UNITED STATES DEPARTMENT OF THE INTERIOR

LOWER PENNSYLVANIAN SPECIES OF MARIOPTERIS, EREMOPTERIS DIPLOTHMEMA, AND ANEIMITES FROM THE APPALACHIAN REGION

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LOWER PENNSYLVANIAN SPECIES OF MARIOPTERIS EREMOPTERIS, DIPLOTHMEMA, AND ANEIMITES FROM THE APPALACHIAN REGION

BY

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A POSTHUMOUS WORK
ASSEMBLED AND EDITED BY

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FOREWORD

By Charles B. Read

Among the projects of David White still unfinished at the time of his death in 1935 was a very large work on the fossil plants that occur in the Pottsville formation, as he interpreted it, of the Appalachian region. He had begun preparation of a manuscript that, as he left it, included preliminary notes on many of the species and a large number of illustrations, both photographs and beautifully executed drawings. Most of the work on this manuscript was done prior to 1912, when White assumed administrative duties that kept him otherwise occupied for a long period. Though in his latest years he returned to descriptive paleobotany, he did not find time to resume work on this project.

A detailed examination of the manuscript was made to determine whether it had reached a sufficiently advanced stage of preparation to permit publication. It was found that treatment only of the species of *Mariopteris*, *Eremopteris*, *Diplothmema*, and *Aneimites* had reached such a stage. The species of *Sphenopteris* were not fully treated, nor were the large and important genera *Neuropteris* and *Alethopteris*. The work on the Lepidodendrons, the Calamites, and the Cordaites was found, after the passage of almost 30 years, to need virtually complete revision.

White's study of the plants of the Appalachian Pottsville clearly represents much time and thought on his part. It was, moreover, intended to meet a real want, one that still exists, and it is greatly to be regretted that he was unable to complete the task. Were American Carboniferous floras at all well-known, the need for such fundamental work as this would not be so great. Published knowledge of these floras is, however, still rather scant. It is true that numerous papers have appeared that bear on paleobotanical problems, but they are, for the most part, stratigraphic rather than taxonomic, and the meaning of the numerous species listed in these various papers is left to speculation.

The present paper is largely an atlas. The descriptions are short and, in the main, little more than diagnoses. Some generic names used in the original draft have been changed to accord with opinions indicated by White in another unpublished manuscript of relatively recent date. The descriptions and the entire concept of each species as expressed by the illustrations are, however, those of White.

As regards specific nomenclature, a number of new names are introduced in this work. Some forms are assigned to species named originally in Europe. These forms are figured and described, and their ranges in this country are given. By far the greater number of species, however, are considered to be distinctively American. It may be true that the Carboniferous floras of this continent are largely a duplication of those so well known in Europe. Old work implied this, and some very recent investigations have tended to confirm it; nevertheless, until American materials have been compared with European type specimens, the best course to follow appears to be that which White has adopted. Though many American species are related to species of Europe, much evidence supports the opinion that, owing perhaps to the great distance separating the two regions, the species are distinct. Whatever may be the reason, the fact remains that there do appear to be more differences between the floras of the two continents than some writers have supposed. It seems best, therefore, to regard the species in the two regions as mainly different, though a few very well known species are considered identical. If at some later time investigators can show that some or all of the American species are identical with European species previously described, it will be early enough then to place them in synonymy. Evidence of this identity must be obtained by comparing authentic specimens, preferably types. Far more important at the present time than such intercontinental correlations are the continued description of American species and the consideration not of correlations between the continents but of correlations within this continent. Actually, many of the details of stratigraphic correlation in the coal measures of America, even within the Appalachian trough, still remain unsolved.

Though this paper is taxonomic, it is a contribution to the ground work for close stratigraphic work in the Pennsylvanian. It must be remembered that the paleobotanists who have worked in the upper Paleozoic of this country in the past have based conclusions chiefly on their knowledge of unpublished material. Adequately figured species are absolutely essential to any modern stratigraphic work based on fossils. The figures here are, the writer feels, ample in most cases. At any rate, this is a step in the direction of order in the chaos of the eastern upper Carboniferous.

LOWER PENNSYLVANIAN SPECIES OF MARIOPTERIS, EREMOPTERIS, DIPLOTHMEMA, AND ANEIMITES FROM THE APPALACHIAN REGION

By DAVID WHITE

ABSTRACT

This report describes 13 species and varieties of *Mariopteris*, 10 of *Eremopteris*, 21 of *Diplothmema*, and 9 of *Aneimites* from rocks of Pennsylvanian age in the Appalachian region.

DESCRIPTIONS OF THE FOSSIL PLANTS

Genus MARIOPTERIS Zeiller

1878. *Mariopteris* Zeiller, Explication carte géol. France, vol. 4 (atlas), (text, 1879), p. 68.

1880. *Pseudopecopteris* Lesquereux (not Grand'Eury) (part), Pennsylvania 2d Geol. Survey Rept. P, vol. 1, p. 190. (Type *Alethopteris mazoniana* Lesquereux.)

As indicated in the synonymy, this genus includes a portion of the group placed by Lesquereux under *Pseudopecopteris*, a name preoccupied by Grand'Eury in 1877.

As founded by Zeiller, the genus *Mariopteris* is distinguished by naked petioles which bifurcate, the two divisions being again more or less unequally bifurcated near their bases before emitting pinnae or pinnules. The frond is, therefore, quadripartite, each of the two primary divisions being symmetrical. The four divisions, though balanced, the one side of the frond with the other, may be pinnate, bipinnate, or tripinnate, the outer portion with reference to the bifurcation being generally smaller than the other. The pinnules are pecopteroid, sometimes attached by their whole width, sometimes constricted at the base, but always decurrent and sometimes confluent. The nervation is sphenopteroid. *Pseudopecopteris mazoniana* Lesquereux, although the mode of division of its frond is unknown, appears, by the aspect of its pinna and pinnules, particularly the heteromorphous basal pinnule, to be definitely referable to Zeiller's genus, its closest affiliation being with the *M. muricata-nervosa* group.

The differentiation of the species of *Mariopteris* is in many cases difficult on account of the variation in the size and form of the pinnules in different portions of the quadripartite frond and in the youngest as compared with the oldest fronds of the plant. The systematic classification of the species is rendered more difficult in some cases by intergradation of species. If, however, the material in the hands of the paleontologist is arranged with reference to localities, and especially as to horizons or stages, it will generally be found that the different forms are confined to and may even be characteristic of those stages. Further, in some cases, these forms will then be seen to constitute distinct species which are confined to certain horizons or areas. Such is frequently found to be the case, particularly when the material under examination is confined to a single basin with its presumed unity of environmental conditions. A large representation from a given locality and horizon is thus often found consistently to represent a single species without intermingling of other forms. On the other hand, the rank of the distinction recognized may be only varietal or subspecific. In this way forms now treated collectively by many authors may differentiate themselves into valid species or subspecies, with great value to the stratigrapher and without any impairment of the evolutionary aspects. With due consideration of both regional (basinal) and stratigraphic variations, these species or subspecies are all the clearer under such treatment, and they lose no weight or interest if there is found to be slight overlapping of species, as is frequently the case in this and other genera, living as well as fossil.

The species first figured and that generally taken as typical of the genus was that illustrated in 1804 and 1820 by Schlotheim as *Filicites muricata*.[1] In fact, as now treated by some authors, *Mariopteris muricata* ranges from beds of Vanuxian and earliest Pottsville age to the middle Stephanian, and this procedure robs the group of phylogenetic clarity while depriving the stratigrapher of important aid. It thus becomes a collective species comparable in its present status to *Asterocalamites radiatus* or *Lepidodendron veltheimianum*. The paleobotanist who holds this collective view of Schlotheim's *muricata* should, to be consistent, include under that name several American species differentiated by Lesquereux or myself, although each presents characters of form of pinna or pinnules and of nervation not yet described or figured from Europe.

[1] Schlotheim, E. F., Flora der Vorwelt, pp. 54, 55, pl. 12, figs. 21, 23, 1804; idem, Die Petrefactenkunde, pp. 409, 410, 1820.

The departure of these forms from the typical *muricata* is not greater than other forms erroneously, as I regard the case, grouped therewith. Accordingly, an effort has been made to maintain the specific or varietal differentiation, according to the rank of the distinctions, of those forms which differ from European species as originally described by their authors and which are characteristic of different horizons or regions. No two of them may on any good grounds be regarded as variations in different parts of the frond or in different fronds of the same plant or species.

Mariopteris pottsvillea David White

Plate 8; plate 9, figures 1–5; plate 10, figures 1–5

1900. *Mariopteris pottsvillea*, David White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, pp. 874–876, pl. 190, figs. 3–6.

Fronds polypinnate, robust, not very dense; penultimate pinnae alternate, distant, lanceolate or linear-lanceolate, slightly contracted at the base; rachis flexuose, lineate coarsely and irregularly; ultimate pinnae alternate or subopposite, open at a right angle or slightly oblique, distant, lanceolate, or linear-lanceolate.

Pinnules alternate or subalternate, distant, oblique, broadly ovate or ovate-pyriform, asymmetrical, obtuse or obtusely rounded, ventrally arched, distinctly constricted at the broad base which is marked by an inferior rounded sinus, the uppermost pinules becoming confluent, more oblique, and rounded, blending into the rather long terminal which has its margin rolled, making it appear acute; lamina thin; nervation strong, distinct, primary nerve originating low at an acute angle, arching outward, not rigid, forking repeatedly pinnately at a moderately wide angle; nervils distant, forking one to three times and arching in passing to the margin.

Mariopteris pottsvillea var. dilatata David White, n. var.

Plate 11, figures 2–6

1888. *Pseudopecopteris* (*Sphenopteris*) *macilenta* (Lindley and Hutton) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 85.

1888. *Pseudopecopteris* (*Sphenopteris*) *muricata* (Brongniart) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 85.

1888. *Pseudopecopteris* (*Sphenopteris*) *schillingsii* (Andrä) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 85.

Fronds large, lax, with flexuose, lineate rachis; ultimate pinnae rather close, somewhat lax in habit; pinnules very large, close, usually imbricating, lax, often nearly flat, usually somewhat inflated, ovate to round-ovate, rounded at the apex, rather broadly attached, the terminals being often short, obtuse, sublobate, and connate with the two preceding pinnules; lamina slightly leathery, usually dull and smooth on the upper surface, and often but slightly convex ventrally at the border. Nervation rarely depressed and usually indistinct on the ventral surface, the nerves arching, not very close and but slightly in relief dorsally.

Mariopteris pottsvillea var. ovalis David White, n. var.

Plate 11, figures 1, 7, 8; plate 12, figure 3

Rachis sparsely and indistinctly corrugated transversely; pinnae large, somewhat lax. Pinnules relatively rather large, close, oblique, broadly attached, decurrent and long-ovate or oval-ovate when large, though short and broad when small, the apices being more or less narrowed and obtusely rounded; lamina somewhat leathery, slightly inflated at the margins and often slightly revolute near the apices, so as sometimes to give the pinnules a pointed aspect. Primary nerve strongly decurrent, arching and depressed ventrally, rather thin, forking at a moderately wide angle at the border.

Mariopteris paddocki David White, n. sp.

Plate 14, figures 1–6

Frond quadripinnate, the primary divisions large, a little lax, with a slightly flexuous, paucicostate, obscurely lineate rachis; secondary pinnae alternate, open at a right angle below, oblique above, close, overlapping or sometimes distant, often curved, lanceolate, or linea-lanceolate, tapering to a slender, acute apex with rather slender, finely striate, ventrally canaliculate, dorsally rounded, slightly flexuous, and narrowly alate rachis; penultimate pinnae alternate, open at a right angle or somewhat oblique, usually a little distant, sometimes touching, 1.2 centimeters to 4.5 centimeters long, 4 millimeters to 20 millimeters wide, very narrowly triangular, becoming narrowly oblong-triangular, or somewhat linear and straight or slightly flexuous, the lower pinnae, especially, in the lower portion of the frond being provided with small, alternate, open, narrowly triangular, slightly obtuse pinnae of the fourth order, 10 millimeters to 12 millimeters long, and 5 millimeters to 8 millimeters wide; proximal penultimate pinnae at the bases of the secondary pinnae very hetermorphous.

Pinnules numerous, small, distant, oblique, the upper ones cuneate, obovate, erect, nearly decurrent and poorly attached, the lower ones broader, becoming ovate and bifid or trifid lobate, or quinquilobate, and elongate with small, cuneate unequal, short, generally broad, and not deeply parted, oblique or nearly erect lobes, and constricted to a narrow subpedicellate, cuneate, attachment with a narrow decurrent wing, the distal margins of all the pinnules being obtusely rounded or even truncate-rounded, the plane of truncation being parallel to the rachis; lowest pinnule heteromorphous; lamina a little thick, inflated, especially near the margins, and ventrally depressed along the mid-rib and principal nerves.

Nervation generally distinct, a little coarse, and ventrally depressed; primary nerve and secondary nerve originating at a slightly open angle, the nerves forking once or twice while curving slightly in passing, a little distant, to the margin.

Mariopteris paddocki var. colliciaris David White, n. var.

Plate 12, figures 1, 2; plate 13, figures 1–9

Primary (?) pinnae somewhat unequal bilaterally, tripinnate, or quadripinnatifid in the lower portion, lanceolate, with heteromorphous secondary pinnae at the base and tapering upward to a slender, acute or acuminate apex; the rachis being not very broad, strongly depressed, ventrally shallowly canaliculate, lineate or irregularly and sparsely ribbed, dorsally rounded, lineate and narrowly alate; secondary pinnae subopposite to alternate, open at a wide angle, a little distant above, contiguous or slightly overlapping below, lanceolate to linear-lanceolate, 8 millimeters to 20 centimeters or more in length, 4 millimeters to 5 centimeters in width, straight or slightly flexuose, often a little lax near the tip, the lateral borders nearly parallel below, and converging slowly above the acute apex, the lowest pair being unequally bifurcate, dilated, and heteromorphous; rachides of the penultimate and ultimate pinnae slender, sometimes slightly flexuose, depressed, shallowly canaliculate above, rounded beneath, very minutely punctate and distinctly alate by the decurrent lamina; ultimate or tertiary pinnae alternate or subalternate, open, usually a little distant, sometimes very distant, ovate when small, becoming narrowly lanceolate, 6 millimeters to 25 millimeters long, 3 millimeters to 9 millimeters wide, obtusely pointed or obtuse, the lowest pair somewhat heteromorphously dilated, the proximal being often unequally bifurcated just above the base.

Pinnules rather small, alternate, subalternate, or subopposite, more or less oblique, usually distant, sometimes close, short, broadly obovate, cuneate or ovate and cuneately contracted, very broadly subpedicellate, attached by their whole width with nearly parallel lateral margins when small and usually as broadly obliquely rounded at the apex, or round-truncate parallel to the rachis, being unequally sub-bilobate, or eventually cut by very shallow decurrent sinuses into two or ultimately into three usually very oblique, unequal, broad, truncate-rounded subcuneate, short, decurrent lobes, the external being much shorter and often narrower than the median, the lowest inferior pinnule, especially at the base of the penultimate pinna, dilate in heteromorphy; uppermost two or three pinnules oblique and shorter, becoming confluent with the narrow, sinuate-marginal, ill-defined apical pinnule of the pinna; lamina thick, finely rugose-striate as if pubescent or minutely villous, slightly concave along the rachis of the smaller pinnae, and along the base of the primary nerve in the pinules, broadly decurrent along the rachis of the ultimate and small penultimate pinnae, ventrally convex, especially near the border, along which it is sharply depressed to form a very distinct, regular and smooth depressed canal about 0.2 millimeter in width.

Nervation generally obscure, especially on the ventral surface; primary nerve originating at an open angle very low on the rachis, and forking at a very open angle, the lateral nerves curving outward near the base of the pinnule or in the lowest lobe, and forking once or twice to furnish four to seven thin or vanishing, rather distant nervils in each of the broader lobes.

Mariopteris lobata David White, n. sp.

Plate 14, figure 7; plate 15, figures 1, 2

Primary pinnae very large, acute, with traces of transverse corrugation in the rachis; ultimate pinnae somewhat lax in aspect, open nearly at a right angle or oblique, close, sometimes a little distant, sometimes overlapping, lanceolate, slightly acute, or narrowly obtuse, with flexuose, ventrally round-sulcate, narrowly alate rachis. Pinnules near the apex of the pinna broadly ovate, simple, oblique, broadly attached, decurrent and but slightly constricted on the primal side of the base; the uppermost pinnules ovate, cuneate, and confluent; larger pinnules especially near the base of the pinna becoming round-trilobate, elongated, and pinnatifid in about five or six lobes, the lowest lobe being round-rhomboidal, the next ovate, the upper ones connate, with the shallowly sublobate terminal which is ovate and relatively very much larger than the lower lobes; lowest proximal pinnules on the basal heteromorphous pinnae developed as pinnae; lamina not very thick, ventrally inflated, particularly in the apical lobes and near the borders, slightly convex ventrally between the nervils, and faintly granulose-striate under the lens. Nervation distinct, ventrally depressed a little, originating low, forking at a wide angle and arching strongly upward at each subdivision, the nervils curving gently outward, nearly parallel, and distant.

Mariopteris eremopteroides David White

Plate 16, figures 1, 2; plate 17, figures 1–9

1900. *Mariopteris eremopteroides* David White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, pp. 776, 872, pl. 189, figs. 1–3.

Frond tripinnate, quadripinnate in part, very large, rather dense, with large, lineate rachis sometimes attaining a diameter of 25 millimeters; primary pinnae large, oblique or open, close, parallel, usually touching or nearly touching, sometimes overlapping nearly one-third their width, linear, or linear-lanceolate, tapering to an acute apex, with rather slender, ventrally concave, dorsally terete, very finely lineate, slightly flexuose-geniculate rachis; secondary pinnae alternate, open

nearly if not quite at a right angle to the rachis, close, usually touching, or slightly overlapping at their bases, but sometimes, especially in the upper part of the secondary pinna, a little distant, lanceolate or linear-lanceolate, acute, hardly contracted at the base, sometimes slightly flexuose-subgeniculate, the lower inferior pinna somewhat polymorphous; tertiary pinnae alternate, or subopposite, usually oblique but often nearly at a right angle to the rachis, close, generally touching or slightly overlapping, the smaller and basal ones a little distant from the secondary rachis, triangular-ovate, strongly inequilateral, sometimes broadly deltoid, compact, and but little constricted at the bases, those higher in the secondary pinnae being broadly lanceolate, somewhat acute, generally slightly subfalcate, the apices usually inclined upward, the rachis round-sulcate ventrally, terete dorsally, minutely lineate, and bordered by a narrow wing decurring from the limb of the pinnules.

Pinnules alternate, very oblique or nearly erect in the younger pinnae, or near the apex of the larger pinnae, close, generally ovate-triangular, narrowly ovate to ovate or rhomboidal, very rarely obovate, obtuse or obtusely rounded, the upper ones connate for a little distance, the terminal ovate or ovate-triangular, obtuse, obscurely sublobate, the lower ones attached by very broad, oblique, decurrent bases, only the lowest lobed pinnules becoming pinnatifid, being narrowly constricted at the bases; all the pinnules showing at an early stage a marked tendency to division into two to five obtusely rounded, oblique lobes, which appearing at first as one or two rounded teeth a little above the middle are gradually cut one-half way to the rachis, sometimes, especially in the somewhat heteromorphous basal pinnules, appearing slightly obovate as the pinnule becomes pinnatifid in its development into a pinna, though generally the ovate or ovate-rhomboidal form, with confluent or hardly constricted bases, is preserved to an advanced stage; lamina of the pinnules a little thick, slightly depressed over the primary nerve in the pinnatifid pinnules, faintly rugose, especially on the dorsal minutely striated surface, sometimes rolled backward at the margins so as to make the pinnules or lobes appear more acute and narrower than they really are.

Nervation coarse, distant, distinct, and very slightly depressed on the ventral surface, very clear and in relief on the dorsal side of the pinnule; primary nerve originating at a narrow angle nearly opposite the proximal basal sinus of the pinnule, forking at an open angle near its point of origin and curving strongly outward in the base of the pinnule, forking pinnately and a little widely to supply a secondary nerve for each lobe, the secondary nerves forking one to three, usually two, times at a moderate angle in passing, rather distant, in a gentle slight curve to the distal border.

Mariopteris inflata David White, n. sp.

Plate 18, figure 4; plate 19, figures 1–4

Penultimate pinnae open or oblique, usually close, linear-lanceolate, with deeply depressed, ventrally round-sulcate, striate, and rather strong rachis; ultimate pinnae close or a little distant, open at, or nearly at, a right angle, rather small, oblong to lanceolate, with dorsally round, narrowly alate rachis. Pinnules small, close, oblique; smaller pinnules and basal lobes broadly ovate-rhomboidal, somewhat truncate-rounded, parallel to the rachis, broadly cuneately attached, the lowest lobes broadly reniform-rhomboidal, the higher decurrent, with very oblique distal sinuses, usually round-sinused on the proximal side, and distally more or less apiculate, or rounded at the very obliquely directed distal apex; larger pinnules becoming obliquely and very narrowly ovate-deltoid, more or less apiculate or narrowly rounded at the apex, briefly subpedicellately attached by the very broadly cuneate asymmetrical base, the attachment being narrowed in those pinnules attaining the pinnatifid stage; terminal pinnules or lobes broadly ovate, unsymmetrical and cuneate with the highest lateral pinnules; lamina thick, leathery, slightly inflated near the border, particularly toward the apices, and sometimes backward rolled, especially in the terminal lobes, decurrent along the rachis, minutely rugo-striate, and sparsely provided in the neighborhood of the median nerve with short bristle-like hairs. Nervation mostly obscure on the later, thick lamina, primary nerve decurrent, slightly flexuose, not deeply depressed ventrally, diminishing in passing upward and persistent to near the apex only in the largest pinnules; lateral nerves rather slender, originating at a moderate angle and forking two or three times at a rather wide angle, each distal division arching rather strongly from the bifurcation, the nervils being distant and oblique.

Mariopteris inflata var. sewaneensis David White, n. var.

Plate 14, figure 8; plate 18, figures 1–3

Pinnules often larger than in the normal type and generally more distant, oblique, and lax, the lateral pinnules less constricted and less distinctly cordate, and sessile at the base, the terminals proportionately shorter and more asymmetrical, the lobes being often distant and slightly irregular in form, more distant and more oblique on approaching the border, and the lamina often distinctly sparsely hirsute near the median nerve, and sometimes slightly depressed ventrally over the nervils.

Mariopteris cheilanthoides David White, n. sp.

Plate 19, figures 5, 6

1888. *Sphenopteris polyphylla?* (Lindley and Hutton) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 85.

1888. *Pseudopecopteris latifolia* (Brongniart) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 85.

1888. *Sphenopteris (Diplothmema) dicksonioides* (Göppert) Schultze. Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 84.

1888. *Pseudopecopteris trifoliata* (Brongniart) Lesquereux, U. S. Nat. Mus. Proc., vol. 11, p. 84.

Frond very open; penultimate pinnae lanceolate to long-lanceolate, narrow, acute, and very distant along a ventrally sulcate, lineate, somewhat flexuose rachis; ultimate pinnae small, alternate, very distant, open nearly at a right angle, oblong-ovate, tapering in the upper part, more or less obtuse.

Pinnules small, a little distant, ovate to asymmetrically ovate-deltoid, obtusely rounded or sometimes very obliquely apiculate, broadly and somewhat cuneately attached along the lower portion of the base, the border being sometimes slightly sinuate, decurrent along the ventrally round, sulcate rachis; lamina rather thick, somewhat inflated especially near the borders, nervation generally distinct and depressed, the nerves forking at a very wide angle and extremely distant in proportion to the size of the pinnule.

Mariopteris phillipsi David White, n. sp.

Plate 20, figures 1–3; plate 22, figure 1

Frond large, quadripinnate or polypinnate, spreading, though not very dense; rachis strong, slightly rigid, very finely lineate, marked in the larger portions by small, short, rather distant, not very distinct, transverse, incision-like indentations, ventrally strongly canaliculate, dorsally round and bordered by a narrow wing zone in the penultimate and ultimate pinnae; secondary pinnae alternate, open, the lower ones at a right angle, lanceolate, acute; penultimate pinnae alternate, at a right angle to the rachis below, slightly oblique above, close or touching, occasionally overlapping a little, often somewhat curved, lanceolate or linear-lanceolate, tapering to an acute apex, very slightly contracted at the base; ultimate pinnae alternate, open, the lower ones at a right angle to the rachis or even reflexed, the upper ones not very oblique, usually distant one-half the width of the pinna, rarely touching, sometimes curving slightly upward, lanceolate or linear-lanceolate, acute.

Pinnules alternate, open or at an angle of about 45° with the rachis, rather distant, seldom touching, quite small and irregular in outline, ovate or triangular, obtusely acute, obtuse or rounded, the terminal ones ovate-triangular, obtuse, the lowest round-ovate or round-obovate, sometimes truncate rounded, becoming uneven and passing into the pinnatifid form with one or two lobes, usually at the base of the pinnule, the lowest inferior pinnule being markedly heteromorphous; lamina not very thick, rather strongly arched ventrally, minutely rugose, somewhat creased over the primary nerve in the lower half of the average pinnule.

Nervation rather fine, plainly visible on the ventral surface of the lamina, quite distinct on the dorsal surface; primary nerve rather strong near the base, clearly flexuose-geniculate in accordance with the position, at rather wide angles of divergence, of the secondary nerves, which, very few in number, usually fork once or twice at a very wide angle, both nervils arching outward above the point of union, in passing, very distant and obliquely to the margin.

Mariopteris tennesseeana David White

Plate 20, figure 4; plate 21, figures 3, 4; plate 22, figure 2

1900. *Mariopteris tennesseeana* David White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, p. 878.

Frond large, quadripinnate, somewhat lax; rachis faintly subgeniculate, rather narrow, marked by a few irregular ribs and by irregular short transverse corrugations; penultimate pinnae alternate, open at a right angle, rather distant, seldom touching or overlapping, lanceolate or linear-lanceolate, acute, very slightly contracted at the base, not rigid, ultimate pinnae alternate or subalternate, open, at or nearly at a right angle near the base of the pinnae, and only slightly oblique above, lanceolate or linear lanceolate.

Pinnules alternate, close, ovate or ovate-triangular, strongly inclined upward, obtuse or rounded at the apex, slightly arched near the margins, the fully developed ones cut nearly to the decurrent base, those in the middle and upper portions of the pinnae more broadly confluent and blending as lobes of the round, denticulate, apical portion of the pinnae.

Nervation usually indistinct; primary nerves of moderate strength, originating extremely low at the base of the pinnule, passing nearly parallel to the rachis, then curving outward and giving off the not very strong nerves which fork once or twice in passing nearly straight to the margin.

Mariopteris pygmaea David White

Plate 21, figures 1, 2; plate 22, figure 3

1900. *Mariopteris pygmaea* David White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, pp. 780, 876, pl. 192, figs. 2–6.

Frond small, compact; rachis relatively strong, lineate, deeply depressed, ventrally canaliculate; penultimate pinnae alternate, nearly at a right angle to the rachis, close, touching or overlapping, lanceolate, or linear-lanceolate, acute or acuminate; ultimate pinnae alternate, very compact, very open, usually touching or slightly overlapping, lanceolate or oblong-lanceolate, acute or sometimes obtusely acute, somewhat rigid.

