTINE.

SELAGINELLA ACANTHONOTA UNDERW.

SELAGINELLA TORTIPILA A. BR.



SELAGINELLA SHERWOODII UNDERW.