Pinnules very small, 1.25 millimeters to 8 millimeters long, 1 millimeter to 6 millimeters wide, alternate, usually contiguous or slightly overlapping, crowded, very highly inflated, generally ovate, the lowest reniform-ovate, slightly distally apiculate, dilated near the base, conspicuously constricted at the inferior side of the rather broad attachment, those of the middle portions dilated-ovate or ovate-triangular, apiculate or obtuse, the terminal usually short and obtuse or apiculate or, at the end of the penultimate pinnae, slightly sinuate-margined, acute or mucronate; lamina thick, very much inflated or arched and smooth ventrally, the margins curving strongly backward, decurring in a narrow wing along the rachis.

Nervation rather coarse, the nervils concealed on the ventral surface, but somewhat distinct on the strongly concave, dorsal surface of the pinnules; primary nerve strong, originating at a narrow angle and sharply marked in the largest pinnules by a vanishing furrow on the ventral surface of the lamina; nervils originating at a rather narrow angle, those in the lower part of the pinnule arching near the primary nerve and passing straight or curved, relatively close together, the lower ones forking once or rarely twice, the upper nervils often simple.

Genus EREMOPTERIS Schimper

1869. *Eremopteris* Schimper, W. P., Traité de paléontologie végétale, vol. 1, p. 416.

Eremopteris neffii David White, n. sp.

Plate 23, figures 1–5

Penultimate pinnae linear, acute, with rather narrow, rigid, lineate rachis; ultimate pinnae alternate, open at an angle of about 45° or more, close, about 12 millimeters or more distant, sometimes touching, or slightly overlapping in the lower portion of the frond, slender, linear-lanceolate, tapering gradually upward, narrow at the base, and narrowly obtuse at the apex; pinnules or lobes alternate, very oblique, nearly erect, relatively small, linear, slightly cuneate or extremely narrowly cuneate-spatulate, obtuse, distant, becoming shorter, narrower, and coalescent in approaching the sublobate or narrowly and very sparingly dentate, broad, large, somewhat elongated termina; lamina ventrally convex, rather thick, decurrent, and rugose-striate between and parallel to the nerves; nervation rather fine, sometimes observed on the ventral surface, but distinct and in relief on the dorsal surface; nerves derived from a slender, decurrent primary nerve, forking two or three times at a narrow angle while passing, regular, nearly parallel, and about 0.4 millimeter distant towards the apex of the lobe.

Eremopteris strigosa David White, n. sp.

Plate 23, figures 6, 7

Penultimate pinnae alternate, oblique, close, lanceolate or linear-lanceolate, acute, with depressed, ventrally sulcate, dorsally strongly rounded, slightly flexuose rachis; ultimate pinnae alternate, subpedicellate, oblique, oblong-lanceolate, rather narrow, sometimes ovate, acute; pinnules deeply and decurrently laminate; pinnules or laciniae very distant, separate to near the axis, oblique, decurrent, linear or oblong-cuneate, slightly spatulate, obtuse or round-obtuse, the lowest shallowly bifid or trifid, and slightly outward-curved, the largest lobes and pinnules sometimes briefly and unequally bidentate; lamina ventrally convex, rugose-striate, decurring along the axis in a narrow wing; nervation rather obscure on the ventral surface; primary nerve decurrent, flexuose, the lateral nerves forking at a rather wide angle, one or two nervils entering each lobe or tooth.

Eremopteris crenulata Lesquereux

Plate 23, figures 8–10

1879. *Eremopteris crenulata* Lesquereux, Pennsylvania 2d Geol. Survey Rept. P., text, vol. 1, pp. 292, 293, 1880; atlas, pl. 53, figs. 1, 2.

Secondary, robust pinnae alternate and open nearly at a right angle along a relatively broadly bordered, dorsally round, ventrally canalicuate, slightly flexuose, rachis; pinnules very large, close or distant, a little broadly attached, the lower palmately cut in two or three very broad divisions which are sometimes again cut once or twice in narrow cuneate or cuneate-obovate, more or less divaricate divisions, the upper pinnules being less deeply cut, more elongated, oblique, and closely lobate and sublobate, the teeth of the very narrow terminal lobes of the lowest pinnules of the lower pinnae, or at the apex of the pinna, being sometimes produced as broad claws which may be more or less distinctly recurved at the apices; lobes unequally denticulate, even crenulate or crenulo-denticulate when very broad, the teeth being fewer and generally longer in the higher pinnules, those of the terminal being often prolonged to form the claws; lamina rather thin, hardly convex ventrally, distinctly decurrent along the rachis, and becoming a border to the nerve in the claw; nervation moderately coarse, distinct, slightly in dorsal relief, very distant, the primary decurrent bundle forking low at a wide angle and again two or three times before passing far in the lobes, in which a nervil is provided for each denticle or claw.

Eremopteris lincolniana David White

Plate 24, figures 1–8

1900. *Eremopteris lincolniana* David White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, p. 869, pl. 192, figs. 1, 1a.

Fronds tripinnate with broad sinuous axis consisting of a central densely fibrous interior bordered by broad expansions of more delicate, probably cortical tissue; primary pinnae distant, very open, slightly lax, penultimate pinnae alternate, open, the lowermost at nearly a right angle or slightly reflexed, the upper somewhat oblique, usually rather distant, slightly rigid, though often curved, lanceolate to linear-lanceolate, the rachis being slightly flexuose, round-canaliculate ventrally, and distinctly margined; ultimate pinnae or compound pinnules alternate, very open below, rather oblique above, usually hardly touching, generally triangular, the lowest very broadly triangular, approaching a palmate form, the uppermost often rather narrow, very deeply dissected into compound lobes or subdivided pinnules, slightly decurrent from the narrow attachment; subdivisions or compound lobes separated almost to the rachis, hardly touching, effecting a slightly trifoliate arrangement, ventrally convex, usually rather broadly cuneate, or obovate-cuneate, laterally more or less distinctly convex, obtuse, or obliquely denticulo-truncate at the apex, or cut, often obscurely, in two or three unequal, short, obtuse teeth, the apical lobes becoming, especially near the apices of the lower pinnae, greatly elongated or produced as long, rigid, narrow, subspinose, and often hooked claws; lamina not very thick, dull, convex ventrally between the nerves, and strongly so at the margins, and faintly striate under a strong lens; nervation distinct, very distant, smooth, depressed in the lower portions of the pinnules; primary nerve rather coarse, distinctly derived somewhat obliquely from the depressed axis of the rachis, forking at a very open angle in the base of each lobe or division, the subdivisions curving upward and passing with slight geniculation, while diminishing; nervils of each compound lobe or division forking pinnately at a wide angle, usually in the lower part of the division, to supply a nerve for each ultimate lobe or tooth.

Eremopteris lincolniana var. antiqua David White, n. var.

Plate 25, figures 8–10

Ultimately pinnae short, compact, the short, obtuse, or round-obtuse lobes closer and less deeply pointed than in the normal form, the claws, on the terminal lobes very much less elongated; lamina dense, indistinctly striate, and but faintly, when at all, depressed on the nerves; nervation coarse though often obscured by the thick lamina.

Eremopteris subelegans David White, n. sp.

Plate 24, figures 9–11

Ultimate pinnae alternate, oblique, close, narrowly triangular to lanceolate-triangular, and linear-lanceolate, acute; pinnules oblique, alternate, broadly attached, elongated, narrow, close, cut according to position in the pinnae into several erect, oblong, rather broad, laterally slightly convex, obtuse, or obtusely bidentate or tridentate lobes; rachis shallowly sulcate on the ventral surface, round dorsally and finely striate, like the nearly flat lamina of the pinnules and narrow decurring border; lobes erect, oblong-cuneate to linear-cuneate, in general not deeply dissected, the uppermost entire or slightly bidentate or tridentate, and obtuse, the lower separate almost to the base and shallowly notched near the apex in two or three rounded, short, unequal teeth, which are more deeply separated in the lower pinnules; lamina rugose, clothed with small, rather rigid, acuminate scales, or marked by minute punctations when the scales are fallen in the process of maceration; nervation coarse, somewhat rigid and distant, though sometimes partly masked by the thick, densely lineate or scaley epidermis; primary nerve slightly flexuose, forking pinnately at a not very wide angle below the base of each division of the pinnule, the branches dividing to furnish one or two nerves, one of which enters each tooth or ultimate lobe.

Eremopteris gracilis David White, n. sp.

Plate 25, figures 6, 7; plate 26, figures 1–10

Pinnae linear, slender, usually at an angle of 45° or less, with the narrow, often slightly flexuose, very narrowly alate rachis; pinnules more or less ovate, narrowing distinctly cuneately to the base, more or less distinctly and unequally trilobate, the outer lobes oblique, obtusely subdentate, smaller, and shorter, the terminal lobe somewhat capitate, more or less obscurely sublobate, the lower proximal lobe often considerably smaller and somewhat recurvate; lamina not thick, somewhat inflated ventrally, faintly striate; nervation distinct, forking at a rather wide angle, the nervils passing nearly parallel into the lobes.

Eremopteris dissecta Lesquereux

Plate 25, figures 1–3

1879. *Eremopteris dissecta* Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, text, vol. 1, pp. 292, 293, 1880; atlas, pl. 53, fig. 4.

Pinnae dense, overlapping, obliquely placed on a slender, deeply round-canaliculate, very narrowly bordered rachis; ultimate pinnae large, oblique, parallel, deeply dissected, generally very obliquely trilobate in narrowly cuneate or very narrowly spatulate divisions, the better developed lobes being unequally bidentate

or tridentate at the apex, or, in the most advanced or laciniate stage, becoming sublobate, in which case the lobules are denticulate; lamina somewhat rugose, convex at the borders, slightly inflated between the nerves; nervation coarse, distinct, slightly depressed ventrally, and forking two to four times, widely in the lower part of the pinnule and narrowly in the bases of the lobes, the nervils passing nearly parallel to supply a strand to each denticle.

Eremopteris artemisiaefolia (Sternberg) Schimper

Plate 25, figures 4, 5

1826. *Sphenopteris artemisiaefolia* Sternberg, Essai flore monde primaeval, vol. 1, fasc. 4, p. 15, pl. 56, fig. 1; vol. 2, fasc. 5, 6, pl. 58, (1883).

1828. *Sphenopteris artemisiaefolia* Brongniart, Prodrome d'une histoire des végétaux fossiles, p. 50.

1829. *Sphenopteris artemisiaefolia* Brongniart, Histoire des végétaux fossiles, vol. 1, p. 176, pl. 46; pl. 47, figs. 1, 2.

1869. *Eremopteris artemisiaefolia* Schimper, Traité de paléontologie végétale, vol. 1, p. 416, pl. 30, fig. 5.

Primary pinnae open below the bifurcation of the main rachis in the lower part of the frond, oblique above, alternate to subopposite or nearly opposite, lanceolate to linear-lanceolate, slightly contracted and cuneate at the base, often curved slightly outward, acute, and decurrent on the very broad, strong, finely lineate, ventrally shallowly furrowed, and thickly alate rachis; ultimate pinna and pinnules alternate to opposite, distant, oblique, outward-curved, very deeply, distantly and very obliquely dissected, bilobately or trilobately, into narrow, rather long, slightly outward-curved, often convex, simple or shallowly bidentate or tridentate, very decurrent lobes; lamina rather thick, and very minutely striato-rugose; nervation usually distinct, very slender, originating very low in the decurrent base of the pinnule, and gradually curving outward while forking two or three times at a very narrow angle, to furnish two or three nearly parallel, erect nervils in each lobe.

Eremopteris trappensis David White, n. sp.

Plate 27, figures 1–9

Penultimate pinnae very lax, flexuose, lanceolate or linear-lanceolate, with very slender, flexuose or slightly flexuose-geniculate, ventrally round-caniculate, dorsally rounded, narrowly, but distinctly alate rachis; ultimate pinnae open or oblique, alternate, rather distant, more or less distinctly ovate, very broadly cuneate or even palmate at the base, deeply pinnately dissected into cuneately laciniate pinnules or lobes; lobes or pinnules a little distant, slightly outward curved or divergent, broadly cuneate, usually, but not always, slightly convex laterally, more or less deeply bilobate or trilobate, the lower ones of the upper part of the primary pinna being very broad, broadly and obliquely round-truncate at the somewhat irregularly and obtusely dentate or denticulo-crenulate apex; upper pinnules more narrowly lobed, the lobes narrower, obtusely and unequally bidentate or tridentate, the lower pinnules of the pinnae in the lower part of the primary pinnae being often narrowly lobed and palmately divaricate, the teeth being deeply cut and slender at the apex of the pinna; lamina not very thick, slightly convex ventrally, minutely striate in a direction parallel to the nerves; nervation coarse, distinct, slightly depressed ventrally, in relief on the dorsal surface; primary nerve decurrent, forking at a wide angle and flexuose in the base of the pinnule, the lateral nerves for each division of the pinnule, forking at a wide angle two or three times, the nervils being distant and nearly parallel, and two ultimate divisions entering each of the narrow teeth or crenulations.

Genus DIPLOTHMEMA Stur[2]

To *Diplothmema* are referred fernlike species from the Pennsylvanian that are characterized by petiolate, bipartite fronds naked below the point of division, each division (primary) being provided with enlarged, basally dilated or even somewhat heterophyllous, lower external subdivisions (secondary pinnae) which may be reflexed and enlarged so as to suggest a second bipartition; and by broadly cuneate or rounded-lobate, or rounded pinnules and lobes which may be entire, dentate, or even slightly laciniate, the nervation being arched. It includes the nonquadripartite group of species with more or less rounded or pecopteroid pinnules originally placed by Stur in the genus *Diplothmema*, with the exception of those plants given special and more definite generic classification on the bases of their discovered fructifications.

Diplothmema as first proposed by Stur was formed to include not only fronds in which the naked rachis is divided into two major, bilaterally symmetrical and more or less nearly equal divisions, but also fronds in which each of these divisions is again forked without intervening ultimate pinnae into two very widely divaricate divisions with apparently equally strong rachides, the inner division of each half of the frond being larger and more elongate than the outer divisions. Without naming a type species, Stur built up the genus about (1) a group of bipartite, more or less nearly dissected and laciniately-lobed sphenopteroid forms including *Diplothmema schutzei* Stur, *Sphenopteris dissectum* Goeppert, *S. elegans* Brongniart, *S. furcatum* Brongniart, *S. patentissima* (Ettingshausen), *S. spinosus* Göppert, and *S. hildrethi* Lesquereux. This consistent, compact, and well-defined unit is typical of the genus according to modern rules of botanical nomenclature, and, in case of division of the genus,

[2] Stur, D., Die Culm-Flora—Beiträge zur Kenntniss der Flora der Vorwelt, Band 1, Teil 2: K.-k. geol. Reichsanstalt Abh., Band 8, Nr. 2, p. 130 (236), 1877.

the generic name should be retained for one of its species. From this narrow-lobed sphenopteroid group Stur widened the genus to include among others (2) the broad-lobed pecopteroid and more or less rounded-pinnuled sphenopteroids with somewhat distinctly quadripartite fronds including *Sphenopteris obtusiloba* Brongniart, *S. irregularis* Sternberg, *S. schillingsii* Andrä, *S. nummularoides* Gutenberg, *Pecopteris pluckenetii* (Schlotheim) Brongniart, and (3) a group of distinctly quadripartite fronds including *Sphenopteris acuta* Brongniart, *S. muricata* (Schlotheim), and *Pecopteris nervosa* Brongniart. It embraced a large portion of the very early established genus *Sphenopteris*, together with species of other early form genera, and was regarded by Stur as an absolutely natural genus, although from the modern point of view it is obviously too comprehensive.

In 1879 the group of species (3d as enumerated above) with quadripartite fronds and triangular or broadly rounded or pecopteroid pinnules, including *Diplothmema latifolia*, *D. acuta*, *D. muricata*, and *D. nervosa*, was removed from Stur's genus by Zeiller [3] to compose a new genus *Mariopteris*.

In 1886 Zeiller segregated another rounded-pinnuled species in which the two primary divisions of the frond are hardly or only very indistinctly bilobate as a distinct genus, for which he retained Stur's name *Diplothmema*.[4] The mode of division of the frond is shown in plate 18, figure 3, of the Valenciennes flora. At the same time he figured as *Diplothemema zeilleri* Stur a species which, as shown on plate 16 of his Valenciennes flora, has both a laciniate spenopteroid pinnule and the mode of division of the frond nearly typical of the sphenopteroid or typical division of the genus as established by Stur. As *Diplothmema* has subsequently been employed the name is restricted in application to the species with broad, generally rounded or oblong, deltoid pinnules and in which the two divisions of each primary bipartite symmetrical division are generally so unequal and so unsymmetrical that the external basal divisions may be regarded as more or less divaricately placed or even reflexed and especially developed basal pinnae of the primary division.

Still later, in 1893, species that are typical of Stur's original genus and that constitute the nucleus about which he organized *Diplothmema* and for which that name should have been retained by Zeiller were removed by Potonié,[5] who applied to this group of species the new name *Palmatopteris*, *P. furcata* being stressed as representative of the new genus. It is, however, to be borne in mind that even as late in 1893 little regard was given by most European paleobotanists to the matter of type species of genera and their retention where possible under the original generic designation.

Very recently Paul Corsin [6] while monographing the *Mariopteris* of the Carboniferous of the Sarre and Lorraine reached the conclusion that no fundamental difference in the architecture of the frond separates *Mariopteris* from *Diplothmema* as the latter was restricted by Zeiller. He points out that one intergrades with the other; that very often the fronds are quadripartite in both genera; and that more frequently one finds primary pinna in *Mariopteris* in which the outer division may be considered as lateral pinnae springing on the outside from the base of each internal and more highly developed pinna (which he views as having the rank of a secondary pinna), the external divisions having the status only of tertiary pinnae. According to these views, based on an ample series of specimens, the primary pinnae of *Mariopteris* should be considered as bipartite—a conclusion with which, genetically speaking, I agree. Accordingly, Corsin places the round-pinnuled or pecopteroid-pinnuled species with less distinctly quadripartite fronds, included by Zeiller under the name *Diplothmema* as restricted by him, in the second of his four groups of species under *Mariopteris*. The first of the four groups includes, among other species, *Mariopteris muricata* (Schlotheim) and *M. nervosa* (Brongniart). The second contains *M. latifolia* Zeiller, *M. plumosa* (Kidston), and *M. sphenopteroides* Zeiller, while *M. acuta* (Brongniart) Zeiller is numbered among the species of the fourth group.

The transfer to *Mariopteris* of the species included by Zeiller under *Diplothmema* appears to leave no species conforming to Stur's original definition of *Diplothmema* under that name, a procedure contrary to the rules of botanical taxonomic nomenclature.

Meanwhile the genus *Pseudopecopteris* was proposed by Lesquereux [7] in 1879 to include mainly species placed by Zeiller in *Mariopteris* and the restricted *Diplothmema*, the type species being *Alethopteris mazoniana*, a species of *Mariopteris* close to the *muricata-nervosa* group. Under *Pseudopecopteris* were also included *P. obtusiloba*, *P. trifoliolata*, and *P. irregularis*, which originally were included by Stur in *Diplothmema*.

[3] Zeiller, René, Végétaux fossiles du terrain houiller: Explication carte géol. France, vol. 4, p. 68, 1879.

[4] Zeiller, René, Flore fossile du bassin houiller de Valenciennes: Études gîtes minéraux France, atlas, 1886, pl. 18, figs. 3–6; texte, p. 159, 1888.

[5] Potonié, H., Ueber einige Carbonfarne, Theil 3: K. preuss. geol. Landesanstalt u. Bergakademie Jahrb., Band 12, p. 1, 1893.

[6] Corsin, Paul, Marioptéridées: Bassin houiller de la Sarre et de la Lorraine, I, Flore fossile, 3d fasc., Études gîtes minéraux France, pp. 116–118, 1932.

[7] Lesquereux, Leo, Description of the coal flora of the Carboniferous formation in Pennsylvania and throughout the United States: Pennsylvania 2d Geol. Survey Rept. P, vol. 3, atlas, 1879; text, vol. 1, p. 190, 1880.

In this work the tendency at first was to retain Lesquereux's generic term, restricting it, however, to cover the distinctly round-pinnuled group including *obtusiloba*, *trifoliolata*, *irregularis*, *squamosa* (or *neuropteroides*), and several others of the more or less distinctly round-pinnuled species placed by Lesquereux under *Eremopteris*, but whose fronds are probably bipartite with naked rachises below the subdivisions. In the latter case, *Diplothmema cheathami*, with broadly cuneate and sublobate, more or less dentate pinnules, was regarded as near the border line of the genus. However, the retention of the genus *Pseudopecopteris* Lesquereux is, as has elsewhere been pointed out, precluded according to the rules of botanical nomenclature, since the same name was used in 1877 by Grand'Eury, who without special discussion or generic diagnosis applied the name to *Pecopteris defrancei* Brongniart, *P. obliqua* Brongniart, and *Neuropteris bohemica* Ettingshausen. It is to be regretted that the name *Pseudopecopteris* is not tenable.

Under the circumstances, in order to avoid introducing a new generic name for the round-pinnuled or pecopteroid-pinnuled group in which the frond is bipartite but not distinctly quadripartite, effort for a time was made to make use of the term *Cheilanthites*[8] proposed by Göppert in 1836 for a group of sphenopterids. Though it is not necessary that the significance of the generic name conform to the present classification of the genus (e. g. *Calamites*, *Cannophyllites*, etc.), the revival of Göppert's name for this group of species is not permissible, since this group cannot be construed as including the type of the original genus *Cheilanthites* or as having been so regarded by Göppert. Yet, so to apply Göppert's name would doubtless cause less confusion than to replace *Palmatopteris* by *Diplothmema* and *Diplothmema* of Zeiller by *Pseudopecopteris* or *Mariopteris*.

Between several procedures which may be followed without strict conformity to any modern nomenclatural code, it would seem that least confusion (with moderate clarity and some degree of justice to the authors) may be assured by retaining the name *Diplothmema* to include not only the round-pinnuled species placed therein by Zeiller, but also other round-pinnuled species with bipartitely divided, but not distinctly quadripartite fronds, not clearly referable to the genus *Mariopteris* as originally founded. There is no valid generic distinction between *Sphenopteris obtusiloba*, *Eremopteris cheathami*, *Pseudopecopteris anceps*, *P. nummularia* (as interpreted by Gutbier and Andrä), and *Diplothmema dernoncourti* Zeiller. On the other hand, the species of this group appear to be generically distinct from *Mariopteris* by their character-ensembles. Both are "form" genera. The retention of Stur's original name for this group seems desirable as well as requisite, provided the species which Stur treated as typical of his genus continue under the name *Palmatopteris*.

The forms included under *Diplothmema*, *Mariopteris*, and *Palmatopteris* were similar in their major architectural features and habit of growth. They were apparently, in general, climbers or lianas with relatively slender, flexuous, aerial trunks or axes, such as are shown in Stur's *Diplothmema schutzei*,[9] the Appalachian species *Sphenopteris hildrethi* Lesquereux, referred by Stur to *Diplothmema*, in Zeiller's figures[10] of *Mariopteris* and in Zeiller's *Diplothmema jacquoti*. These stems as here interpreted bear bifurcating fronds which in *Mariopteris* are not only merely symmetrical bilaterally, but are more or less distinctly quadripartite. The examination of Zeiller's figures of *D. jacquoti* lends support to Corsin's interpretation of the frond as bilateral, with the two divisions each having a more or less specialized and often somewhat reflexed outer basal pinna. The later features appear to be essentially characteristic of the restricted *Diplothmema*, while the more equally subdivided and broadly divaricate or quadripartite form is characteristic of the *Mariopteris* and *Diplothmema*. Intergradation in form of frond between *Mariopteris* and *Diplothmema*, as noted by Corsin, appears logical and natural if the mode of division be viewed as actually sympodial.

Diplothmema microphylla (Lesquereux) David White

Plate 30, figures 3, 5–7

1879. *Eremopteris microphylla* Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, atlas, pl. 52, figs. 6, 7; text (1880), p. 296.

Fronds large, quadripinnate with large lineate rachis, with very distinct and irregular, short transverse frets; primary pinnae robust, open, usually a little dense, with thick, often curved rachis; secondary pinnae alternate, very open, rather close, usually overlapping somewhat, ovate-lanceolate to lanceolate, acute, often curved somewhat, with moderately strong, fretted, striate, and ventrally sulcate rachis; tertiary pinnae alternate, open, often nearly at a right angle, close, usually overlapping somewhat, ovate-lanceolate or very narrowly triangular-lanceolate, very slightly contracted at the base, acute or slightly obtuse, the rachis sulcate ventrally, dorsally rounded, striate, fretted, and narrowly alate; ultimate pinnae small, usually open at or nearly at a right angle in the middle and lower part of the penultimate pinnae, generally

[8] White, David, The fossil flora of West Virginia: West Virginia Geol. Survey Repts., vol. 5a, pt. 2, p. 394, 1913.

[9] Op. cit., p. 121, pl. 13, fig. 4.

[10] Op. cit., plate 18, figs. 3–5; pls. 16, 21, 22, 23.

touching or nearly touching, sometimes a little distant, ovate to oblong-ovate, the smallest round-triangular, the longer ones acute, somewhat lax or flexuous, touching or a little distant, with slender and very narrowly sulcate, faintly subgeniculate, narrowly bordered rachis; pinnules alternate, coriaceous, densely striate parallel to the nervation, slightly convex ventrally, often somewhat distant, rarely touching when small, the highest cuneate and oblique, obovate-cuneate, obovate and broadly decurrent, outward curved, when large, and ovate to ovate-deltoid and ovate-rhomboidal, all but the lowest oblique, the uppermost entire, or faintly crenulate, the middle and lower ones broadly and divaricately trilobate to quinquilobate, the largest lobes sometimes slightly sub-bilobate and rounded, truncate and broadly crenulate decurrent, the terminal pinnules or lobes very oblique, distinctly cuneate, and relatively broad; nervation moderately strong, generally obscured by the dense and intermediate striation; primary nerve originating very low at a narrow angle, giving off a secondary nerve for each lobe, the secondary nerve forking one to three times at a quite narrow angle, the nervils usually curving slightly outward, especially in the bases of the lobes.

Diplothmema subdecipiens David White, n. sp.

Plate 11, figures 9–11

Main rachis (axis?) not very broad, slightly flexuous, rather distantly, coarsely, and regularly lineate; primary (?) pinnae alternate, open at nearly a right angle, 3 millimeters to 5 millimeters distant on the same side, usually touching or slightly overlapping, more or less flexuous, linear-lanceolate to linear, narrowed to an acute apex, and slightly constricted at the base, the rachis being slender, ventrally canaliculate, narrowly alate, and dorsally round-terete and striate; ultimate pinnae ovate to oblong-ovate, alternate, generally close, open nearly at a right angle, somewhat curvi-lax elongated in habit, and more or less obtuse, with a distinct laminar border decurrent from the pinnules. Pinnules a little distant, short, ovate below, cuneate above, broadly attached, strongly decurrent, the middle and upper ones distinctly outward-curved, the proximal lateral border usually concave, the distal lateral convex, the apices obliquely truncate-rounded or bisublobate or trisublobate in cuneate outward-curved, obliquely truncate entire subdivisions, the terminal being usually longer; lamina rather thin, very minutely granular, flat or slightly arched at the border, and decurrent along the rachis. Nervation distinct and in dorsal relief though not very coarse; primary nerve very oblique, of low origin, forking at a wide angle, the subdivisions forking two or three, or sometimes four times at a moderate angle, the nervils being more or less strongly outward-curved and counting 25 to 30 per centimeter at the border.

Diplothmema glennii David White, n. sp.

Plate 27, figures 10–17

Primary rachis slender, ventrally sulcate, dorsally round-terete, striate, narrowly alate, sometimes slightly flexuose; secondary pinnae alternate, open, often at nearly a right angle, close, usually nearly touching, a little lax, lanceolate, becoming linear-lanceolate, tapering gradually in the upper half and terminating a little abruptly in an obtuse apex; pinnules large, oblique, alternate, close, at first broadly cuneate or obovate-cuneate and slightly outward-curved, coalescent at the apex, becoming ovate and very unequally subtrilobate, and very broadly cuneately attached to the rachis, and finally becoming deeply dissected in three cuneate or obovate-cuneate, close, oblique lobes which are obliquely round-truncate, or obtusely rounded, the lateral borders nearly straight, the terminal crenulate or slightly and irregular denticulate; lamina thin, often transparent, flat or arched very little at the border; nervation not very coarse, quite distinct; primary nerve originating very low on the rachis, oblique, nearly erect, forking once in the extreme base of the pinnule, and again higher to give off several nerves at a very wide angle on the distal side, the subordinate nerves forking usually once or twice at a moderate angle to furnish rather distant and straight nervils, one of which reaches each denticle.

Diplothmema cheathami (Lesquereux) David White

Plate 28, figures 1–3, 5–10

1884. *Eremopteris cheathami* Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, vol. 3, pl. 770, pl. 104, figs. 2–4.

Fronds apparently not very large, rather dense, tripinnate or quadripinnate, branching freely at a wide angle, a little lax; rachis of moderate strength, rigid or slightly flexuose, ventrally broadly and roundly but not very deeply canaliculate, rounded dorsally, minutely rugose-striate, bordered in the smaller pinnae by an extremely narrow decurrent wing; secondary (?) pinnae alternate, lanceolate, acute, close, often nearly at a right angle to the rachis; penultimate pinnae alternate, close, touching or slightly overlapping, very open, generally nearly at a right angle to the rachis, ovate-triangular when small, becoming ovate-lanceolate, or lanceolate when large, nearly acute at the apex; ultimate pinnae alternate, ovate-triangular, narrowly deltoid or oblong-triangular, very widely open, frequently at a right angle to the rachis, close, usually slightly overlapping near their bases, short, generally one and one-half to three times as long as broad, obtuse, terminating in connivent, cuneate, generally denticulate or erose pinnules; pinnules relatively large, brevipedicellate, alternate, open below, oblique above, close, the lower lobate ones frequently overlapping, consisting either of broadly cuneate, obliquely truncate,

or round-truncate, distally denticulate simple pinnules, with a strong, not very wide, oblique basal attachment and a very narrow decurrent wing, or of two or three to five, usually three, narrowly and deeply dissected, broadly cuneate, close, unequally long lobes, the latter, like the simple pinnules, having the lateral margins usually slightly convex, though often nearly straight and not unfrequently, especially near the apex of the pinna and in the middle lobe, slightly concave, the upper, obliquely truncate, or rounded-truncate border being cut in the well-developed pinnules by irregular sinuses into three to seven short, broad, obtuse, uneven, clawlike, erect teeth, usually nearly 0.75 millimeters in length, sometimes 1.5 millimeters long, generally curved backward and buried in the matrix; lamina rather thick, slightly convex ventrally near the margins, finely, but often distinctly rugose-striate parallel to the nerves; nervation generally somewhat obscured by the rugose-striate epidermis, though rather strong, and sometimes, especially on the dorsal surface of the pinnules, quite distinct; primary nerve originating at a very narrow angle, curving and forking two to five times, mostly in the lower part of the pinnule, the lowest divisions being at a rather wide angle, each of the nearly straight, coarse and rather distant nervils passing into one of the distal teeth of the pinnule.

Diplothmema cheathami var. antiqua David White, n. var.

Plate 28, figures 4, 12

Pinnae and pinnules very small, the pinnules being often considerably distant; lobes of the general proportion of the normal type, though exhibiting a greater tendency to sublobation, those of the higher pinnae being distinctly acutely dentate, the teeth being often developed as short, unequal laciniae, much narrower than those of the normal species; nervation largely obscured by the striation of the lamina, which is narrowly decurrent along the ventrally round-canaliculate rachis.

Diplothmema cheathami var. minor David White, n. var.

Plate 28, figures 11, 13

Pinnules, in general, somewhat smaller than those of the normal form of the species and often rather narrower lobed, the lobes being generally farther removed by the elongation of the axis; terminal lobe usually less dissected; teeth small and very short.

Diplothmema spectabilis David White, n. sp.

Plate 29, figures 1–3, 5, 6

Fronds very large, tripinnate or quadripinnate, with very thick, flexuose-geniculate, coarsely lineate axis; primary pinnae alternate, open or oblique, very long, linear-lanceolate or linear, tapering gradually in the upper part to an acute apex; rachis lineate, rigid or gently curved, ventrally concave, dorsally rounded, narrowly alate, and marked in the impressions by short, not very distant, irregularly disposed, transverse, narrow, low ridges or corrugations like frets; penultimate pinnae alternate, open at a right angle or nearly so, close, sometimes nearly touching, lanceolate to linear, sometimes slightly contracted at the base, and tapering towards the slender, often narrow apex, the rachis being ventrally canaliculate, dorsally terete, alate, finely lineate and sparsely and usually obscurely transversely corrugated in the larger portions where compressed; pinnules alternate to subopposite, rather small, usually more or less distant, open, sometimes nearly at a right angle to the rachis, short-ovate or long-ovate, or ovate deltoid, deeply cut into three to five open, divergent and rather distant, broadly cuneate, slightly outward-curved, broadly attached lobes which generally become bilobate or trisublobate, each of the divisions in the lower lobes of the larger pinnules being marked by two short, rounded, unequal sublobules or teeth; lamina minutely rugose, faintly striate under the lens, slightly depressed in the lower portion on the primary nerve, and sometimes intramarginally depressed just within the apices of the teeth; nervation not very strong, dorsally slightly in relief; primary nerve very low and oblique, forking two or three times at a rather wide angle in the lower part of the pinnule, the consequent nerves forking two or three times at a narrow angle in each lobe, which usually contains four or sometimes but two nervils to each lobule or tooth.

Diplothmema pudica David White, n. sp.

Plate 29, figure 4

Ultimate pinnae small, alternate, close or touching, very open, ovate to oblong-lanceolate, with ventrally canaliculate, narrowly alate, often slightly flexuose rachis; pinnules more or less oblique, very small, close or distant, narrowly cuneate above, becoming bilobate or trilobate and broadly obovate or rhomboidal at the base of the pinnule, the lobes being not deeply dissected, slightly divergent, nearly equally wide, rounded at the apices, and but little contracted downward; lamina thick, somewhat convex ventrally and densely finely striate; nervation generally concealed by the dense striation; primary nerve strongly decurrent, forking at a moderate angle, the subdivisions forking again two or three times at a very narrow angle, the nervils being slender, nearly straight and close.

Diplothmema halberstadti David White, n. sp.

Plate 30, figures 1, 2

Ultimate pinnae open nearly at a right angle to the lineate, obscurely fretted rachis; pinnules close, touching or a little distant, open at a right angle and basally constricted ovate-deltoid below, oblique, broadly

cuneate and very broadly attached near the apex of the pinna, more or less distinctly and unequally trilobate, becoming quinquilobate, the lower proximal lobe somewhat recurved, the terminal large, and broad, becoming sublobate or sublaciniate; pinnules and lobes more or less distinctly incised along the distal borders in rather coarse, broad, rounded teeth which in the apical lobe of the largest pinnules often become parted to form very short, oblique, and slightly divergent, broad lobules or very brief lacinia; lamina a little thick, slightly rugose, somewhat convex ventrally between the nervils; nervation distinct, rather coarse, distant, in relief on the dorsal surface, the primary nerve strongly decurrent, the secondary nerves forking two or three times at a wide angle in each lobe.

Diplothmema obtusiloba (Brongniart) Stur

Plate 30, figure 4; plate 35, figures 7, 9

1829. *Sphenopteris obtusiloba* Brongniart, Histoire des végétaux fossiles, p. 204, pl. 53,, fig. 2.

1877. *Diplothmema obtusiloba* Stur, Die Culm-Flora, K.-k. geol. Reichsanstalt Abh., Band 8, Heft 2, p. 230.

Fronds very large, quadripinnate, sometimes, at least, dichotomous at the base, with very large lineate, rather coarsely fretted rachis; primary pinnae opposite-curved, equal or nearly so, to pinnately disposed and alternate, very open, close, overlapping somewhat, apparently ovate-lanceolate, and tapering gradually from near the base to the rather acute apex; secondary pinnae alternate, open usually at a right angle, close, generally overlapping somewhat, ovate- to oblong-lanceolate, tapering a little from a little above the base, and more or less distinctly acute, with ventrally sulcate, finely lineate and distinctly fretted rachis; tertiary pinnae and ultimate (quaternary) pinnae in the lower portion of the frond alternate, open at nearly a right angle, close or touching, ovate to oblong-lanceolate, acute or somewhat obtuse, with narrowly alate, sometimes slightly flexuose, dorsally rounded rachis. Pinnules alternate, open at a right angle below, oblique above, generally close, sometimes nearly touching, sometimes a little distant, the upper ones on the pinnae broadly cuneate, distally rounded, broadly detached and decurrent, the two or three terminal ones somewhat coherent, and divergent, those lower in the pinnae becoming ovate, rounded, and reniform, rather narrowly constricted at the base and more or less equally trilobate, the lowermost becoming quinquilobate with deep and gradually widening sinuses; lobes short, open, widening rapidly above the rather broad base, cuneate, rounded at the apex or, in the upper ones, somewhat round-truncate, or in the lower ones becoming ovate, terminal lobes very broadly cuneate and distally rounded; lamina thick, densely rugose-striate, ventrally convex at the border which is often distinctly smooth-guttered. Nervation indistinct, generally nearly totally obscured by the striation of the lamina; primary nerve very decurrent, forking three or four times at a narrow angle while curving gradually toward the border.

Diplothmema reniformis David White, n. sp.

Plate 31, figures 1, 2, 4, 5

Secondary pinnae alternate, open, linear-lanceolate, tapering from near the base to the slender, acute, apex, the radius finely lineate, and ventrally broadly sulcate and sparsely fretted; ultimate pinnae alternate, a little oblique, generally a little distant, oblong, usually obtuse; pinnules small, open at the base, slightly oblique above, close, often touching or overlapping a little, very broad, the uppermost rounded above with an extremely broadly cuneate, short stalk, those lower being very broadly cordate or reniform with a very broad subpedicellate attachment, the larger being reniform to cordate while becoming trilobate with crowded, broadly-round lobes, the proximal basal one first developed and small with reference to the whole pinnule; lamina very thick, densely rugose and usually distinctly though finely striate, depressed basally along the primary nerve, and strongly convex ventrally between primary nerve and border which is narrowly guttered; nervation nearly always masked by the dense rugosity of the lamina; primary nerve strong at the base, strongly decurrent in the upper pinnules, and rapidly dissolved, the nervils a little coarse, arching gently to the lateral borders, nearly straight distally and moderately close.

Diplothmema aldrichi David White, n. sp.

Plate 31, figures 3, 7; plate 34, figure 3

Primary pinnae large, dense, with robust, lineate, transversely fretted, slightly flexuose rachis plainly reduced by each of the pinnate divisions; secondary pinnae alternate, very open, oblong, or lanceolate, obtuse, close, generally overlapping; ultimate pinnae alternate, nearly at a right angle to the dorsally half-round, ventrally sulcate, lineate and distinctly fretted, strong rachis, ovate to oblong-ovate, becoming elongated, obtuse, or slightly acute, dense and close. usually slightly overlapping.

Pinnules small, alternate, close, usually affecting a more or less distinctly trifoliate form, generally touching and often slightly overlapping, open nearly to a right angle near the base of the pinna, constricted to a rather narrow sessile, usually somewhat decurrent base which descends as a very narrow rachial border, the lower ones ovate, broadly ovate, deltoid, obtuse, cut into three to seven obovate or cuneate, unevenly truncate or obliquely emarginate lobes, the higher pinnules obovate or ovate, more or less distinctly trilobate, those toward the apex becoming narrowly obovate, curving outward, or cuneate, crenulate-emarginate, or the terminal ones narrow, cuneate, emarginate-sublobate and confluent; lobes of the low-

est pinnules obliquely truncate-rounded at the apex, faintly round-sublobate, or very obscurely sublobate; lamina slightly convex ventrally, thick and densely but finely striate so as frequently to obscure the nervation.

Nervation generally obscure; primary nerve originating very obliquely from the ventrally sulcate rachis, and forking at a very narrow angle at the very base of, or low in the pinnule to supply a secondary nerve for each lobe or subdivision of the pinnule, each secondary nerve forking two or three times at a very acute angle, the nervils passing straight or but slightly curved to the margin.

Diplothmema aldrichi var. anthracitica David White, n. var.

Plate 33, figures 6, 9; plate 34, figure 2

Pinnules smaller, more compactly arranged, often imbricated, more broadly attached, more distinctly decurrent and less dissected than in the normal form.

Diplothmema minor David White, n. sp.

Plate 31, figure 6

Frond (?), penultimate pinnae small, lanceolate or linear-lanceolate, tapering to an acute apex; ultimate pinnae alternate, open nearly at a right angle below, slightly oblique above, close, nearly touching, oblong to lanceolate, slightly obtuse; rachis proportionately very strong, ventrally broadly and shallowly canaliculate, minutely striate and distinctly alate; pinnules very small, 1.5 milimeters to 4.5 millimeters in length, 1 millimeter to 2.5 millimeters in width, alternate, hardly touching, round, round-ovate, rarely slightly cordate or even reniform below, becoming ovate and bilobate or trilobate, always very broadly attached, with narrow decurrent sinus, the lowest pair on each pinna unequally bilobate or heteromorphous, those near the apex being oblique, very short, attached by nearly their whole width, the terminal being broadly rounded, asymmetrical, scarcely cuneate, and confluent with the preceding pinnule; lamina dense thick, flat or nearly so, decurring along the pinna in a wing whose border is parallel to the rachis; nervation very obscure; primary nerve decurrent, rather strong, soon vanishing in the thick lamina; nervils thick, few, but obscured in the opaque limb and not yet fully observed.

Diplothmema trifoliolata (Artis) Stur

Plate 32, figures 1–3

1825. *Filicites trifoliolata* Artis, Antediluvian phytology, pl. 11.
1828. *Sphenopteris trifoliolata* (Artis) Brongniart, Prodrome d'une histoire des végétaux fossiles, p. 59 (50).
1829. *Sphenopteris trifoliolata* Brongniart, Histoire des végétaux fossiles, vol. 1, p. 202, pl. 53, fig. 3.
1850. *Sphenopteris trifoliolata* Mantell, G. A., Pictorial atlas of fossil remains, p. 27, pl. 5, fig. 2, pl. 29.
1833. *Cheilanthites trifoliolatus* (Artus) Goeppert, Die fossilen Farnkräuter, pp. 245, 246.
1880. *Pseudopecopteris trifoliolata* (Artis) Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, vol. 1, p. 217.
1885. *Diplothmema trifoliolata* (Artis) Stur, K.-k. geol. Reichsanstalt Abh., vol. 11, No. 1, p. 346, pl. 19, figs. 1–4.
1896. *Sphenopteris trifoliolata* (Artis) Brongniart var. *laxa*, Potonié, Preuss. geol. Landesanstalt Abh., n. f. No. 21, p. 23, text fig. 12.
1897. *Sphenopteris trifoliolata* (Artus) Brongniart var. *laxa* Potonié, Lehrbuch Pflanzenpalaeontologie, p. 137, fig. 130.

Fronds large, quadripinnate, once-dichtomous near the base, the petiole and rachises lineate, and fretted in the larger divisions; primary pinnae opposite or alternate, open at or nearly at a right angle, generally large; secondary pinnae alternate, very open, close, usually touching, generally lanceolate, acute and often slightly narrowed at the base, with rather deeply ventrally sulcate and very narrowly alate rachis; tertiary pinnae alternate, usually open at nearly a right angle, close or sometimes rather distant, ovate to ovate-lanceolate, tapering from a little way above the base, slightly obtuse or subacute with rather narrow, sulcate, and sometimes slightly flexuous rachis; quaternary pinnae developing in the lower part of the frond by the elongation of the pinnae. Pinnules generally small, alternate, very open at the base of the pinnae, more oblique above, close or often distant, the extreme uppermost ovate or ovate-cuneate, the others ovate or ovate-rounded, and more or less abruptly constricted at the base which is broadly brevi-pedicellate, the lowest often broadly reniform, the largest pinnules deeply three-lobed to five-lobed, the lobes ovate or obovate, strongly contorted downward, becoming pedicellate, the median lobe being generally considerably larger and often obtusely and unequally deltoid, as frequently is also the terminal pinnule of the pinna; lamina a little thick, slightly granular-rugose, generally convex ventrally, and sometimes slightly backward rolled, especially in the terminal pinnules and lobes.

Nervation rarely distinct, especially on the ventral surface, not coarse; primary nerve strongly decurrent, forking at a wide angle, the secondary nerves forking two or three times while arching outward, the nervils being rather distant.

Diplothmema trifoliolata (Artis) Stur var. kanawensis David White, n. var.

Plate 33, figures 1–5

Fronds very large, quadripinnate or polypinnate, sometimes dichotomous at the base, with broad, finely lineate rachis, which in the smaller divisions is broadly canaliculate ventrally, and rounded and striate dorsally, often slightly flexuous and narrowly alate in the peripheral portions; primary pinnae very open, tripinnate or quadripinnate in the lower portions; sec-

ondary pinnae alternate, open nearly at a right angle, usually overlapping somewhat, linear-lanceolate, tapering gradually from a point a little way above the base to a slender point; ultimate pinnae alternate, very open, usually nearly at a right angle below, oblique above, close, usually touching or overlapping somewhat, blunt, slightly triangular-oblong, tapering from the base to the usually slightly obtuse apex, which is very rarely extended as a curved spine; pinnules relatively large, very open, alternate, close or touching to distant, brevi-pedicellate, extremely broadly ovate or obovate on becoming distinct near the apex of the pinna, and rapidly becoming reniform or very broadly rhomboidal, and more or less deeply cut with decurrent sinuses into two or three, or rarely more, broad, divergent, round lobes which are subreniform and even pedicellate as well as slightly sublobate at the base of the pinna or in development as pinnae; terminal pinnules usually larger or capitate, strongly asymmetrical, sublobate, and cuneate at the base; borders of the pinnule generally backward curved and in some cases at least slightly and irregularly erose-denticulate; lamina a little thick, very strongly convex, especially near the borders, and in the narrow wing along the rachis, often convex between the nerves, slightly lustrous and smooth except when viewed under a strong lens when it is found to be very faintly and somewhat irregularly striate.

Nervation coarse, distant, very distinct, sometimes depressed, sometimes in relief, from a single strong and narrowly decurrent primary nerve, and forking at a wide angle about three times in passing, arched near the base, to the border and usually counting 7 to 12 nervils in each larger lobe or unlobate pinnule.

Diplothmema composita David White, n. sp.

Plate 32, figures 4–7

Frond not large, very lax, probably tripinnate, the mode of basal division unknown; secondary pinnae alternate, open nearly at a right angle, distant, slender, linear or linear-lanceolate, acute, with a very slender, lax, finely lineate, very narrowly bordered rachis which is flexuous or more or less geniculate; ultimate pinnae lax, alternate, open usually at nearly a right angle, sometimes reflexed, distant, oblong or oblong ovate, 1.5 centimeters to 6 centimeters or more in length, 8 millimeters to 40 millimeters in width, obtuse, often irregular, with a very narrow decurring border along the lax, usually somewhat flexuose, slender, ventrally narrowly sulcate rachis; pinnules very large, ovate or round-ovate, rounded above, sometimes faintly apiculate, more or less obscurely and very broadly cuneately contracted at the broad decurrent base, or becoming sinuate-margined, sublobate and cut in two to five very broad, rounded, more or less cuneate, usually distant, broadly and strongly decurrent lobes, the terminal very broad and obliquely rounded; lamina not very thick, slightly inflated at the border, decurrent along the rachis in a very narrow border, depressed along the nerves, where it is finely rugose-striate, by very fine, short, appressed rows of scaly epidermal cells parallel to the nervation; nervation distinct; primary nerve originating very low in the decurrent base of the pinnule, not very strong, forking several times at a moderate angle near the base, the subordinate nerves curving outward somewhat while forking once or twice and passing with slight curvature or nearly straight and parallel through the last two-thirds of the distance to the margin, where they are about 0.5 millimeter distant from one another.

Diplothmema morrowensis David White, n. sp.

Plate 34, figure 1; plate 35, figure 1

1860. *Sphenopteris dilatata* Lesquereux (not Lindley and Hutton), Lesquereux, Arkansas 2d Geol. Survey Rept., p. 310, pls. 2, 3, 3a.

1880. *Pseudopecopteris decipiens* Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, vol. 1, p. 214 (part), pl. 52, figs. 9, 9a (not figs. 10, 10a).

1880. *Pseudopecopteris macilenta* (Lindley and Hutton) Lesquereux, Pennsylvania 2d. Geol. Survey Rept. P, vol. 1, p. 219 (part).

1884. *Pseudopecopteris macilenta* (Lindley and Hutton) Lesquereux, Pennsylvania 2d Geol. Survey Rept. P, vol. 3, p. 754, pl. 98, fig. 2.

1889. *Pseudopecopteris macilenta* Lesley, Pennsylvania 2d Geol. Survey Rept. P, vol. 2, p. 799, text fig.

1917. *Pseudopecopteris* cf. *macilenta* Lesquereux, Jackson, Indiana Acad. Sci. Proc., p. 416, pl. 2, figs. 1, 3, 4.

1917. *Pseudopecopteris* cf. *dimorpha* Lesquereux, Jackson, op. cit., p. 416, pl. 2, fig. 5?.

Frond tripinnate or quadripinnate, large; secondary pinnae alternate, oblique, close, lanceolate or linear-lanceolate, acute, with distinctly lineate rachis; penultimate pinnae compact, close, alternate, very open, or oblique, lanceolate, linear-oblong, or ovate-triangular, acute or rather obtuse with ventrally canaliculate dorsally round-carinate, alate, finely lineate rachis; ultimate pinnae at nearly a right angle to the rigid rachis below, slightly oblique above, usually close, sometimes touching, oblong-linear, or lanceolate, often curving somewhat, or ovate-deltoid and obtuse when small; pinnules close, generally touching or slightly overlapping, alternate, compact, rather thick, decurrent, with broad bases, never very large, ovate, obovate or broadly ovate-triangular, those in the middle and upper portions of the pinna affecting a more or less distinctly trifoliolate form, the cuneate obovate or obovate lobes being sinuate margined or somewhat obscurely sublobate or crenulate-sublobate in two or three divisions, the pinnules at the apex of the pinna becoming cuneate-obo-

vate, obliquely semitruncate, strongly decurrent, coherent, and obscurely sublobate; lowest inferior pinnule slightly polymorphous; lamina slightly convex near the border; rugose and dotted with small, narrowly triangular, acute scales; nervation rather coarse, often obscured in the rather fleshy lamina on the ventral side, the median nerve of the larger compound pinnules or young pinnae being slightly canaliculate ventrally, and sometimes a little flexuous; nerves derived from a single, very obliquely decurring strand low in the decurrent base of the pinnule, forking very low to supply a principal nervil for each subdivision or lobe of the pinnule, each principal nervil forking at a moderate angle from two to four times, while arching gently, and usually becoming fainter in passing obliquely to the margin where the nervils count about three to the millimeter.

Diplothmema erectiloba David White, n. sp.

Plate 33, figures 7, 8

Secondary (?) rachis strong and densely lineate; subordinate pinnae alternate, very open, oblong to linear-lanceolate, sometimes acute with carinate, ventrally sulcate rachis, bordered by the decurrent lamina and sometimes slightly flexuous; pinnules not very large, rather distant, open, broadly-ovate to narrow-ovate or rhomboidally constricted, or sometimes obscurely and rather broadly subpedicellate, cuneate to rectangular below, broadly capitate at the apex; simply cuneate or faintly sublobate at the apex of the pinnae and becoming bilobate or trilobate in the lower portions of the pinnae, the lateral lobes being not deeply parted, erect, the distal border of the lobe being obliquely and slightly rounded-truncate in a direction parallel to the axis of the pinnule; terminal lobe cuneate and capitate, extended considerably beyond the lateral lobes and sometimes twice the length of the latter, becoming broadened and more or less distinctly unequally and roundly bisublobate or trisublobate at the apex, which has the aspect of transverse truncation; lamina thick, densely striate, slightly depressed over the primary nerve in the lower part of the pinnule, slightly convex ventrally near the border and decurring in a narrow, striate border along the rachis; nervation rather fine and almost entirely concealed by the dense striation, the nervils passing not very close and nearly straight to the rounded apices of the lobes or sublobes, each of the narrower lobes of lobules usually containing six or eight nervils.

Diplothmema mendenhalli David White, n. sp.

Plate 35, figures 8, 10

Fronds apparently small, rather delicate, with very open pinnae; rachis slender, slightly flexuose, ventrally round-canaliculate, narrowly alate, with distinctly chambered (?) pith; penultimate pinnae rather lax, alternate, open at a right angle below, more oblique above, close, lanceolate or oblong-lanceolate, slightly acute, with slender axis; ultimate pinnae close or a little distant, alternate, ovate to oblong, usually very open, obtuse, pedicellate, with narrowly alate, ventrally sulcate, finely striate, often flexuose rachis; pinnules small, alternate, close or distant, open below, oblique above, distinctly pedicellate, the lower ones dissected almost to the axis in three generally narrow, divergent, cuneate, usually very slightly concave-margined, often slightly bifid, obtusely and irregularly dentate, truncate laciniae or lobes ordinarily about 3 millimeters to 3.5 millimeters in length, and averaging about 2 millimeters in width, the higher pinnules being cuneately slightly bifid, or trifid, the less distinct and more oblique divisions being similarly irregular and unequally denticulate, the uppermost pinnules being very narrowly cuneate, oblique or nearly erect, about 3 millimeters in length, less than 2 millimeters in width at the apex, which is obtusely bidentate or tridentate; lamina not thick, very faintly striate-rugose, slightly depressed along the primary nerve at the base of the pinnule, and decurring in a narrow wing along the rachis; nervation rather thin, not very distinct; primary nerve decurrent, forking at a moderate angle in the base of the pinnule to provide a secondary nerve for each lobe of the pinnule, the secondary nerves dividing to furnish a very thin nervil to each of the short, obtuse, or obtusely pointed teeth.

Diplothmema pygmaeoides, David White, n. sp.

Plate 35, figures 2–6

Radius rather strong, rigid and distinctly fretted by short, narrow, irregularly disposed, low, transverse prominences; tertiary (?) pinnae open nearly at a right angle, small, narrow, alternate, close or a little distant, tapering to the obtuse apices; pinnules very small, alternate, touching or usually overlapping a little, oblique, broadly ovate-round, becoming open, ovate, asymmetrical, rounded at the apex, unequally trilobate, and abruptly constricted at the base, the basal pinnules being often short and reniform; terminal pinnule larger than the slightly cuneate pinnules next below, broadly and asymmetrically ovate, round at the apex, and sublobate; lobes very short, more or less oblique, very broad at the truncate round apices; lamina very thick, finely rugose-striate both ventrally and dorsally, ventrally convex, especially near the border which is narrowly guttered; nervation generally marked by the striation; primary nerve very obliquely decurrent, ventrally depressed, arching outward and forking at a rather narrow angle, the nerves forking once or twice at a narrow angle while gently curving toward the margin where they are fine and rather close.

Genus ANEIMITES Dawson

1860. *Ancimites* Dawson, J. W., Canadian Naturalist, vol. 5, 1860, p. 461.

1904. *Wardia* White, David, Smithsonian Misc. Coll., vol. 47, pt. 3, pp. 322–331.

Aneimites (Wardia) tenuifolius (Göppert) David White, n. comb.

Plate 36, figures 1–7, 9, 10; Plate 38, figures 10, 14

1846. *Cyclopteris tenuifolia Göppert*, Die Gattungen der fossilen Pflanzen, Lief. 5, 6, p. 95, pls. 4, 5 (double plate), figs. 11, 12.

1875. *Adiantides tenuifolius* (Göppert) Stur, Beiträge zur Kenntniss der Flora der Vorwell, Band 1, pp. 65, 66, pl. 16, figs. 2, 3.

Fronds rather delicate, quadripinnatifid or quadripinnate (?), with slender, slightly flexuose, ventrally sulcate, rugose-striate divisions of the rachis; ultimate pinnae oblong or linear, slightly obtuse, close, alternate, very open, scarcely decurrent; pinnules alternate, a little distant, more or less open, subpetiolate, obovate, obovate-cuneate, sometimes cuneate and asymmetrically rounded above, the larger near the apex of the penultimate pinnae, being 5 to 10 millimeters in length, 2 to 7 millimeters in width, or still broader and cut to, or nearly to, the base into two or three cuneate, apically rounded lobes, the pinnules on the lower lateral pinnae becoming narrower, sometimes larger, often divided and more distinctly cuneate; lamina not thin, very faintly rugose-striate between the nerves; nervation distinct and strong, slightly depressed ventrally, in relief on the dorsal surface; nerves somewhat flabellate from the primary bundle in the subpetiolate base, straight or nearly so, rather close, and forking two or three times at a moderate angle in passing to the distal margin; fertile pinnae becoming alternate with greatly reduced and distant pinnules, the pedicels very slender, lax, ramose, costate and but little dilated at the apices; seeds (*Wardia tenuifolia*) rhomboidal, faintly striate, about 5 millimeters long, and equally broad below the middle, broadly alate near the base, the wing being narrow, very well-defined above the middle and continuous to the apex.

Aneimites (Wardia) tenuifolius var. difoliolatus David White, n. var.

Plate 36, figures 8, 11; plate 38, figures 8, 12

Rachis strong, slightly flexuose, dorsally rounded, narrowly alate, rugose, obscurely punctate; pinnules not very large, often somewhat distant, asymmetrically obovate, cuneately narrowed to the subpedicellate base, becoming divided into two or three, usually two, strongly unequal lobes, the proximal shorter, narrowly cuneate, very obliquely truncate, often somewhat recurved; the distal rounder, broader, longer, more or less distinctly rhomboidal or obliquely round-truncate, becoming unequally sublobate in passing into the trifoliolate and pinnatifid stages; lamina a little thick, obscurely rugose-striate between the nerves, sometimes slightly arched at the border, and decurring to form a very narrow, rhomboidal border in the ultimate pinnae; nervation distinct, rather coarse, dorsally in strong relief, nearly straight, forking two to three times at a moderate angle.

Aneimites (Wardia) virginianus David White, n. sp.

Plate 39, figures 1–12, 17–29

Rachis slender, coarsely striate, broadly geniculate in the lower part of the frond, slightly flexuose above, narrowly caniculate ventrally, and striate, with distant, obscure punctations; pinnules alternate to subopposite, coriaceous, not very distant, oblique, cuneate, usually narrowly cuneate, narrowly attached, 7 to 30 millimeters in length, 2 to 13 millimeters in width, the lateral margins straight or slightly concave, the apices round-truncate, or obtusely rounded, the lateral pinnules sometimes deeply divided into three lobes of equal or nearly equal breadth, the middle lobe being longest; terminal pinnule often broadly cuneate and more or less oblique as well as somewhat narrowly truncate; lamina thick, densely rugose-striate, probably by rows of scaly epidermal cells between and parallel to the nervation which is generally largely obscured thereby; nervation moderately strong, not very distinct, with but very faint development of a primary nerve, the flabellate nerve being straight, close, forking three to five times at a narrow angle and passing upward parallel to and seldom terminating in the lateral borders of the pinnule; fruit deciduous, oval, faintly rhomboidal, lineate from the base upward and finely rugose-striate intermediate and parallel to the lineation; 5 millimeters in length, 3.5 millimeters in width, narrowly rounded at the base and apex, pedicellate, and consisting of an oval or slightly obovate flattened nucleus about 4 millimeters long and 2.5 millimeters broad, surrounded by a fibrous envelope which in the flattened specimens forms a narrow border, densest near the base, slightly dilated a little below the middle, and much narrower toward the apex.

Aneimites (Wardia) fertilis David White

Plate 37, figures 1–5, 7–11; plate 39, figures 13–16

1904. *Aneimites (Wardia) fertilis* David White, Smithsonian Misc. Coll., vol. 47, pt. 3, pp. 322–331, pls. 47, 48.

Fronds quadripinnatifid, or quadripinnate (?) spreading, a little delicate, but hardly lax, and rather dense, the divisions of the rachis being slender, somewhat rigid except at the apices, very finely striate, sparsely and obscurely punctate, rounded dorsally, shallowly canaliculate ventrally, the ultimate rachis

being slightly flexuose and bordered by a very narrow wing of the decurrent lamina; penultimate pinnae alternate or subalternate, open at or nearly at a right angle, close, usually touching or overlapping somewhat, linear or linear-lanceolate, acute or acuminate, and provided with larger pinnatifid and fasciculately lobed pinnules above the ultimate pinnae, the uppermost being sublobate or simple and narrowly cuneate; ultimate pinnae alternate, subalternate, or subopposite, close, more or less open, usually rigid, overlapping a portion of their width, ovate to lanceolate or linear-lanceolate obtuse or acute when sterile, attenuated and curviramose above when fertile; pinnules alternate to subopposite, of greatly varying size, 3 to 18 millimeters in length, the lobes or divisions being 1 to 3.5 millimeters in width, narrowly cuneate, occasionally narrowly spatulate, the lateral margins slightly convex above, often slightly concave near the narrow or slightly subpedicellate base, the upper pinnules of the sterile pinnae being very narrow and simple, becoming bifid, and bifoliately or trifoliately dissected to or nearly to the base in three to five palmate or somewhat fasciculately radiating lobes or fully developed pinnules on an elongating axis, the apices being rounded, truncate-rounded, more or less oblique, sometimes emarginate, the distal basal pinnule or lobe being usually noticeably broader than the other lobes or pinnules in the fascicle while the proximal basal pinnule is often reduced in size, and more narrowly lobed; laminae very thin, decurring in an extremely narrow wing along the rachis, and minutely rugose-striate when viewed under a strong lens; nervation very thin, but usually distinct and very slightly in dorsal relief; primary nerve strongly decurrent, forking once or twice at a wide angle in the base of the pinnule, the nervil forking once or twice at narrower or moderate angles in passing upward, threadlike, often appearing double, nearly parallel and not very close to the apex of the pinnule in which they often appear to slightly converge.

Fertile portions of the frond peripheral, laxly ramose at the apex and somewhat reduced as to lamina, the pinnules in the upper portion of the pinnae becoming very small and distant, the lobes sometimes slightly thickened; fructification (*Wardia*) small, oval, thin, deciduous, borne sometimes singly, but mostly in sparsely paniculate arrangement at the dilated apices of thick, sparsely lineate, distantly, elongately, and faintly punctate, ramose pedicels which correspond to the greatly elongated and thickened lobes of the reduced pinnules, the somewhat irregularly curved and often bifurcated pedicels constituting the uppermost divisions of the rachis; seeds oval, rhombic, bilaterally symmetrical, the longitudinal axis averaging 4.5 millimeters, the transverse being 2.5 millimeters, rounded at the angles, slightly flatly obtuse at the apex and a little concave at the point of attachment, from which ascends on either side a narrow, striate, rather thick wing formed by a lateral dilation of the outer fibrous envelope, about 0.3 millimeter wide at the base, gradually attaining a maximum width of 0.75 millimeter a little below the lateral angle, and narrowing rapidly but regularly to the point of disappearance near or at the apex of the fruit; outer surface of the seed rugose by fine longitudinal, irregular lines, or striae, which either converge near the apex or blend with the margin of the compressed specimens, which also rarely have the appearance of being traversed by numerous, very obscure, irregular ribs, forking and converging parallel to the striation, which is longitudinally continuous, often passing from the lateral wing to the surface of the inner nutlet; nutlet less distinctly rhomboidal, the lateral angle being less pronounced; polleniferous organs not definitely correlated.

Aneimites pottsvillensis David White

Plate 37, figures 6, 15–18

1900. *Aneimites pottsvillensis* White, U. S. Geol. Survey 20th Ann. Rept., pt. 2, p. 868, pl. 190, figs. 1, 2.

Fronds lax, bipinnate or tripinnate (?); pinnae slender, slightly flexuose or subgeniculate, loose, slightly irregular, with very slender, sulcate, lineate, narrowly bordered rachis; pinnules somewhat coriaceous, alternate, distant, open near the base, oblique above, coriaceous, polymorphous, usually asymmetrically ovate or rhomboidal-ovate, rarely obovate, obtuse, 7 to 18 millimeters long, 3 to 11 millimeters wide, the lower ones neuropteroid in outline, the terminal pinnules cuneate-obovate, generally broad and truncate-rounded, the lowermost sometimes dissected to the base to form young pinnae of three pinnules, of which the middle one is similar to the ordinary terminal ones, the lateral being rhomboidal, all the pinnules being constricted to a very narrow point of attachment, with straight, distal margins, and finely striate lamina between the nerves; nervation a little coarse, radiating flabellately from a single basal fascicle, and forking three to five times while passing straight to the border, and counting about 25 to the centimeter along the distal margin.

Aneimites pottsvillensis var. intermedius David White, n. var.

Plate 37, figures 12–14, 19

Robust, with relatively thick, distinctly bordered, slightly flexuose, lineate, secondary (?) rachis; pinnule large, less rhomboidal, slightly convex near the border, the terminal lobes more elongated and broad; lamina thicker, rugose-striated between the nerves; nervation distinct, coarser in relief dorsally, sometimes obscured by the striation ventrally, a little more distant than in the normal type.

Aneimites polymorphus David White, n. sp.

Plate 38, figures 7, 11, 16–18

Frond very lax; secondary pinnae open nearly at a right angle to the axis, often reflexed, distant, with slender, flexuose, ventrally narrowly canaliculate and minutely striate rachis; pinnules large, polymorphous, alternate, distant, more or less oblique, 7 to 25 millimeters long, 6 to 13 millimeters wide, ordinarily triangular-obovate or rhomboidal and narrowed below when full-grown, obovate or ovate, oblique and broadly attached when small, sometimes becoming sublobate, bilobate, or trilobate, and more cuneate-obovate and pedicellate and even elongated in neuropteroid forms, the distal and lateral margins somewhat sinuate, the lamina rather coriaceous, rugose-striate, and slightly arched near the margin; nervation rather coarse, distinct, slightly depressed ventrally, dorsally somewhat in relief, more or less flabellate from the point of attachment, with a slight development of a midrib in the largest pinnules, the nerves passing nearly straight, or with but slight curvature while forking three or four times to the margin where they average about two to the millimeter.

Aneimites (Wardia) cardiopteroides David White, n. sp.

Plate 38, figures 1–4, 19

Ultimate pinnae a little lax, with ventrally sulcate, very narrowly bordered, finely striate rachises; pinnules cyclopteroid, close, usually overlapping a little, open, ovate or ovate-deltoid, broadly rounded at the apex, squarrose to cordate at the base and narrowly subpedicellate, becoming very broadly trilobate, the distal borders of the lateral lobes being nearly at right angles to the rachis, the smallest pinnules just below the apex being obliquely reniform, and extremely broad cuneate at the broad and decurrent base; lamina very thick, inflated near the borders, minutely rugose, coarsely striate parallel to the nerves; nervation often obscured by the striation, rather coarse, oblique, with a slight development of a median nerve in the large pinnules, the nerves forking two and sometimes three times while curving, strongly in the lower part of the pinnule, to the border which is often met nearly at a right angle.

Seed ovate-oval, 5 millimeters long, 3.5 millimeters broad a little above the base, rounded at the apex, proportionately very broad at the base, very finely striate, faintly and distantly lineate, the wing narrow, broadest (nearly 0.6 millimeter) near the base, and narrowing gradually upward to near the apex, which it surrounds.

Aneimites (Wardia) pseudopecopteroides David White, n. sp.

Plate 38, figures 5, 6, 9, 13, 15

Fronds quadripinnatifid or possibly quadripinnate, large, rather dense; rachis of the larger segments broad, irregularly low-ribbed and obscurely lineate, ventrally round, canaliculate along the middle of the larger divisions and through the greater part of the width in the ultimate divisions which are striate; secondary pinnae close, alternate, and open, often to nearly a right angle, the ultimate pinnae alternate, close, more or less open, oblong or linear-lanceolate, slightly obtuse, the lower pinnules becoming trifoliately pinnatifid; pinnules alternate, not very distant, oblique or ovate-deltoid to ovate-triangular, very broadly cuneate at their bases, obtuse, inequilateral, often slightly apiculate, rather broadly attached, 5 to 12 millimeters long, 2 to 8 millimeters wide, the upper ones cuneate, becoming ovate and concave along the distal oblique margins, the lower ones more or less distinctly bilobate, trilobate, or sublobate, the lateral very oblique and very obtuse lobes being less than or but little more than one-half the length of the central, elongated ovate portion of the pinnule, the lobe on the proximal side being shorter and broader than that on the distal side; lamina a little thick, often ventrally arched and minutely striate between the nervils; nervation usually distinct, though sometimes partially obscured on the ventral surface by the thick substance of the pinnule, strong and in relief dorsally, partially flabellate, partially derived from a more or less distinctly developed decurrent median nerve in the lower portion of the pinnules; nerves a little coarse, forking two or three times at a narrow angle, the nervils in the lateral portion of the pinnule gently arching, those in the central portion straight or nearly so, and rather close.

PLATES 8–39

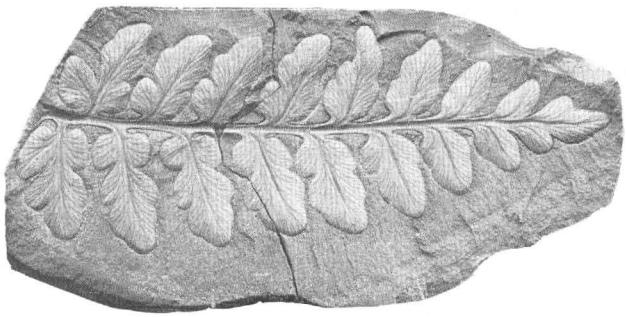
PLATE 8

Page

Mariopteris pottsvillea David White 86

A specimen that bears pinnules perhaps slightly larger than those typical of the species, but typical in form and in laxity of the frond make-up. Roof of the Castle Rock coal, Lookout formation, near Cole City, Dade County, Ga. U. S. Nat. Mus. 13657.

SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.



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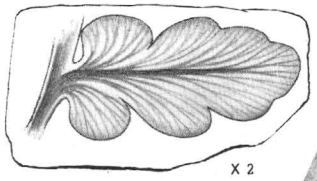

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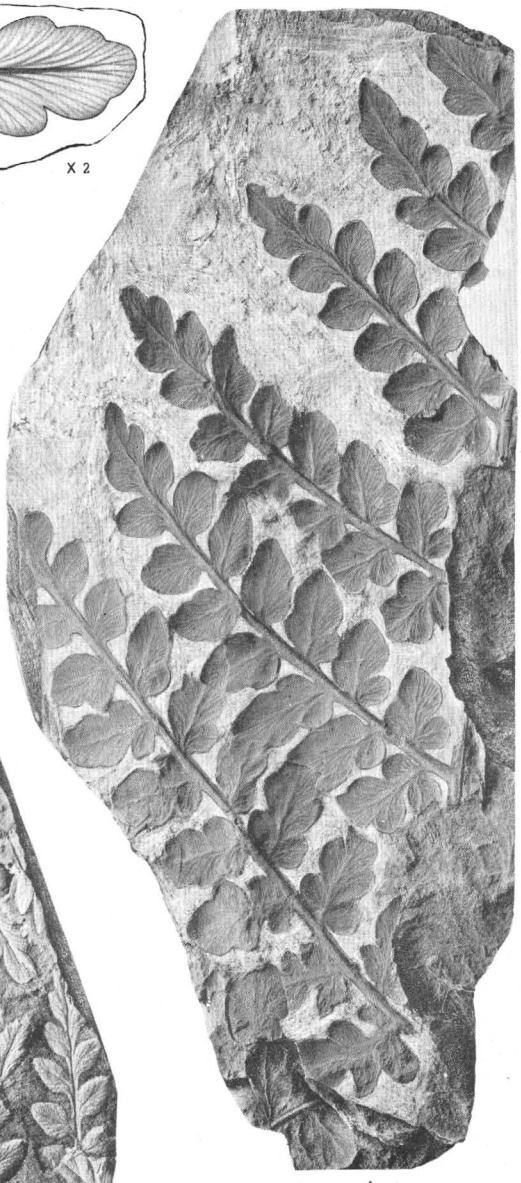

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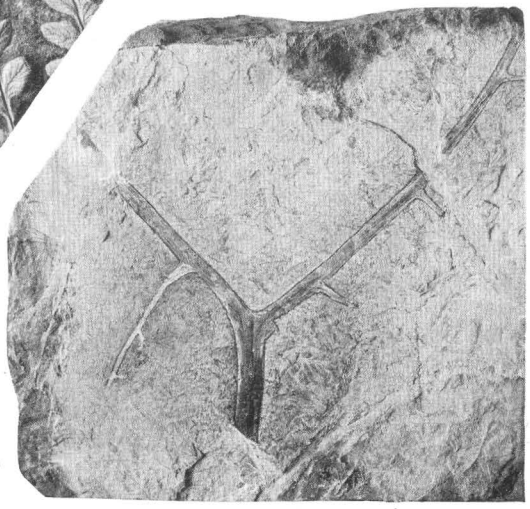

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

PLATE 9

Page

FIGURES 1–5. *Mariopteris pottsvillea* David White 86

1–4, Lookout formation, Cole City, Dade County, Ga.; 5, Precise horizon unknown, probably from Black Creek coal group, Warrior Creek, Ala.

1. A pinna bearing the somewhat broad, thin type of pinnule characteristic of parts of the frond. U. S. Nat. Mus. 13717.
2. Single pinnule of the specimen shown in figure 1, enlarged to show venation.
3. The more compact, smaller pinnuled type. U. S. Nat. Mus. 13658.
4. Upper part of a frond showing the generally large pinnules. Compare this with the specimen in figure 3 from a lower point on the frond. U. S. Nat. Mus. 13752.
5. Part of a rachis showing dichotomy. U. S. Nat. Mus. 2206.

PLATE 10

Lookout formation, Dade County, Ga.; 1, 5, from Cole City.

1. A small secondary pinna showing pinnule form. U. S. Nat. Mus. 13656.
2. Pinnule form in the larger pinnae. U. S. Nat. Mus. 13712.
3. Part of the rachis with attached pinnae, showing the variation in form between the distal and proximal types of pinnules on the frond. U. S. Nat. Mus. 13711.
4. Sketch of a pinna shown in plate 10, figure 3. U. S. Nat. Mus. 13711.
5. Sketch of a pinna shown in plate 9, figure 4.

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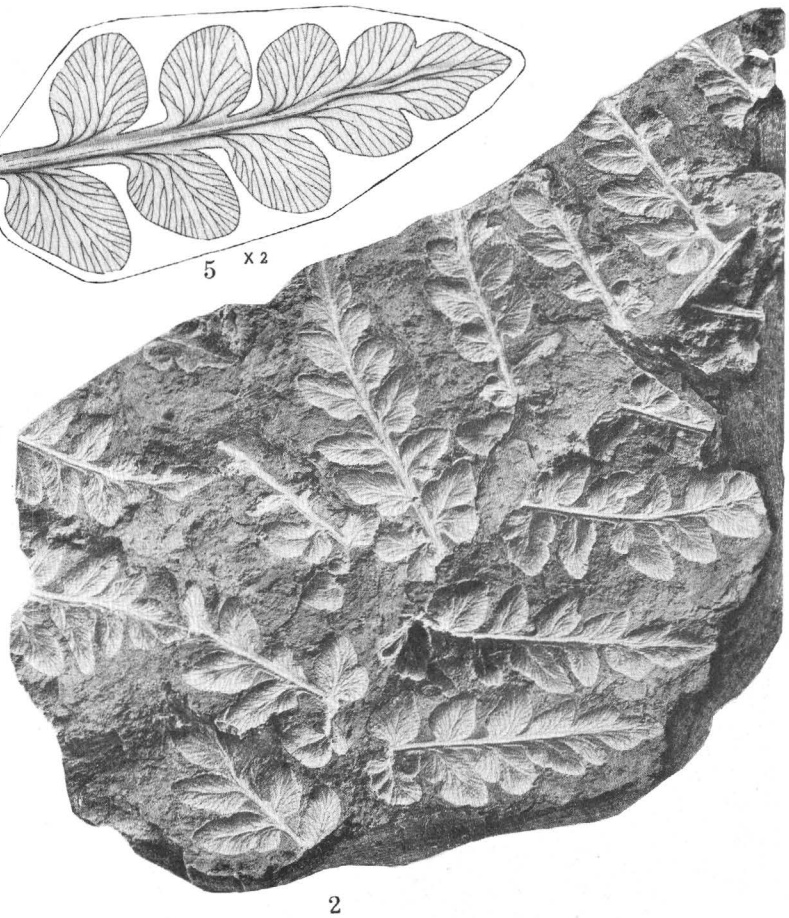

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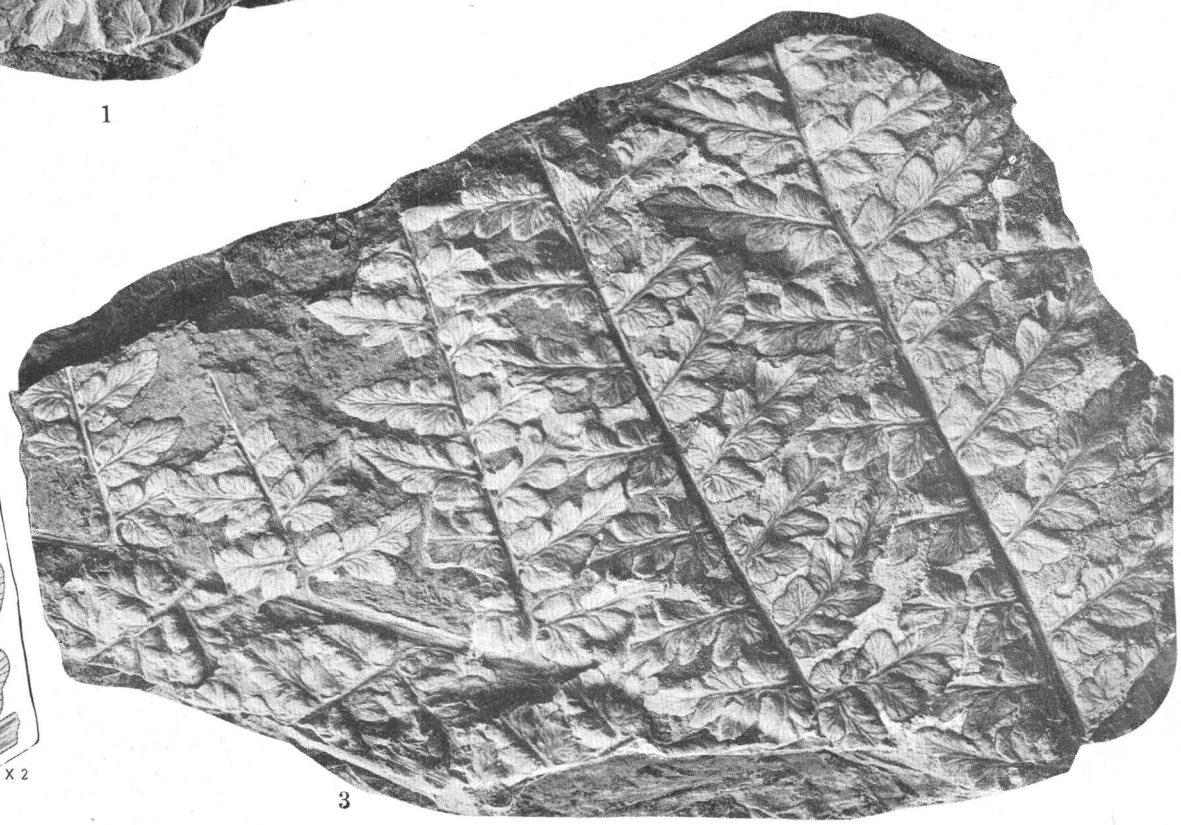

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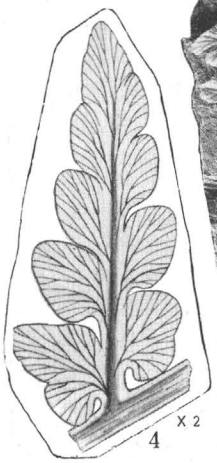

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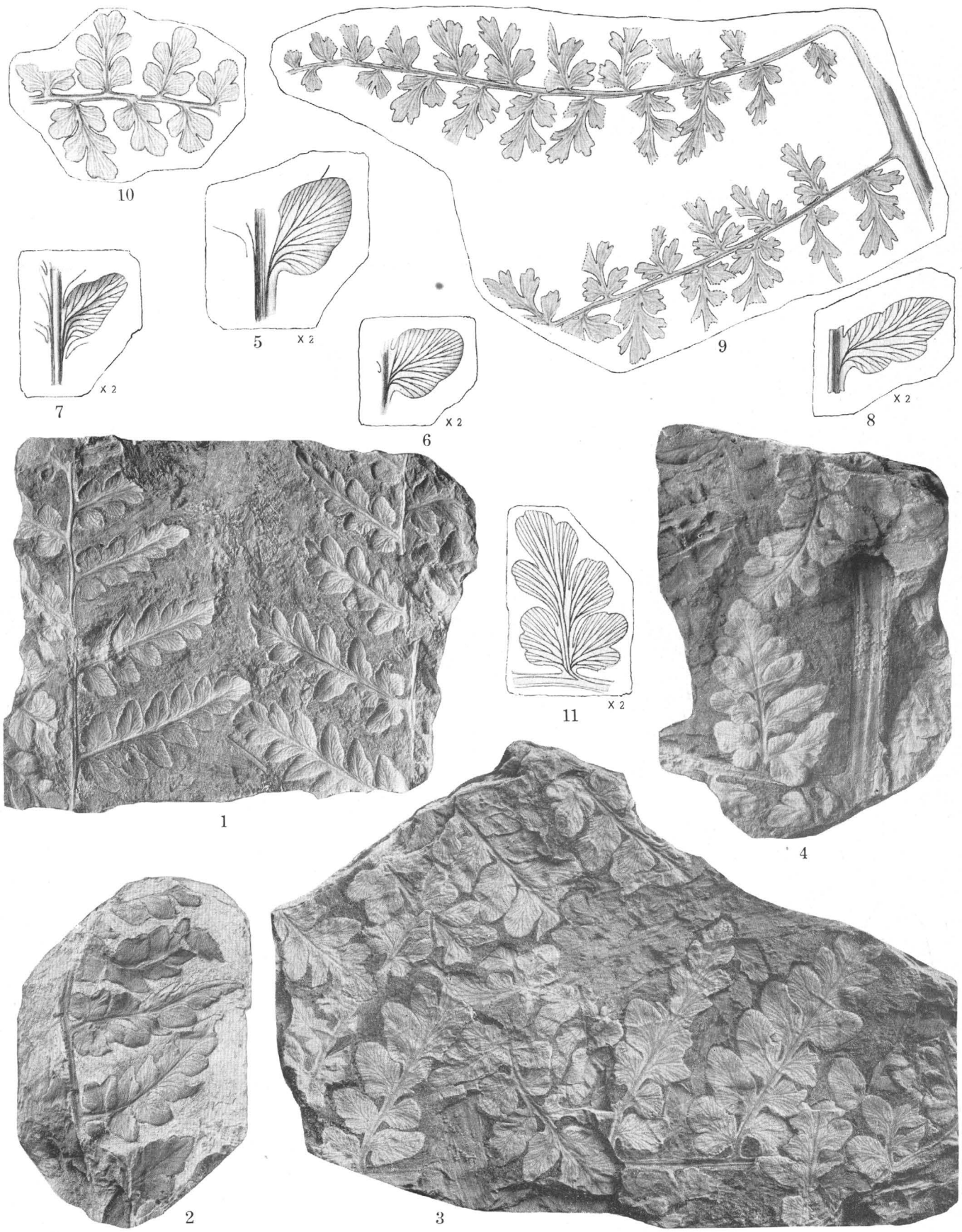
SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.



SPECIES OF MARIOPTERIS AND DIPLOTHMEMA FROM THE APPALACHIAN REGION.

PLATE 11

Page

FIGURES 1, 7, 8. *Mariopteris pottsvillea* var. *ovalis* David White, n. var 86

An apparently minor variation of *M. pottsvillea* in which the pinnules are somewhat more lax and compact and in which the large pinnules are more distinctly oval than in the typical form. Supposed to be from shale immediately below No. 3 coal (Pocahontas formation), three-quarters of a mile south of Squirejim, Tazewell quadrangle, Va. Cotype, U. S. Nat. Mus. 40074.

FIGURES 2–6. *Mariopteris pottsvillea* var. *dilatata* David White, n. var 86

A variety characterized by the large size of some of the pinnules, by the tendency to develop large size before becoming lobate, and by fewer rolled margins. Walden formation, along Black Creek, south end of Lookout Mountain, 1 mile northeast of Gadsden, Ala. Cotypes, U. S. Nat. Mus. 2669, 2668.

FIGURES 9–11. *Diplothmema subdecipiens* David White, n. sp 95

Sketches showing character of the pinnae and details of venation. Kanawha formation, roof of a 30-inch coal bed on the Lawson-Acme road, about 320 feet above Lawson, Kanawha Falls quadrangle, W. Va. Cotypes, U. S. Nat. Mus. 40677a, b.

407089—43——3

PLATE 12

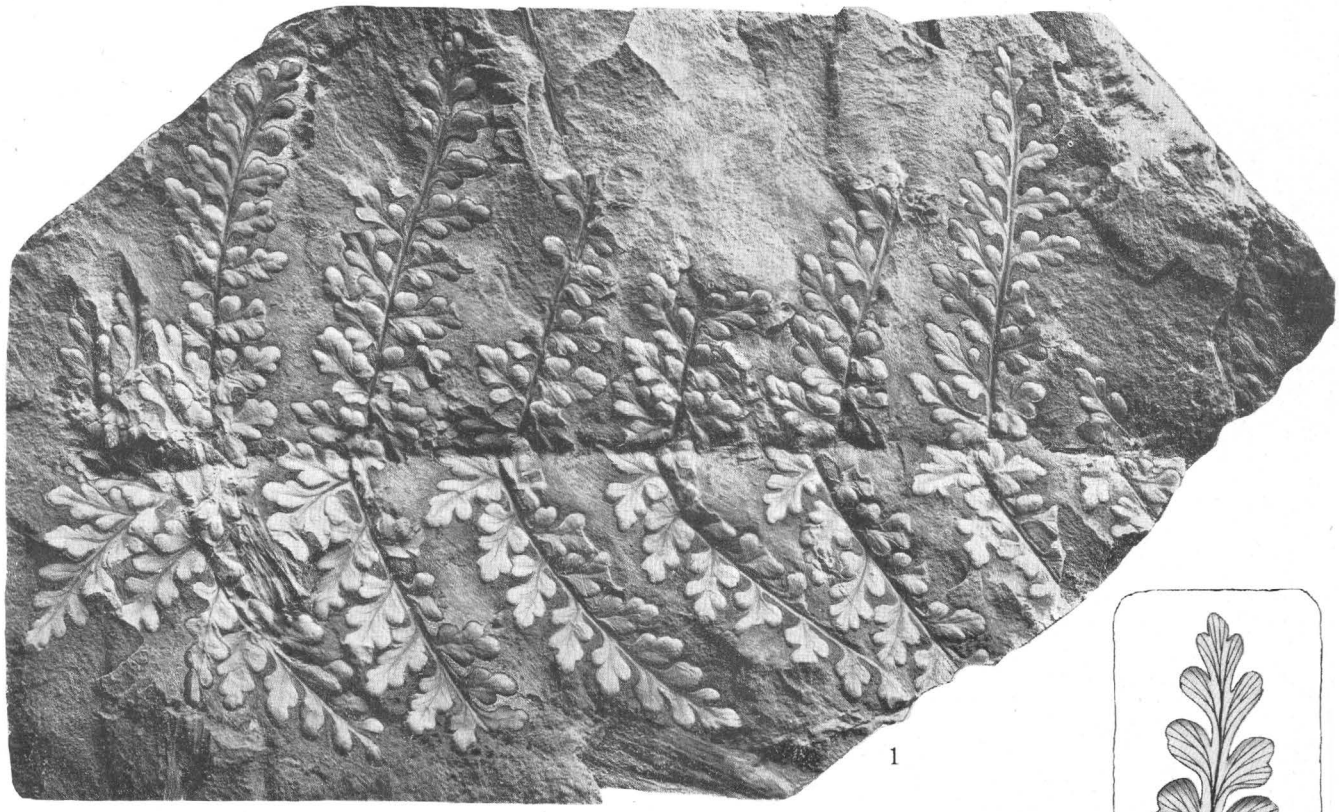
Page

FIGURES 1–2. *Mariopteris paddocki* var. *colliciaris* David White, n. var..... 87

Slab and pinnule showing general aspect of this variety, which appears to be somewhat intermediate in form between *M. paddocki*, s. s., and the *M. pottsvillea* section of the genus. Lower railroad cut, below second sandstone below Raleigh sandstone (360 feet below Raleigh sandstone), Nuttall, W. Va. Cotypes, U. S. Nat. Mus. 40076a, b.

FIGURE 3. *Mariopteris pottsvillea* var. *ovalis* David White, n. var..... 86

Slab with fragments of large pinnae referable to this form. Supposed to be from shale immediately below No. 3 coal, three-quarters of a mile south of Squirejim, Tazwell quadrangle, Va. Cotype, U. S. Nat. Mus. 40075.



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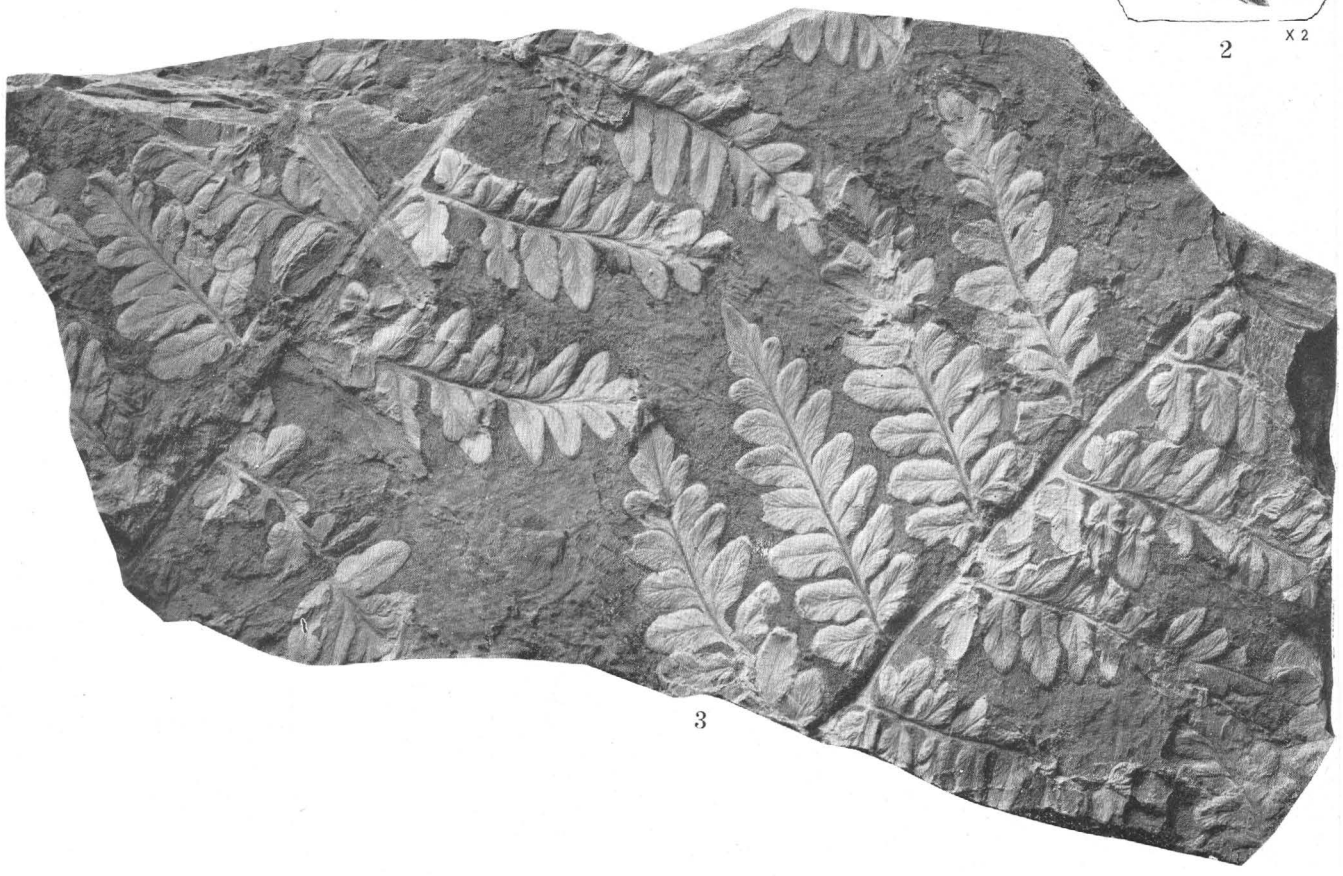

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

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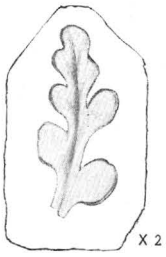

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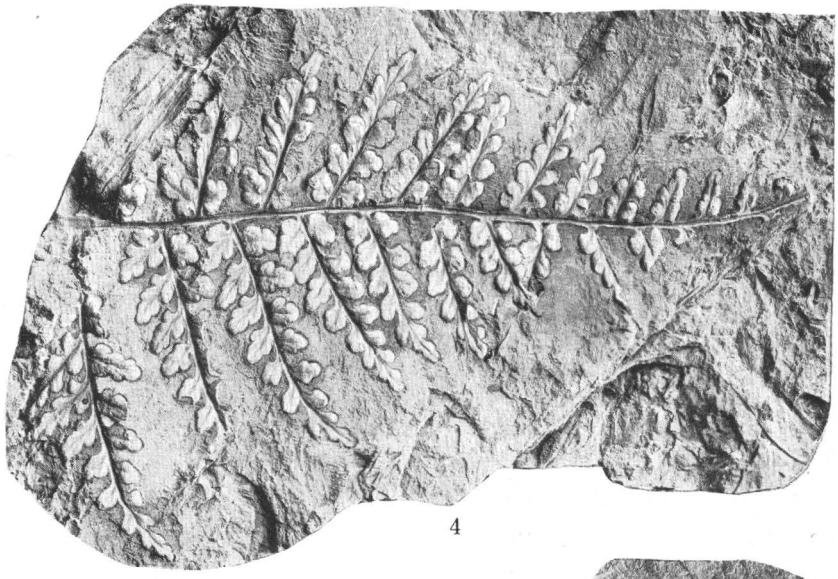

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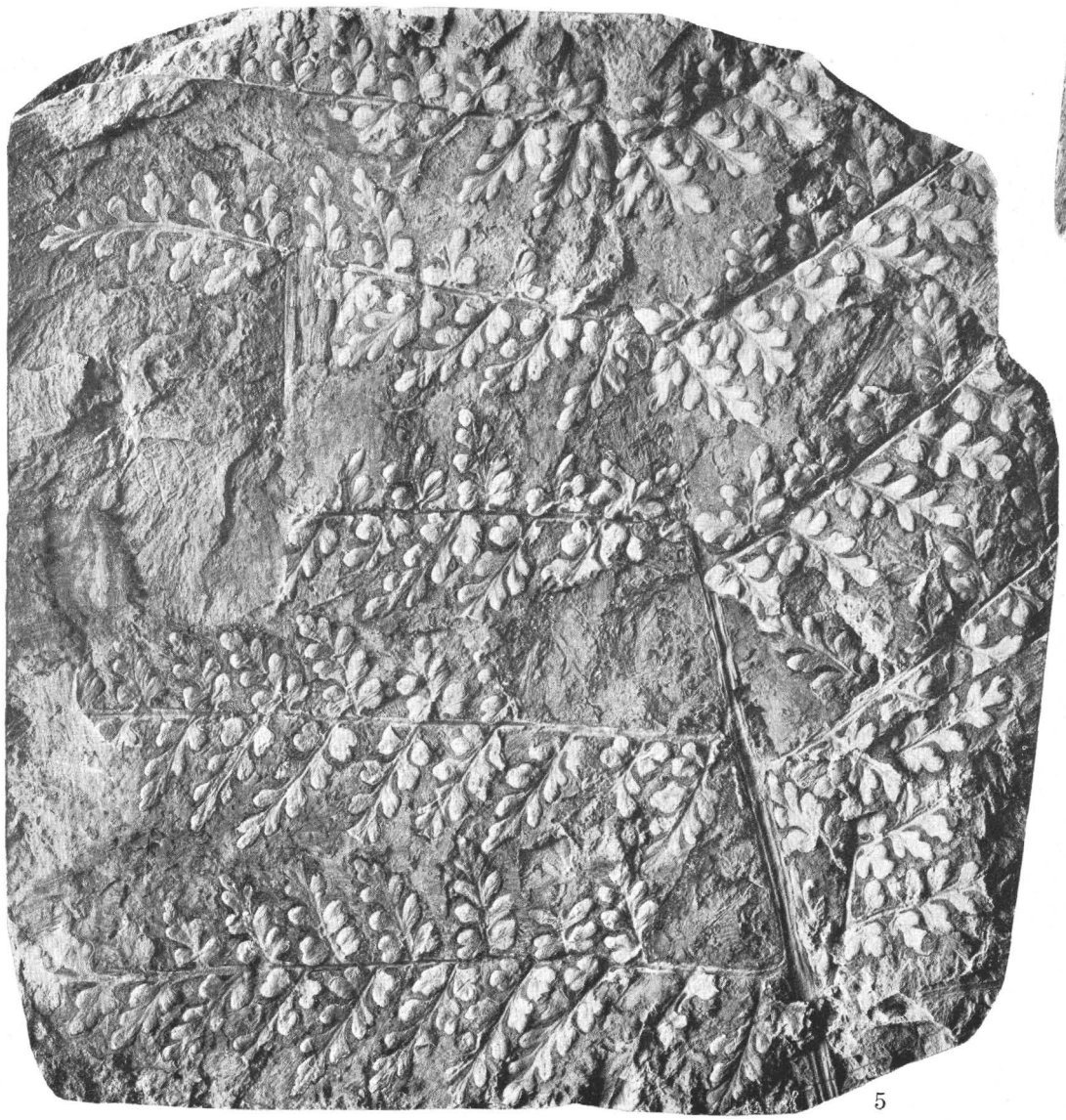

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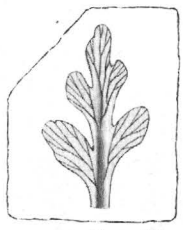

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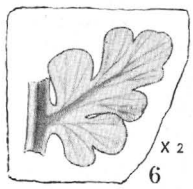

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

PLATE 13

Page

FIGURES 1–9. *Mariopteris paddocki* var. *colliciaris* David White, n. var..... 87

Specimens showing general features of the variety. Except for the common heteromorphy of the basal pinnules, this form is similar to species here described under the genus *Diplothmema*. Lower railroad cut, below second sandstone below Raleigh sandstone (360 feet below Raleigh sandstone), Nuttall, W. Va. Cotypes, U. S. Nat. Mus. 40076a–e.

PLATE 14

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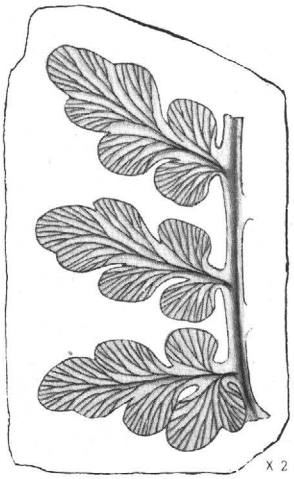

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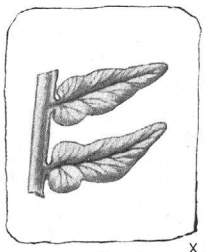

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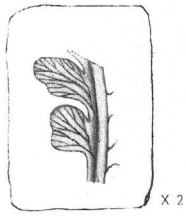

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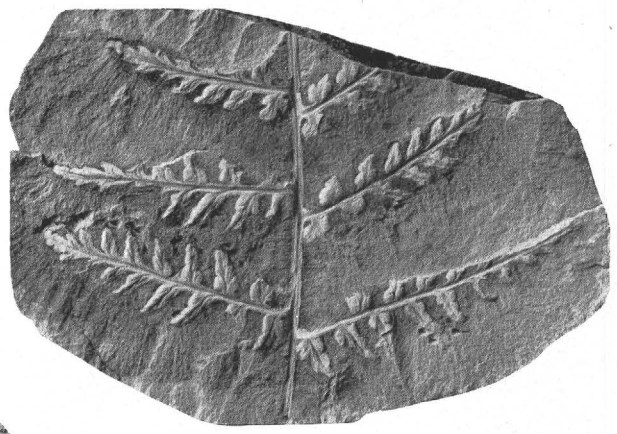

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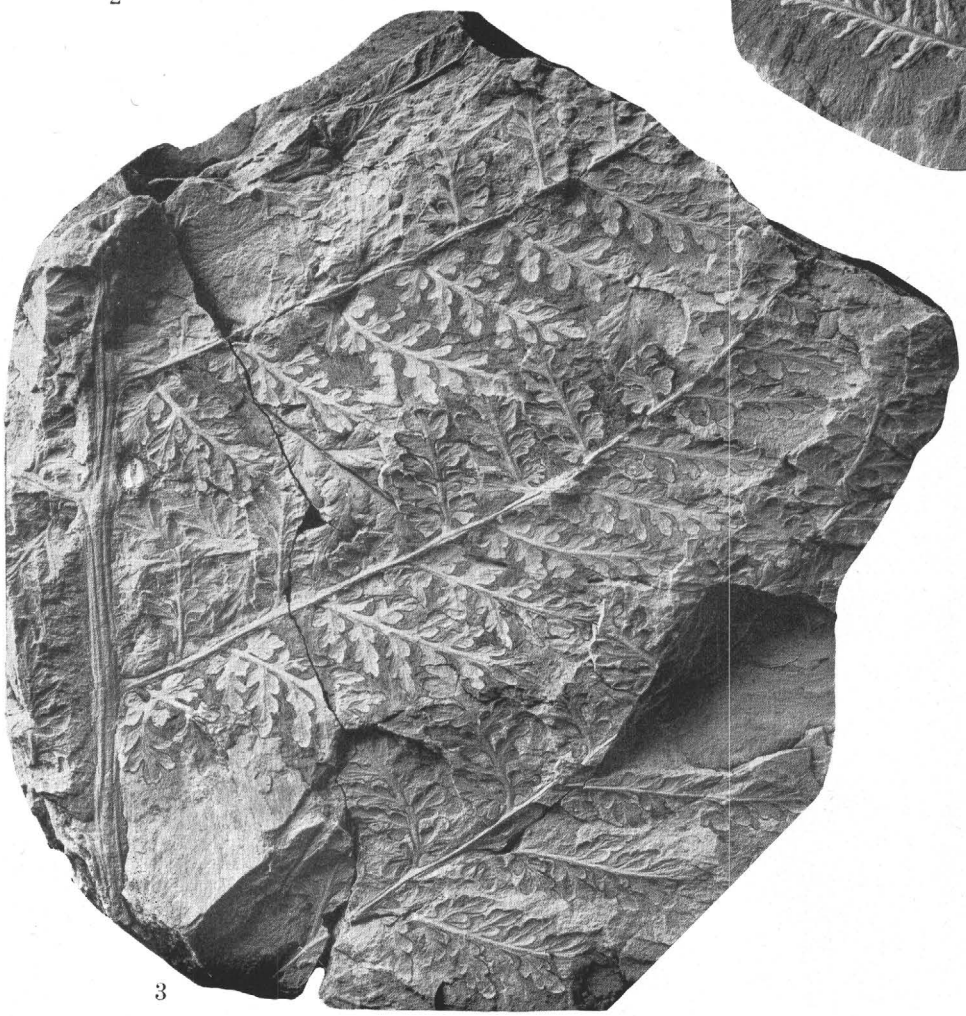

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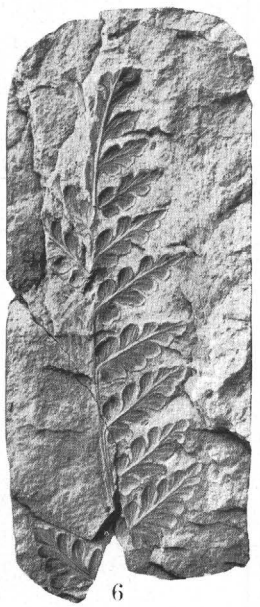

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

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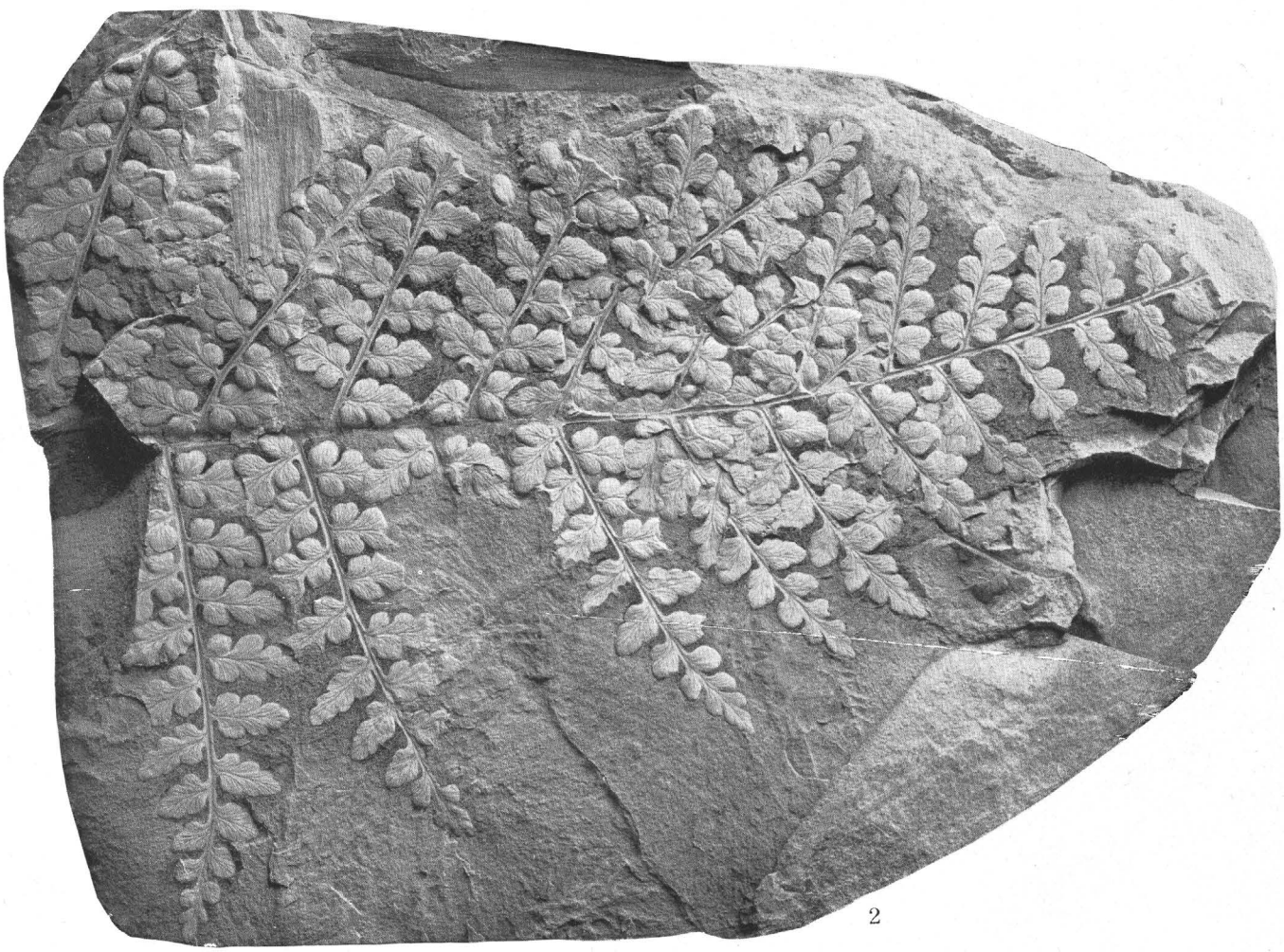

2

SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

PLATE 15

Page

FIGURES 1, 2. *Mariopteris lobata* David White, n. sp 87

Slabs showing general aspect of pinnae. This species is similar to *M. pottsvillea* but differs in the greater degree of subdivision or lobation. Precise horizon unknown, probably from Black Creek coal group, Warrior Creek, Ala. Cotypes, U. S. Nat. Mus. 13748, 13746.

PLATE 16

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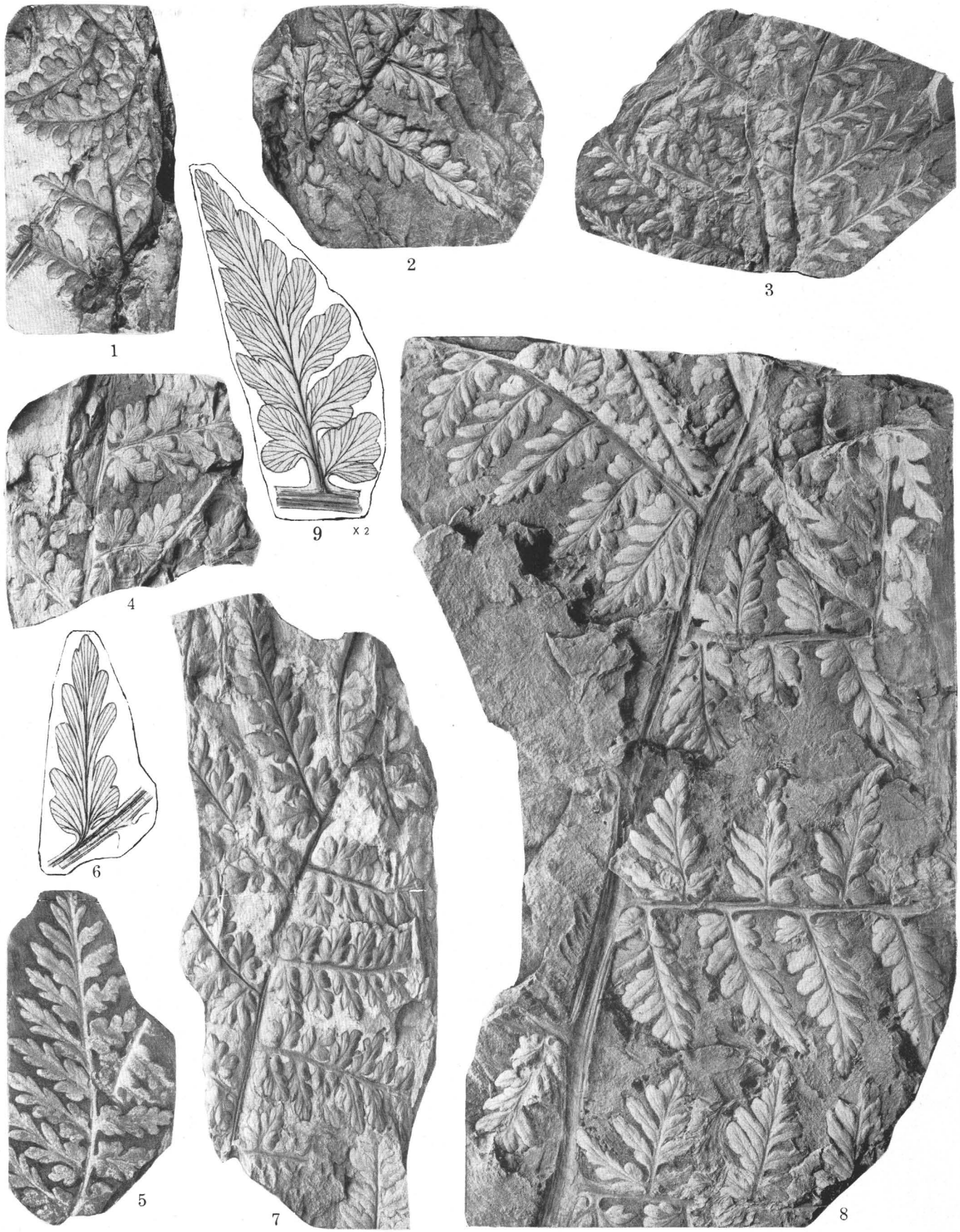
SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.



SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

PLATE 17

FIGURES 1–9. *Mariopteris eremopteroides* David White ..... Page 87

Specimens showing details of leaf form. Rock dump, Lykens coals Nos. 4 and 5, Pottsville formation, Brookside, Southern Anthracite coal field, Pa. U. S. Nat. Mus. 40081c–i.

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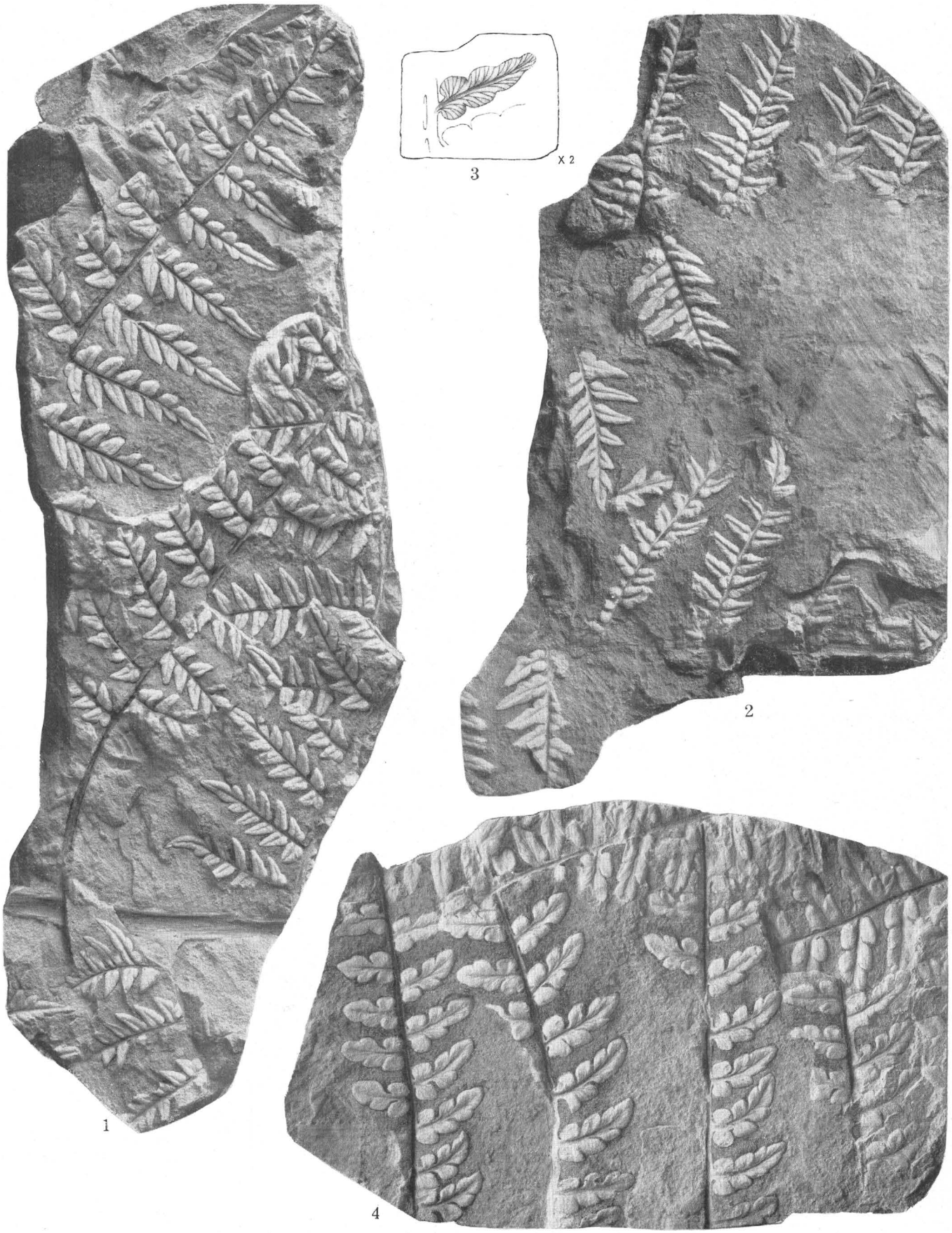
FIGURES 1–3. *Mariopteris inflata* var. *sewaneenis* David White, n. var 88

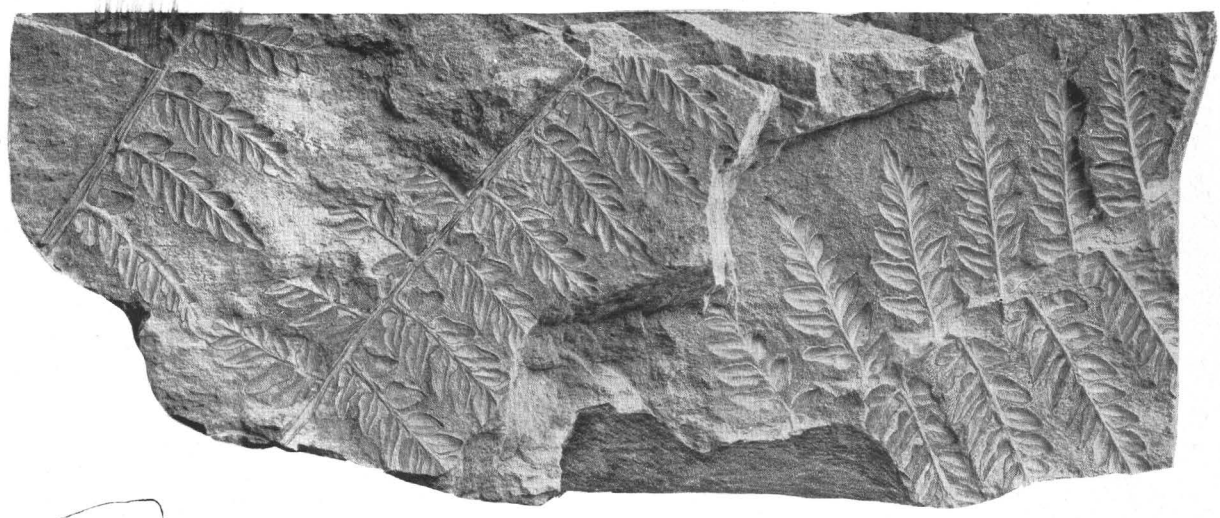
Specimens showing the characters by which this variety is distinguished from *M. inflata*, s. s., the less cordate and constricted pinnule bases, their more distant arrangement, and the oblique and distant venation. 1, Sewanee coal, Lower Mine, Rockwood, Tenn.; holotype, U. S. Nat. Mus. 40078. 2–3, Sewanee coal, Tracy City, Tenn.; U. S. Nat. Mus. 13661.

FIGURE 4. *Mariopteris inflata* David White, n. sp 88

Specimen showing the features that distinguish this form, the lax, distinctly rhomboidal pinnules with subpedicellate bases. Sewell coal; Thurmond Coal Co.'s mine, Thurmond, W. Va. Paratype, U. S. Nat. Mus. 40079a.



SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.



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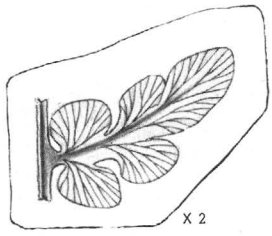

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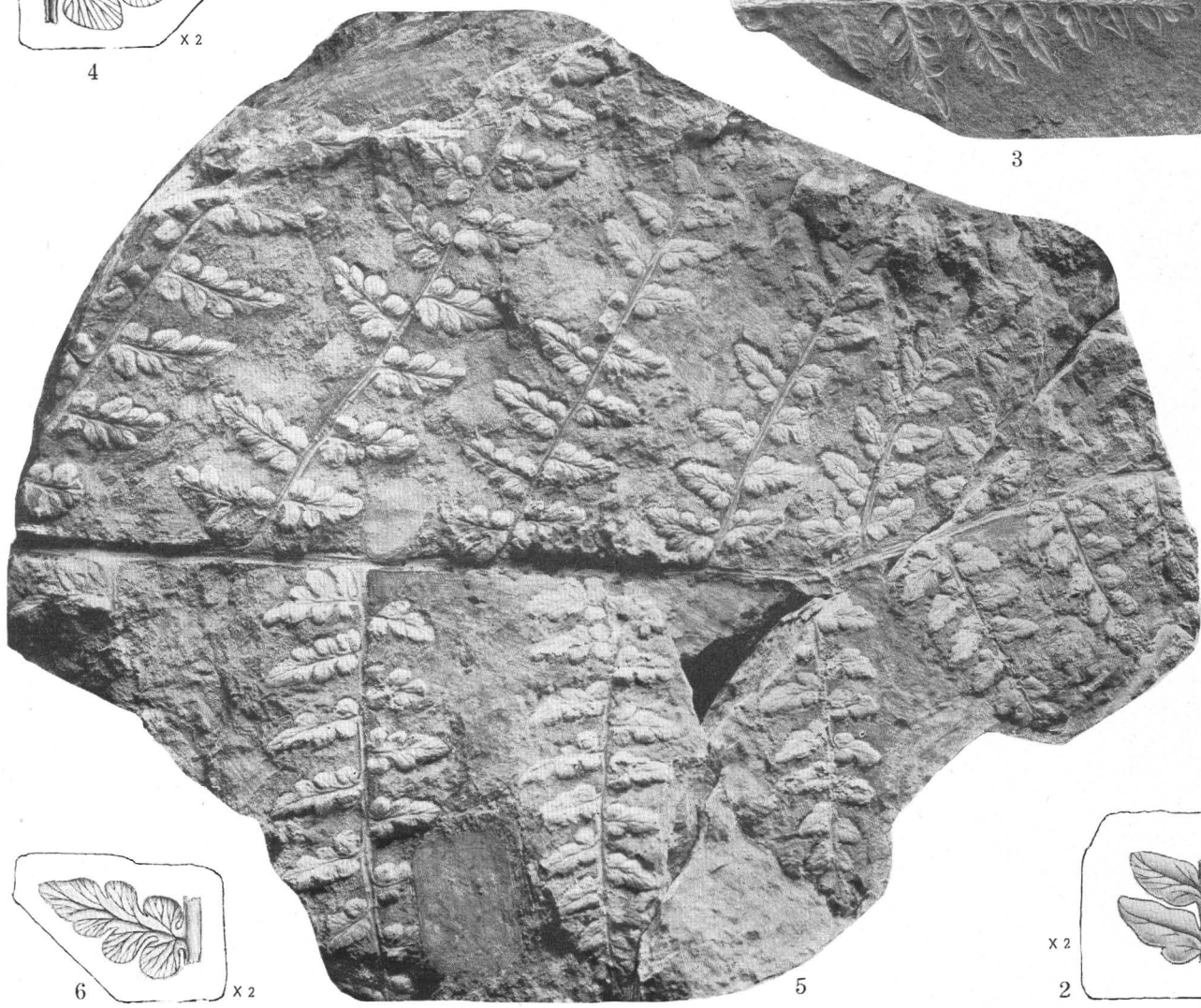

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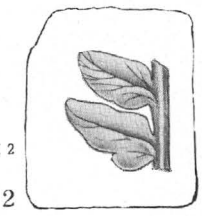

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

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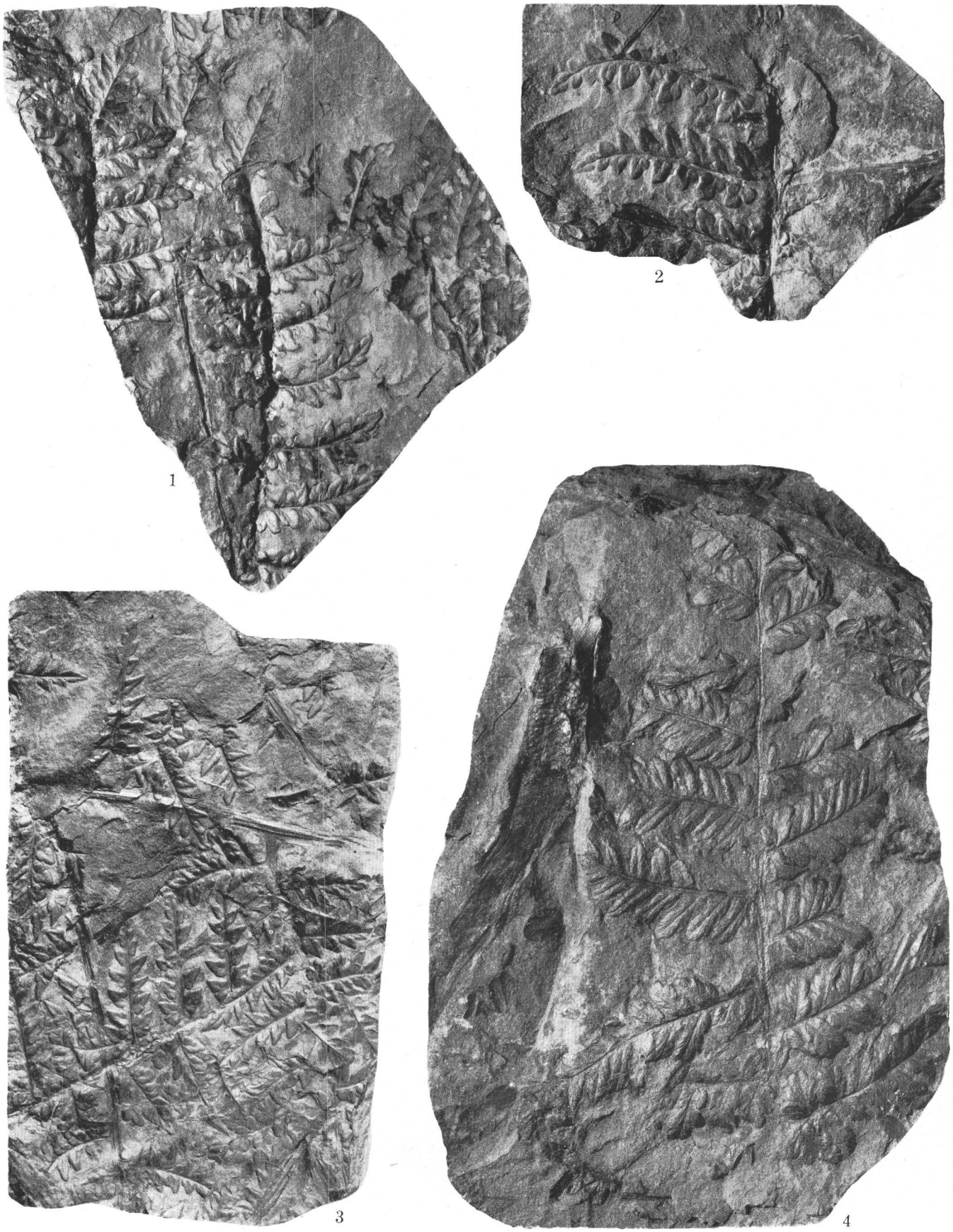
FIGURES 1–3. *Mariopteris phillipsi* David White, n. sp 89

Specimens showing form of the pinnae and pinnules. Horizon of Lykens coal No. 3, Pottsville formation, Southern Anthracite coal field, 6 feet south of milepost 127, Pottsville Gap, Pa. Cotypes, U. S. Nat. Mus. 40084a–c.

FIGURE 4. *Mariopteris tennesseeana* David White 89

Slab showing the pinnule variation. Quinnimont shale, in tunnel at Crow, Raleigh County, W. Va. U. S. Nat. Mus. 40085a.



SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

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SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.

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FIGURE 1. *Mariopteris phillipsi* David White, n. sp 89

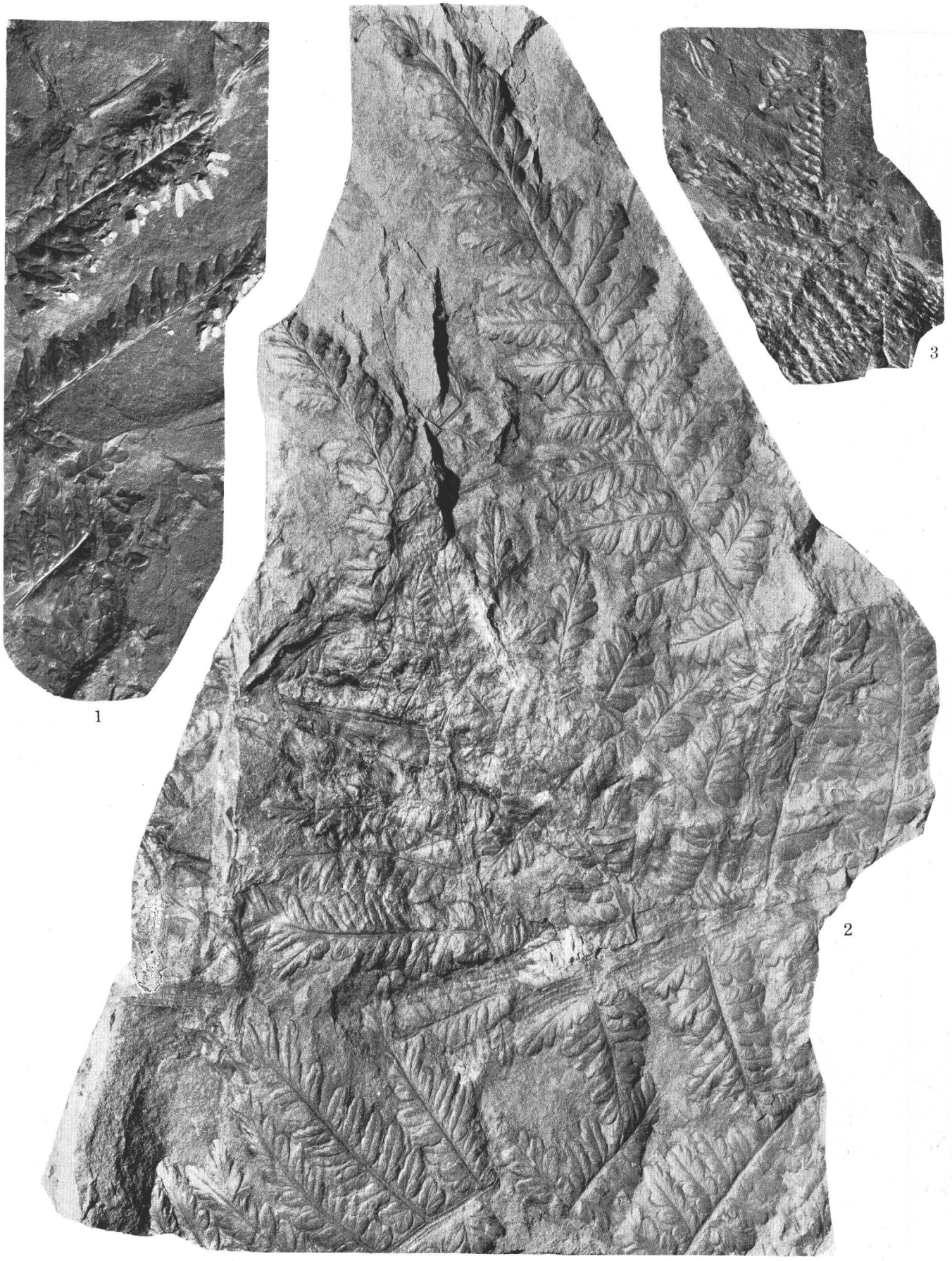
Several pinnae. Horizon of Lykens No. 3 coal; 5 or 6 feet south of milepost 127, Pottsville Gap, Pa. Cotype, U. S. Nat. Mus. 40084d.

FIGURE 2. *Mariopteris tennesseeana* David White 89

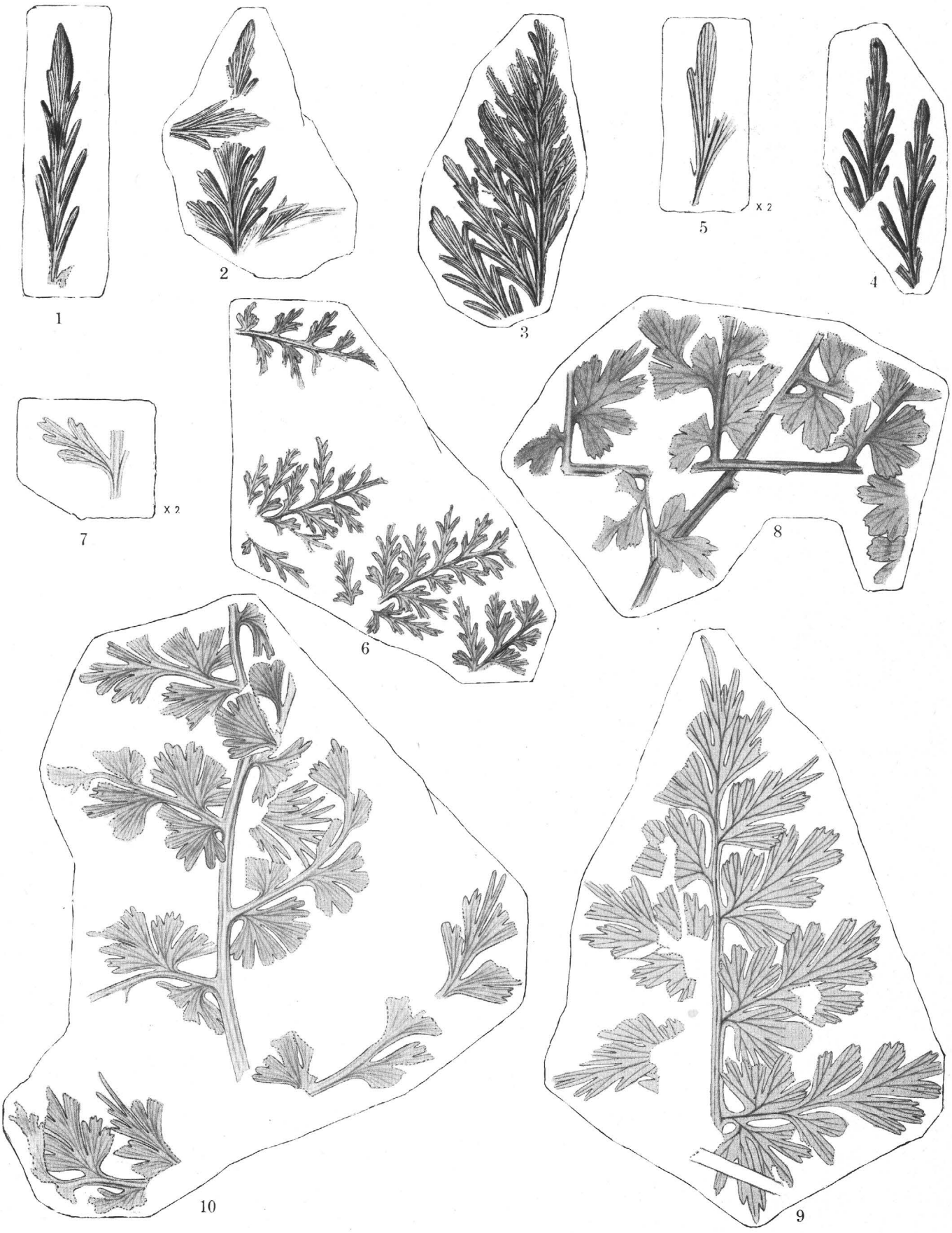
A large slab showing numerous pinnae and fragments of the broad rachis. Quinnimont shale, tunnel at Crow, Raleigh County, W. Va. U. S. Nat. Mus. 40085b.

FIGURE 3. *Mariopteris pygmaea* David White 89

Specimen showing the small size of the leaf. From Lykens coal No. 2, or from other veins, New Lincoln colliery, 3 miles west of Tremont, Pa. U. S. Nat. Mus. 40086.



SPECIES OF MARIOPTERIS FROM THE APPALACHIAN REGION.



SPECIES OF EREMOPTERIS FROM THE APPALACHIAN REGION.

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FIGURES 1–5. *Eremopteris neffii* David White, n. sp 90

1–3, lower part of Kanawha formation, roadside at mouth of Rock Fork of Bell Creek, Nicholas quadrangle, W. Va. 4, 5, Canfield cannel coal, Loveland, 2 miles south of Canfield Station, Mahoning County, Ohio.

1. A large pinnatifid pinnule. Cotype, U. S. Nat. Mus. 40143a.
2. A fragment of a lateral pinna showing terminals and pinnules next below. Cotype, U. S. Nat. Mus., 40143b.
3. The apical part of a primary pinna showing the dense arrangement of pinnae and pinnules. Cotype, U. S. Nat. Mus. 40143c.
4. A fragment showing two pinnules with very oblique lobes. Cotype, U. S. Nat. Mus. 40144.
5. Detail of venation of specimen shown in figure 4.

FIGURES 6–7. *Eremopteris sirigosa* David White, n. sp 90

6. Several fragmentary pinnae. Fire Creek seam, Rush Run, W. Va. Holotype, U. S. Nat. Mus., 40145.
7. Detail of venation of specimen shown in figure 6.

FIGURES 8–10. *Eremopteris crenulata* Lesquereux 90

8, 9. Fragmentary pinnae showing the flat subdivisions of the lobes, the prolongation of some of the teeth, and the winged rachis. Helena mines, Montevallo coal group, Cahaba coal field, Alabama. Type specimens, loaned by the Geological Survey of Alabama.

10. A lax form with distant pinnae and pinnules. Brookville coal, Brookville quadrangle, Brookville, Ala. U. S. Nat. Mus. 40146.

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FIGURES 1–8. *Eremopteris lincolniana* David White 91

A suite of specimens showing the denticulate pinnule lobes, the prolonged spinose terminals, the stalked bases, and the depressed, distant nerves. There is some variation in the clawed terminals, and clawless types occur on the fronds with clawed types, as in figures 6 and 7. 1, Mine in Peerless vein, half a mile below Cedar Grove, Kanawha Falls quadrangle, W. Va. 2, Gas coal, St. Clair mine below Eagle, Kanawha Falls quadrangle, W. Va. 3, Lower Banner or intermediate coal, mixed, Weiss Coal Co.'s mine, Dorchester, Estellville quadrangle, Va. 4, 6, Kanawha formation, 4-foot seam above forks of Drews Creek, 4 miles above mouth of creek, Raleigh quadrangle, W. Va. 5, Kanawha formation, three-quarters of a mile above Gauley Bridge, on road up Gauley River, W. Va. 7, 8, Old mine on coal about 30 feet above railroad, Handley, Kanawha Falls quadrangle, W. Va. U. S. Nat. Mus. 40135–37, 40138a, b, 40139, 40140.

FIGURES 9–11. *Eremopteris subelegans* David White, n. sp 91

Typical specimens. 9, Bloyd shale, Privette coal banks, Washington County, Ark.; holotype, U. S. Nat. Mus. 40142. 10, 11, Pottsville formation, 22 paces below milepost 127, Pottsville Gap, Pa.; U. S. Nat. Mus. 40141.

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SPECIES OF EREMOPTERIS FROM THE APPALACHIAN REGION.

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FIGURES 1–3. *Eremopteris dissecta* Lesquereux 91

Montevallo coal group, Helena mines, Cahaba coal field, Birmingham quadrangle, Ala. Type specimen, loaned by the Geological Survey of Alabama.

FIGURES 4, 5. *Eremopteris artemisiaefolia* (Sternberg) Schimper 92

Fragments showing lobation, alate rachis, decurrent pinnule lobes, and very slender nerves. Lacoe collection; Mercer group, Blossburg, Pa. U. S. Nat. Mus. 40132.

FIGURES 6, 7. *Eremopteris gracilis* David White, n. sp 91

A typical pinna and the apical part of a frond. Cedar Grove vein, E. B. Coal & Coke Co.'s mine, East Bank, Kanawha Falls quadrangle, W. Va. Cotypes, U. S. Nat. Mus. 40133a, b.

FIGURES 8–10. *Eremopteris lincolniana* var. *antiqua* David White, n. var 91

Fragmentary pinnae. Compare with the clawless forms of the typical *E. lincolniana*. From mines on the Little Warrior seam (Mary Lee?), a quarter of a mile east of Littleton Station, Birmingham quadrangle, Ala. Cotypes, U. S. Nat. Mus. 40134a, b.

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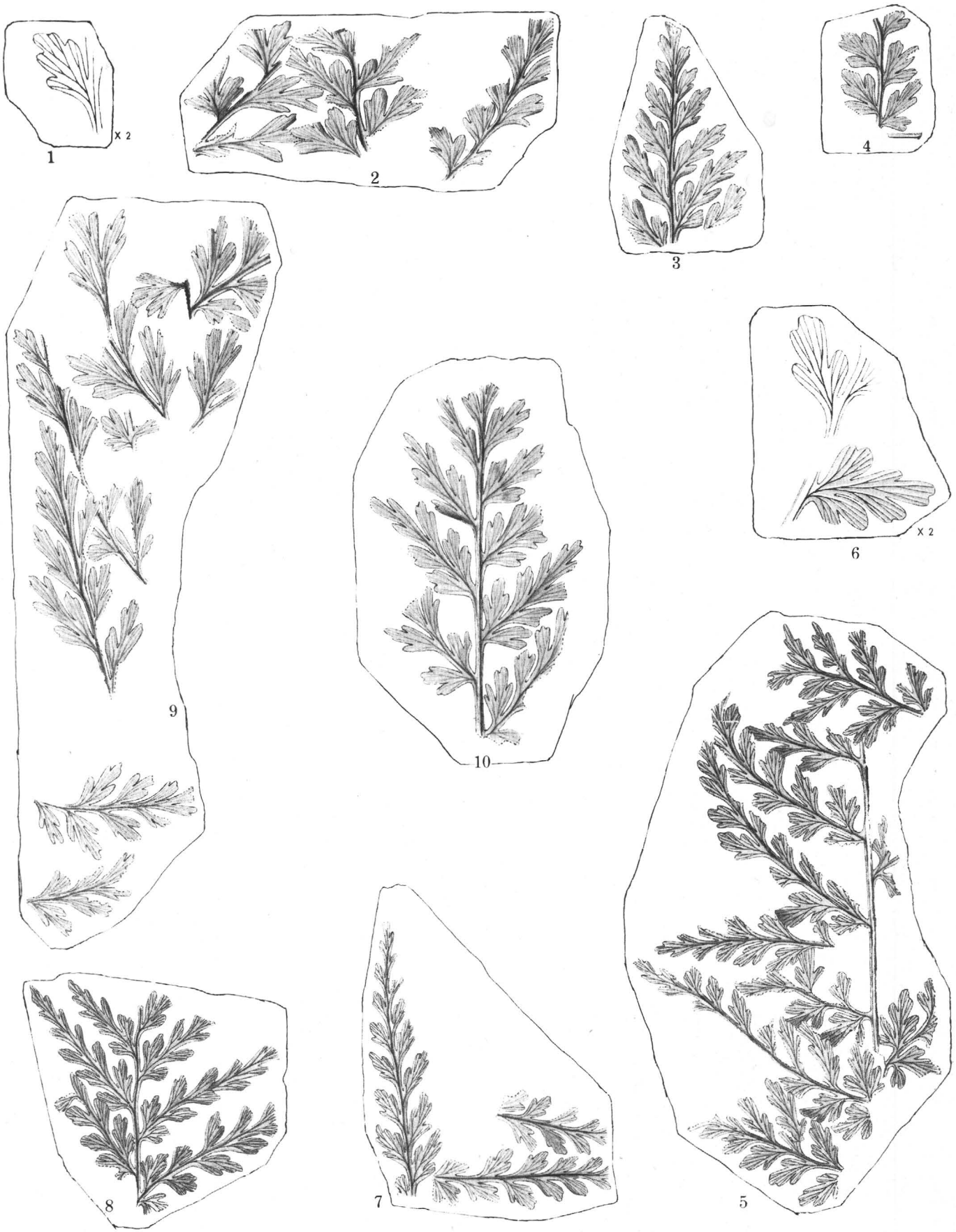
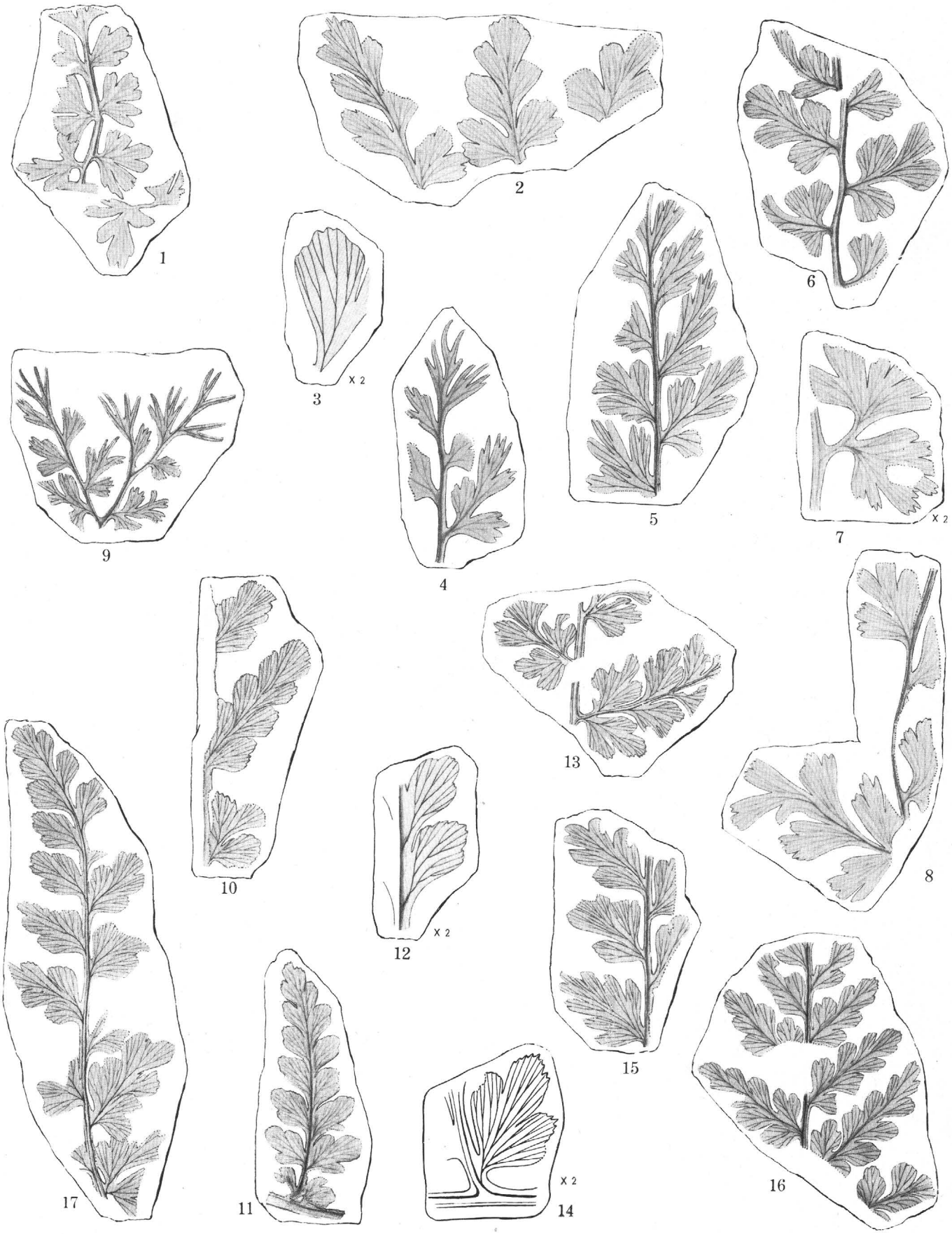
FIGURES 1–10. *Eremopteris gracilis* David White, n. sp 91

Typical pinnae and pinnule details. 1–7, North Jellico mine, near Gray's Station, 7 miles southeast of Corbin, Ky.; cotypes, U. S. Nat. Mus. 40129a–e. 8, North Jellico, east of Corbin, Ky.; U. S. Nat. Mus. 40130. 9, 10, Norton formation, Upper Banner coal, Smith's mine, Coeburn, Bristol quadrangle, Va.; U. S. Nat. Mus. 40131a, b.



SPECIES OF EREMOPTERIS FROM THE APPALACHIAN REGION.



SPECIES OF EREMOPTERIS AND DIPLOTHMEMA FROM THE APPALACHIAN REGION.

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FIGURES 1–9. *Eremopteris trappensis* David White, n. sp. 92

Typical specimens: 1, Shows palmate form of lower pinnules; 2, 3, a phase with very broad lobes; 4, 9, forms with more marked dissection and clawlike terminals. Shale probably within 50 feet of the top of the Hampton conglomerate; Oceana road, 1 mile west of Trap Hill, W. Va. Cotypes, U. S. Nat. Mus. 40127a-h.

FIGURES 10–17. *Diplothmema glennii* David White, n. sp. 95

Forms showing large, compact, broad pinnules and, in figures 11, 12, and 13, 14, erose pinnule margins. Small coal in the upper Kanawha formation, a quarter of a mile east of Ferguson, Wayne County, W. Va. Cotypes, U. S. Nat. Mus. 40128a-f.

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FIGURES 1–3, 5–10. *Diplothmema cheathami* (Lesquereux) David White, n. comb 95

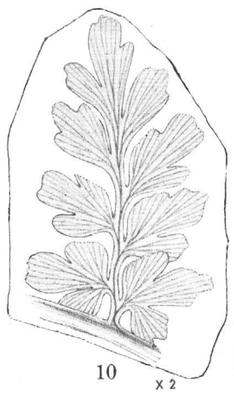
Specimens showing the frond form, details of pinnae, and pinnule venation. Note in figure 1, the striate rachis, the dichotomy, and the frequent development of very large basal pinnae on the lower side of the next lower order of pinnae; also the variation throughout the specimen from entire to erose margins. 1,10, American seam, New Pratt mine, 2 miles north of Blossburg, Birmingham quadrangle, Ala.; U. S. Nat. Mus. 40106a, b. 3, Lacoe collection; Sewanee coal, Dayton, Tenn.; U. S. Nat. Mus. 15043. 2, 5–9, Lacoe collection; Sewanee coal, Tracy city, Tenn.; figures 2, 5, 8, 9, cotypes, U. S. Nat. Mus. 15026, 40104, 15027; figures 6, 7, U. S. Nat. Mus. 15039.

FIGURES 11, 13. *Diplothmema cheathami* (Lesquereux) var. *minor* David White, n. var 96

Fragmentary specimens upon which this form is based. Upper New River formation, splash dam in branch of Laurel Fork, 3 miles east of Jumbo, Buckhannon quadrangle, W. Va. Cotypes, U. S. Nat. Mus. 40111a, b.

FIGURES 4, 12. *Diplothmema cheathami* (Lesquereux) var. *antiqua* David White, n. var 96

Early form of *D. cheathami* distinguished by its smaller size and marked pinnule dissection. Coal in Welch formation, Dry Fork road, 2 miles above mouth of Bradshaw Creek, Tazewell quadrangle, W. Va. Cotypes, U. S. Nat. Mus. 40105a, b.



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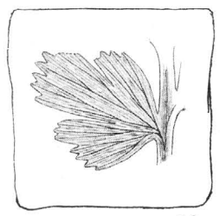

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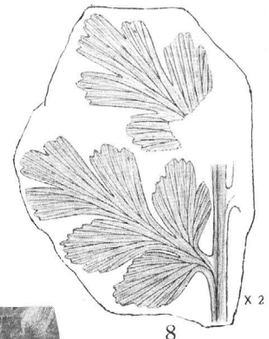

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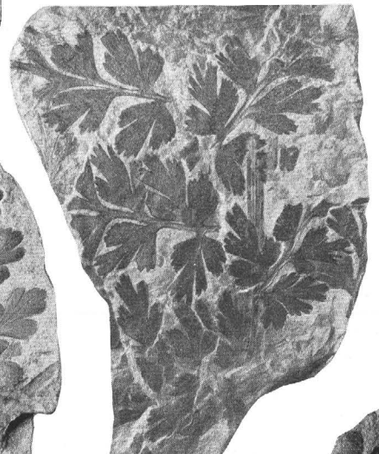

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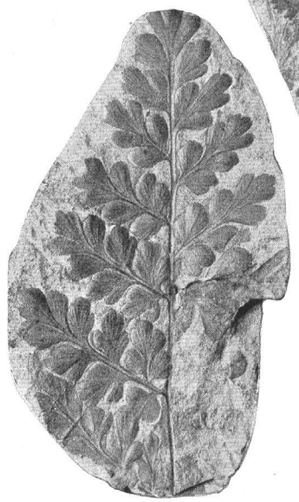

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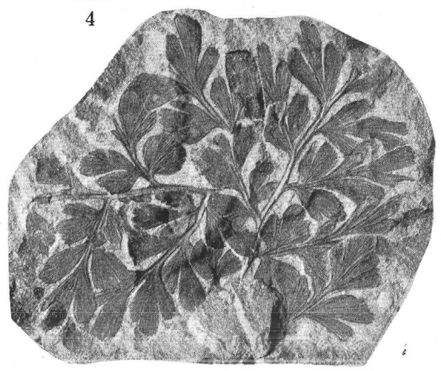

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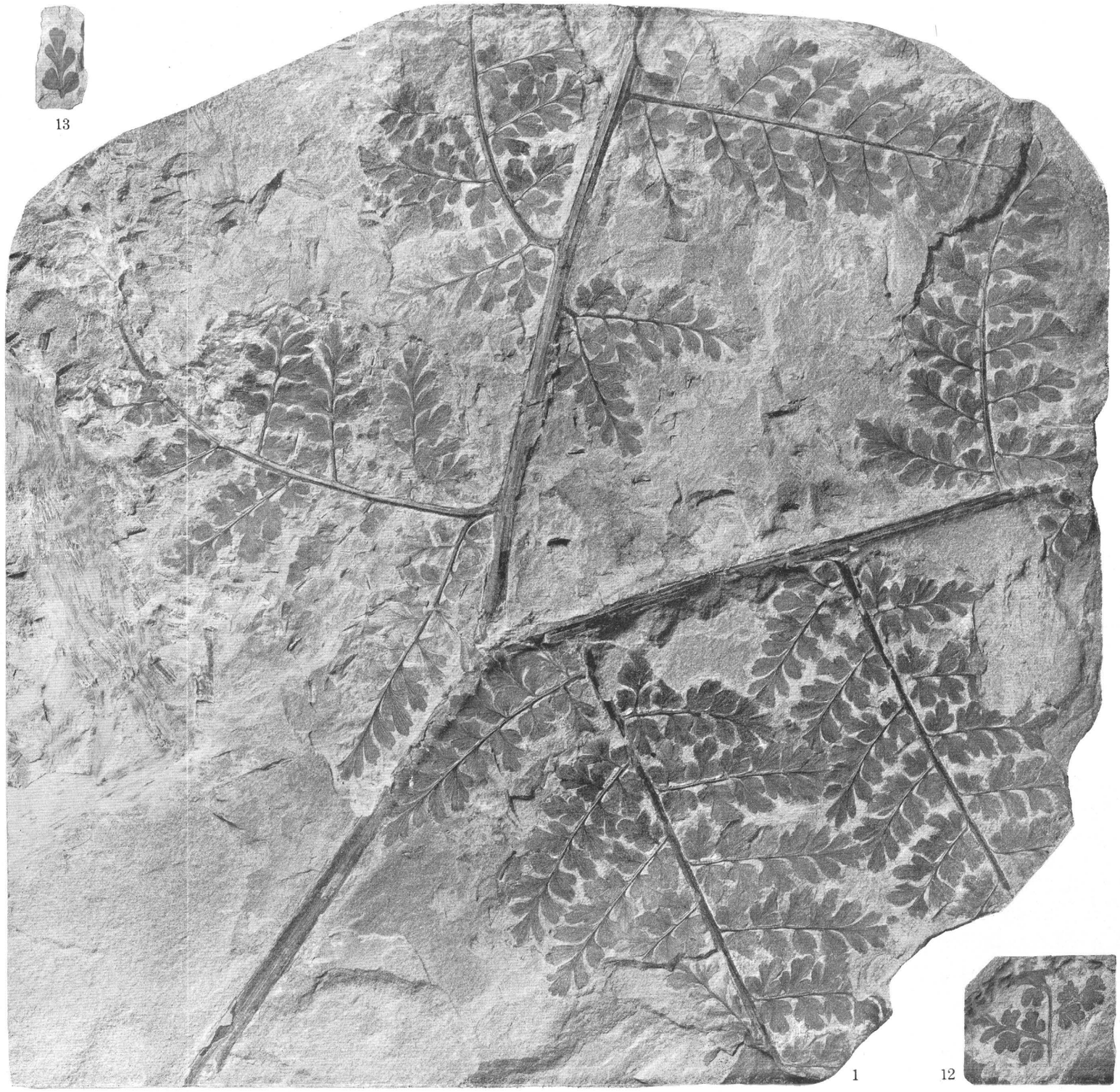

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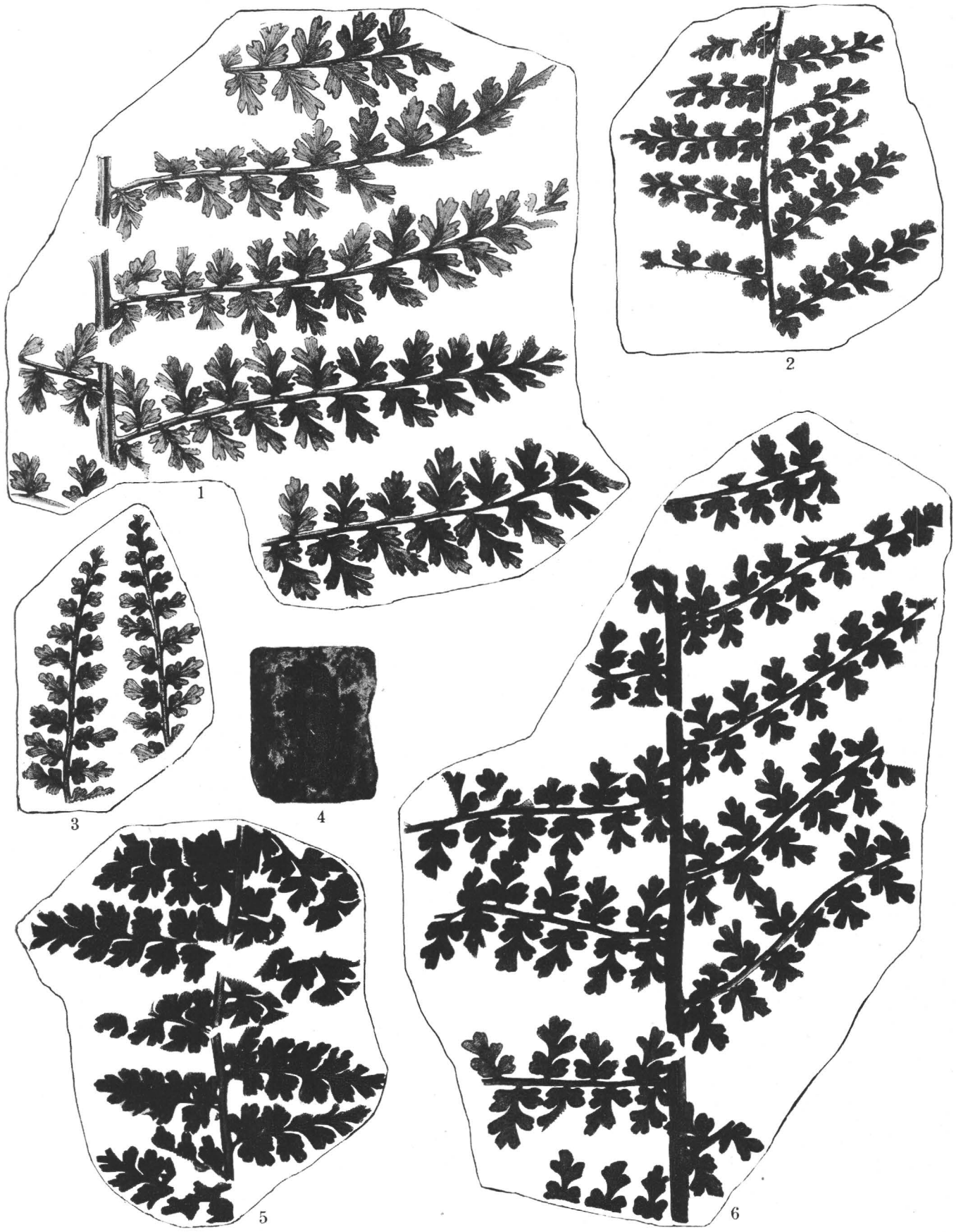
SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.



SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.

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FIGURES 1–3, 5, 6. *Diplothmema spectabilis* David White, n. sp 96

Several large specimens illustrating general form. Middle vein, between Upper and Lower Banner, Norton formation; Dorchester, Estellville quadrangle, Va. Cotypes, U. S. Nat. Mus. 40087a–e.

FIGURE 4. *Diplothmema pudica* David White, n. sp 96

A small specimen illustrating the pinnule form. Horsepen group of coals, Lee formation; Horsepen, Va. Holotype, U. S. Nat. Mus. 40088.

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FIGURES 1, 2. *Diplothmema halberstadti* David White, n. sp 96

About 550 feet below Twin coal, Upper Lykens division, Pottsville Gap in Sharp Mountain, Pottsville, Pa.

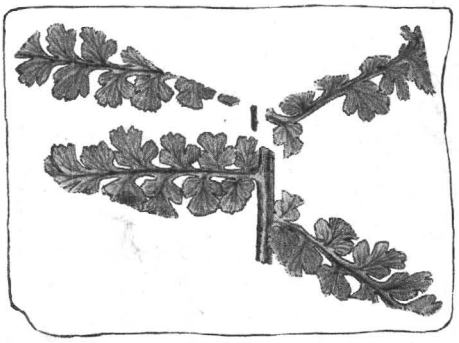
1. Small pinnae. Cotype, U. S. Nat. Mus. 40107a.
2. A fragment with lobate pinnules. Cotype, U. S. Nat. Mus. 40107b.

FIGURES 3, 5–7. *Diplothmema microphylla* (Lesquereux) David White 94

3. A lax specimen with distant pinnules. Brookwood group, probably next to highest coal group under conglomerates, Asylum (University) mine near Tuscaloosa, Ala. U. S. Nat. Mus. 40108a.
5. Fragments of tertiary pinnae. Lykens coal No. 2 or other veins, New Lincoln Colliery, 3 miles west of Tremont, Pa. U. S. Nat. Mus. 40109.
6. A very compact form. Brookwood group, probably next to highest coal group under conglomerates, Asylum (University) mine near Tuscaloosa, Ala. U. S. Nat. Mus. 40108b.
7. One of Lesquereux's original types from Alabama. Montevallo coal group, Helena mines, Cahaba coal field, Montevallo, Ala. U. S. Nat. Mus. 40110.

FIGURE 4. *Diplothmema obtusiloba* (Brongniart) Stur 97

A typical fragment apparently referable to Brongniart's species. This form is regarded as the genotype of *Diplothmema*, as the genus is here interpreted. Block coal, Scott shale, Red Ash mine, 1 mile north of Careyville, Tenn. U. S. Nat. Mus. 40102a.



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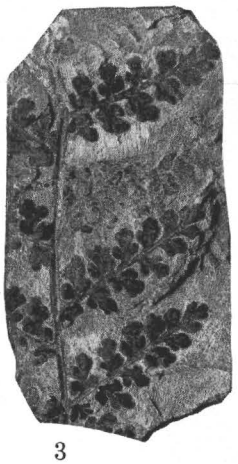

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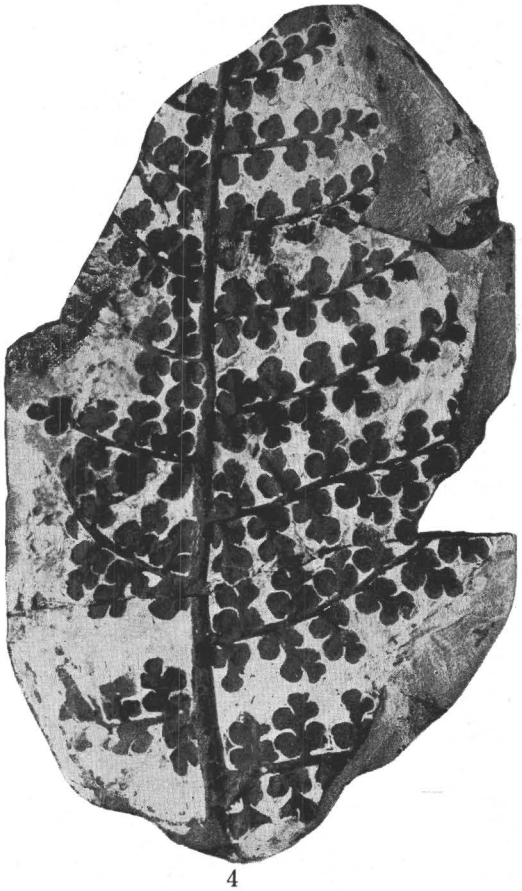

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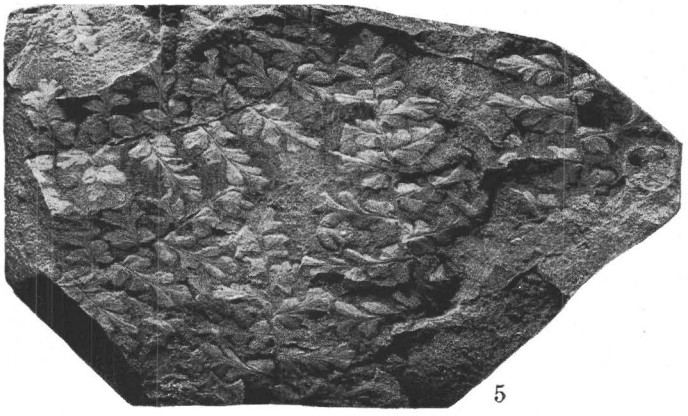

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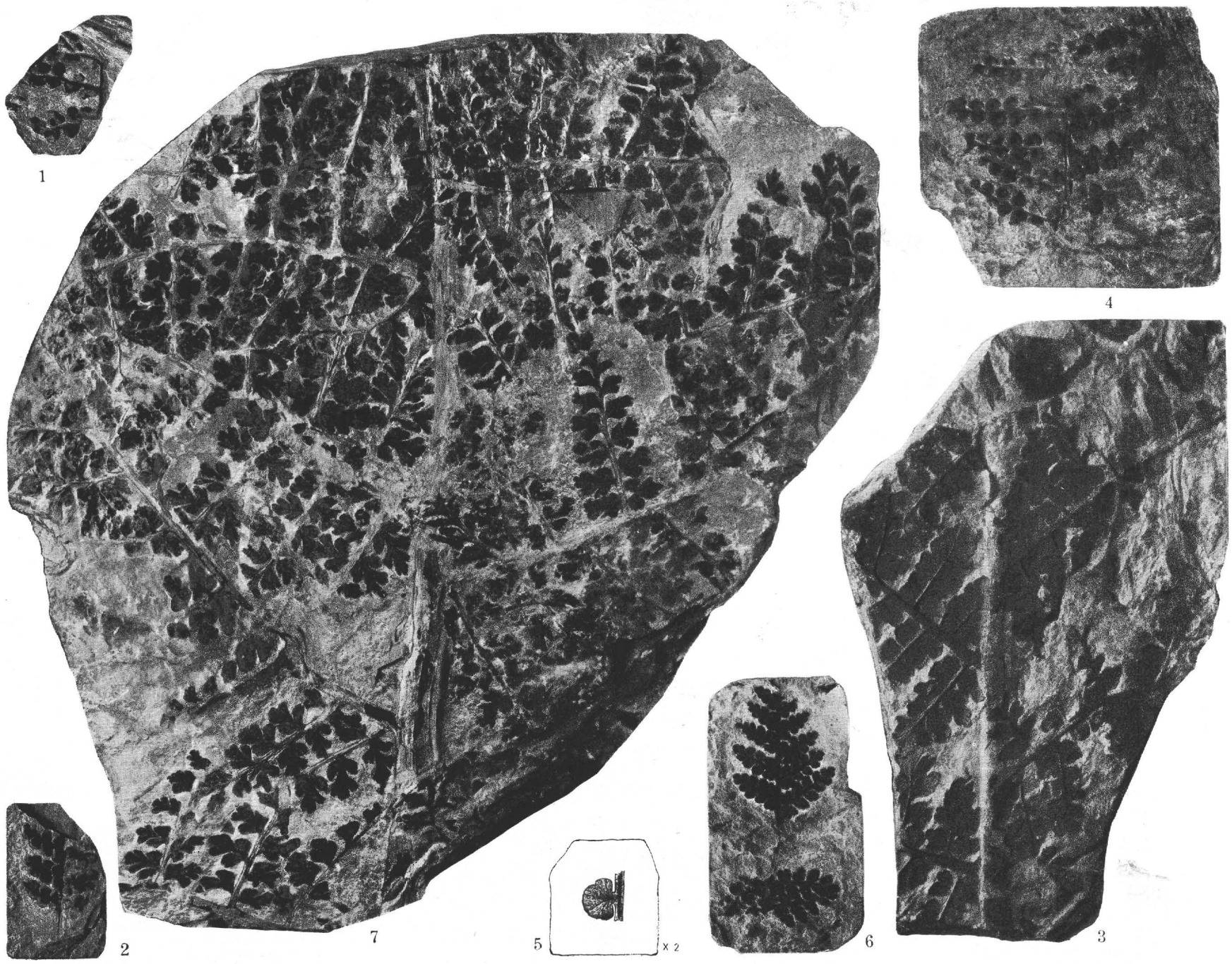
SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.



SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.

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FIGURES 1, 2, 4, 5. *Diplothmema reniformis* David White, n. sp 97

Specimens showing the small, compact, crowded pinnules, and the generally erect, rigid pinnae. Mingo formation, Bennetts Fork Coal Co.'s mine, on Bennetts Fork, 4½ miles southwest of Middlesboro, Ky. Cotypes, U. S. Nat. Mus. 40094a–c.

FIGURES 3, 7. *Diplothmema aldrichi* David White, n. sp 97

Fragments of fronds showing the lineate rachis with small subepidermal transverse bars, and the highly dissected pinnules. Lacoe collection; Black Creek seam, Jefferson, Birmingham quadrangle, Ala. Cotypes, U. S. Nat. Mus. 15031, 15044.

FIGURE 6. *Diplothmema minor* David White, n. sp 98

A fragment showing the small, compact pinnae. Mercer group, cut just southeast of Bingham, McKean County, Pa. Holotype, U. S. Nat. Mus. 40095.

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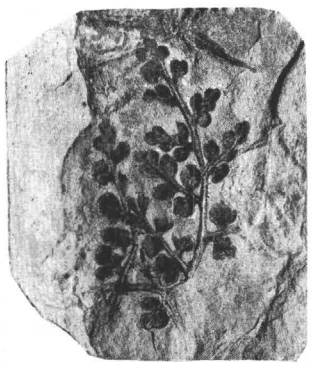
FIGURES 1–3. *Diplothmema trifoliolata* (Artis) Stur. 98

Apparently typical examples of this species. 1, Kanawha formation; 3 miles up Twentymile Creek from store at lower ford near mouth. 2, Peerless mine, Peerless, W. Va. 3, Cedar Grove vein; E. B. Coal and Coke Co.'s mine, Eastbank, W. Va. All in Kanawha Falls quadrangle, W. Va. U. S. Nat. Mus. 40096, 40097, 40098.

FIGURES 4–7. *Diplothmema composita* n. sp. 99

The lax types with large pinnules that characterize this form. Very low in the Pocahontas formation, milepost "P. 2," north of station, Bluestone Junction, W. Va. Cotypes, U. S. Nat. Mus. 40099a–d.



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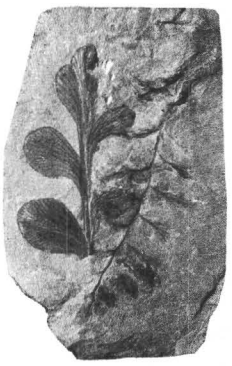

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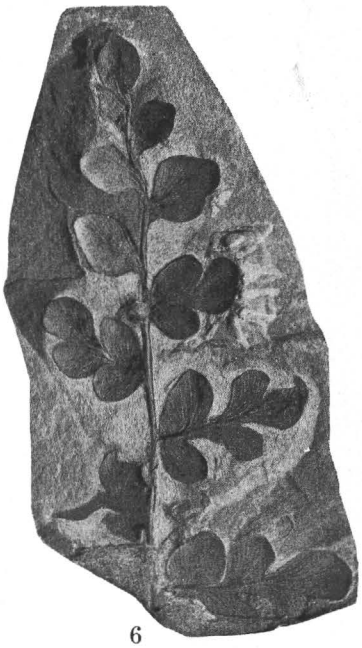

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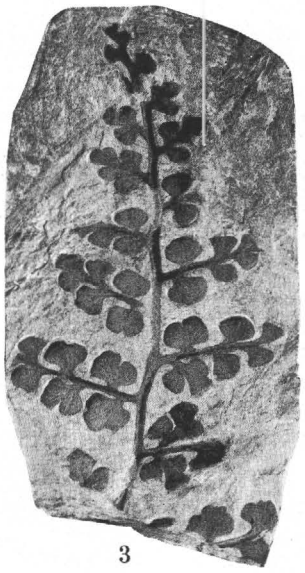

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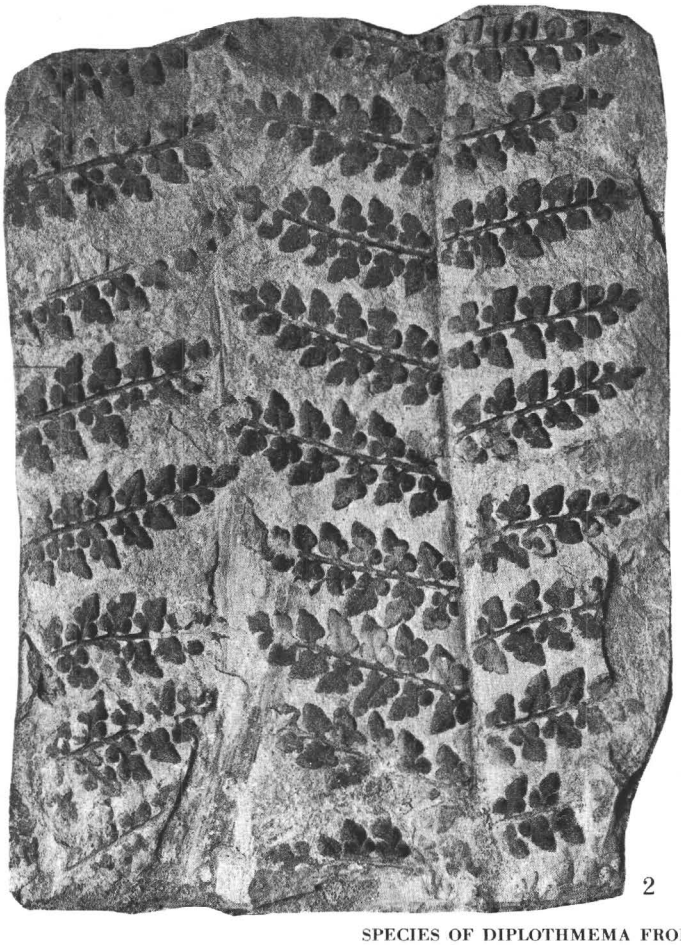

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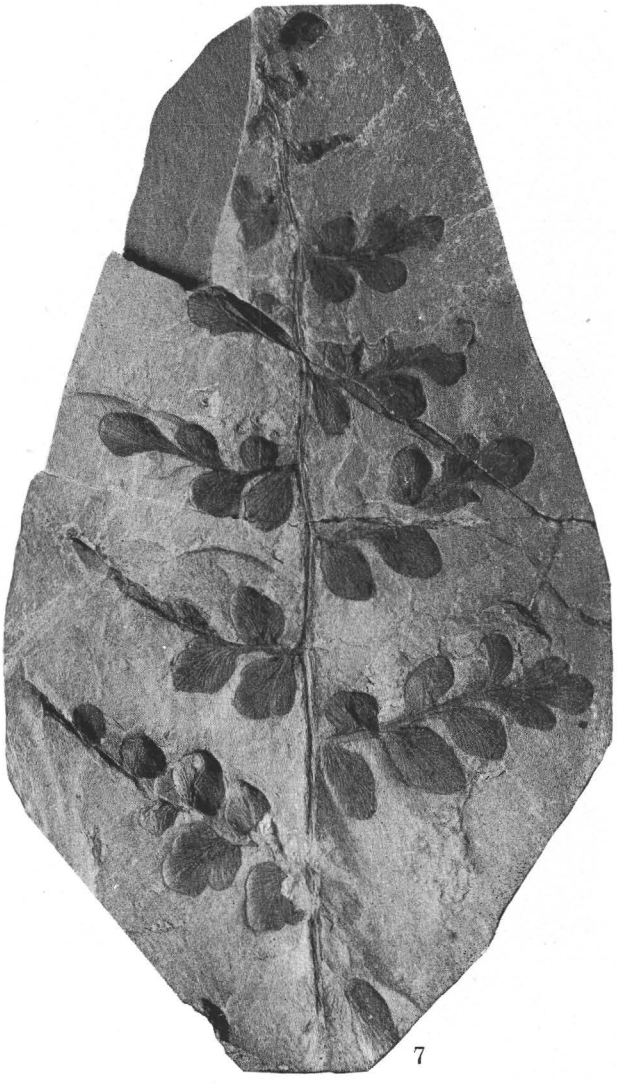

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SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.

SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.

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FIGURES 1–5. *Diplothmema trifoliolata* (Artis) var. *kanawensis* David White, n. var 98

This form is characterized by the great breadth and large size of the pinnules and lobes. 1, 3, 5, Kanawha formation, Wyoming mine, near Upper Creek, Kanawha County, W. Va.; figures 1 and 3, paratypes, U. S. Nat. Mus. 13624, 13622; figure 5, holotype, U. S. Nat. Mus. 13618. 2, Kanawha formation, old mine on coal about 30 feet above railroad, Handley, Kanawha Falls quadrangle, W. Va.; U. S. Nat. Mus. 40089. 4, Kanawha formation, Peerless mine, Peerless, Kanawha Falls quadrangle, W. Va.; U. S. Nat. Mus. 40090.

FIGURES 6, 9. *Diplothmema aldrichi* var. *anthracitica* David White, n. var 98

Sketch of venation in a typical pinnule, and a fragment showing the rather broadly attached, rounded pinnules. About 465 feet below Twin coal, 29 paces south of milepost 127, Pottsville Gap, Pa. Cotypes, U. S. Nat. Mus. 40091a, b.

FIGURES 7, 8. *Diplothmema erectiloba* David White, n. sp 100

Sketches showing general aspect and pinnule form. Welch formation, Horsepen schoolhouse, Tazewell quadrangle, W. Va. Holotype, U. S. Nat. Mus. 40092.

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FIGURE 1. *Diplothmema morrowensis* David White, n. sp 99

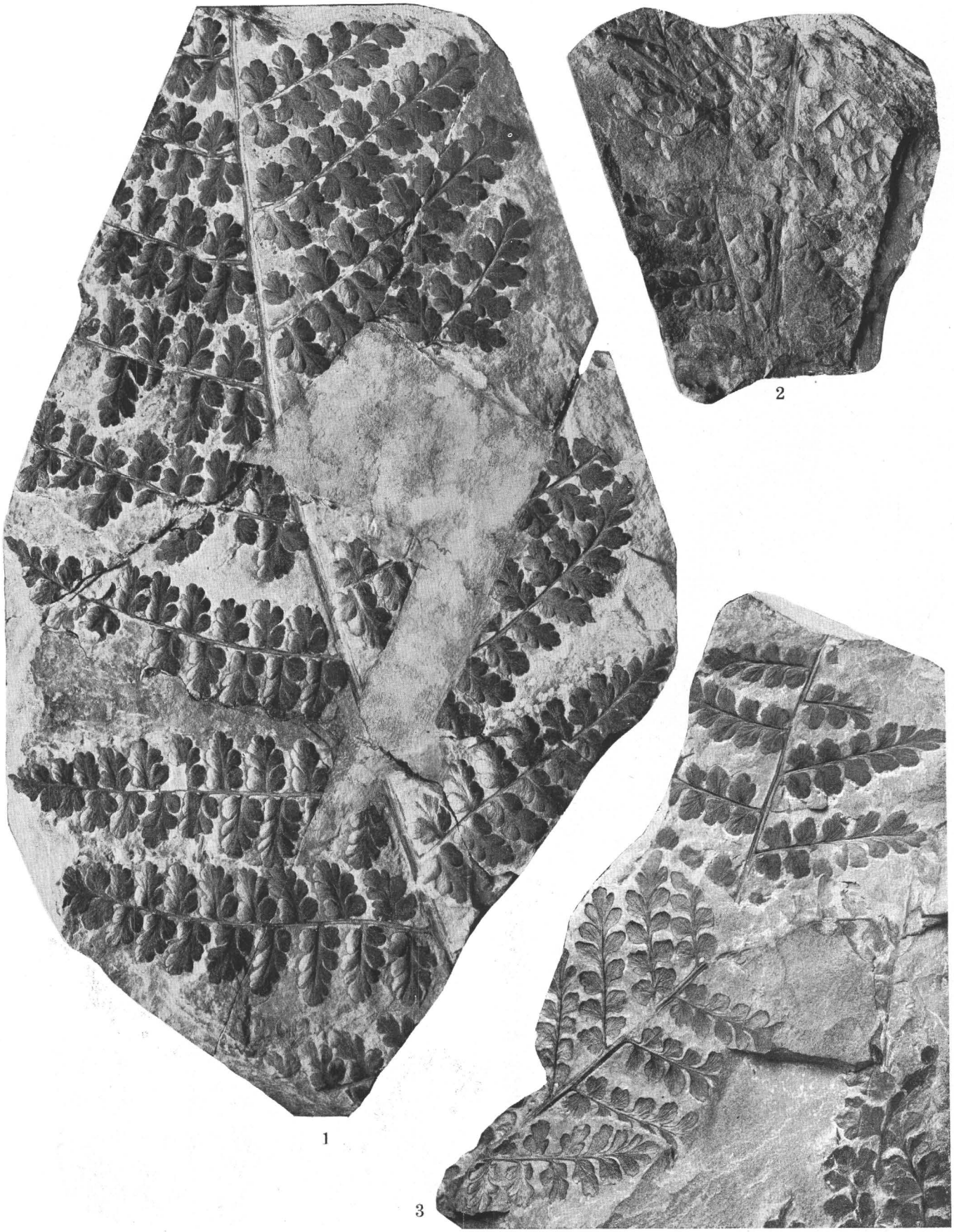
A large segment of a secondary pinna showing pinnule variation. Bloyd shale, Morrow formation, Washington County, Ark. Holotype, U. S. Nat. Mus. 15012.

FIGURE 2. *Diplothmema aldrichi* var. *anthracitica* David White, n. var 98

Specimens showing form of pinnae. About 465 feet below Twin Coal, 29 paces south of milepost 127, Pottsville Gap, Pa. Cotype, U. S. Nat. Mus. 40091a.

FIGURE 3. *Diplothmema aldrichi* David White, n. sp 97

Fragments from the upper part of a frond showing the large but slightly lobate pinnules. Precise horizon unknown, probably from Black Creek coal group, Warrior, Ala. Paratype, U. S. Nat. Mus. 40093.



SPECIES OF DIPLOTHMEMA FROM THE APPALACHIAN REGION.

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FIGURE 1. *Diplothmema morrowensis* David White, n. sp 99

Frond showing a part of the rachis and fragments of two large pinnae. Sewell formation, about 200 feet above Hampton sandstone, left fork of Stover Fork of Clear Fork (precise location not known), Raleigh County, W. Va. U. S. Nat. Mus. 40100.

FIGURES 2–6. *Diplothmema pygmaeoides* David White, n. sp 100

Specimens showing the small, compact pinnae and pinnules. Sewell formation, Peters Creek Pike between Ansted and Homewood, just above church above Winston, W. Va. Cotypes, U. S. Nat. Mus. 40101a–d.

FIGURES 7, 9. *Diplothmema obtusiloba* (Brongniart) Stur 97

Medial fragments of large pinnae. Block coal, Scott shale, Red Ash mine, 1 mile north of Careyville, Tenn. U. S. Nat. Mus. 40102b, c.

FIGURES 8, 10. *Diplothmema mendenhalli* David White, n. sp 100

Specimens showing the highly dissected *Eremopteris*-like aspect of the pinnules. Middle seam above schoolhouse, Horsepen group of coals, Lee formation, Horsepen, Va. Cotypes, U. S. Nat. Mus. 40103a, b.

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FIGURES 1–7, 9, 10. *Aneimites* (*Wardia*) *tenuifolius* (Göppert) David White, n. comb. 101

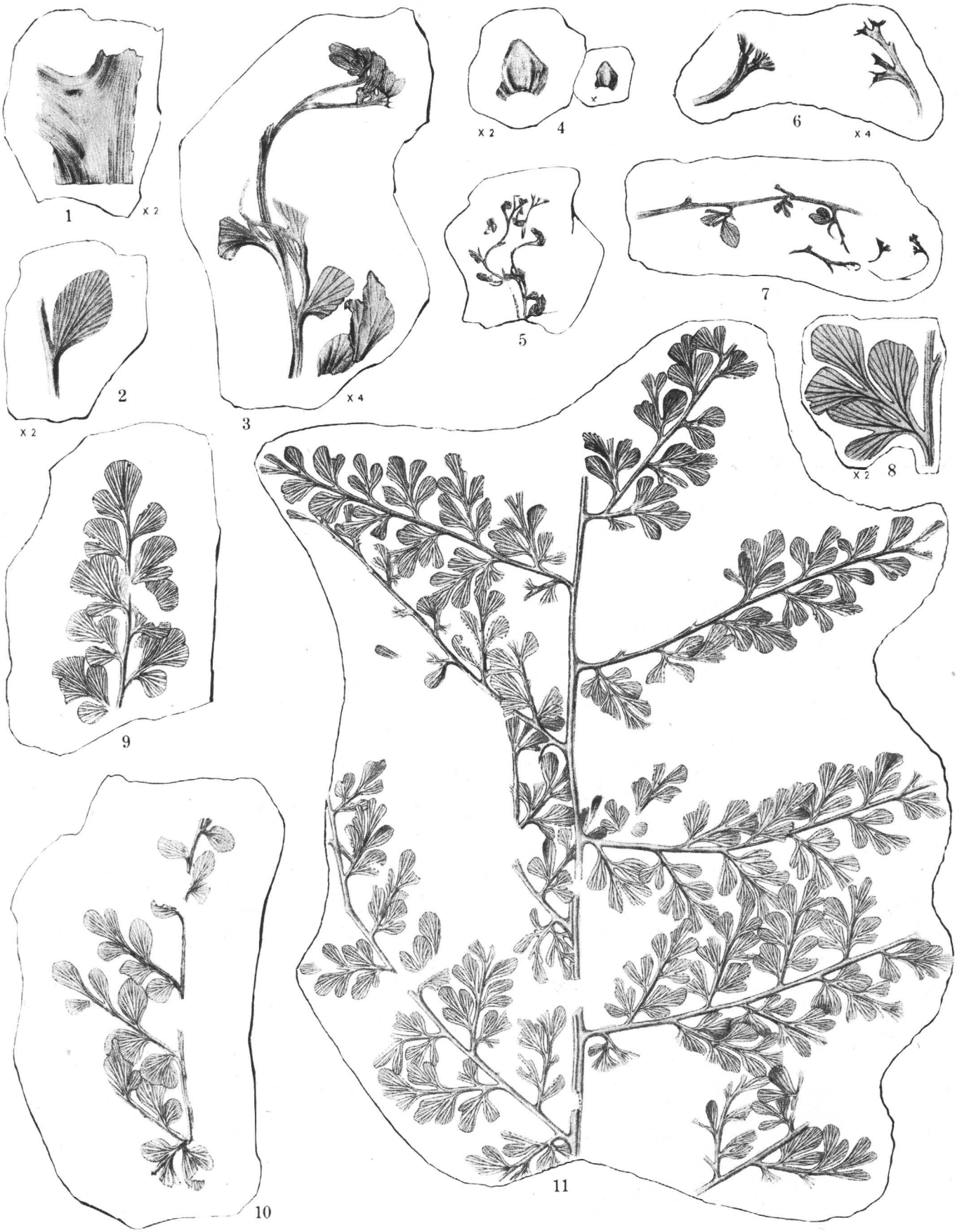
1. Fragment of rachis suggesting dichotomy. Thick bed of dark shale, Quinnimont shale, Raleigh-Private pike south of Piney Creek crossing. U. S. Nat. Mus. 40112.

2, 9, 10. Sterile segments of the frond. Shales beneath heavy sandstone about 300 feet below the Nuttall seam, Quinnimont shale, Nuttallburg, W. Va. U. S. Nat. Mus. 40113c, d.

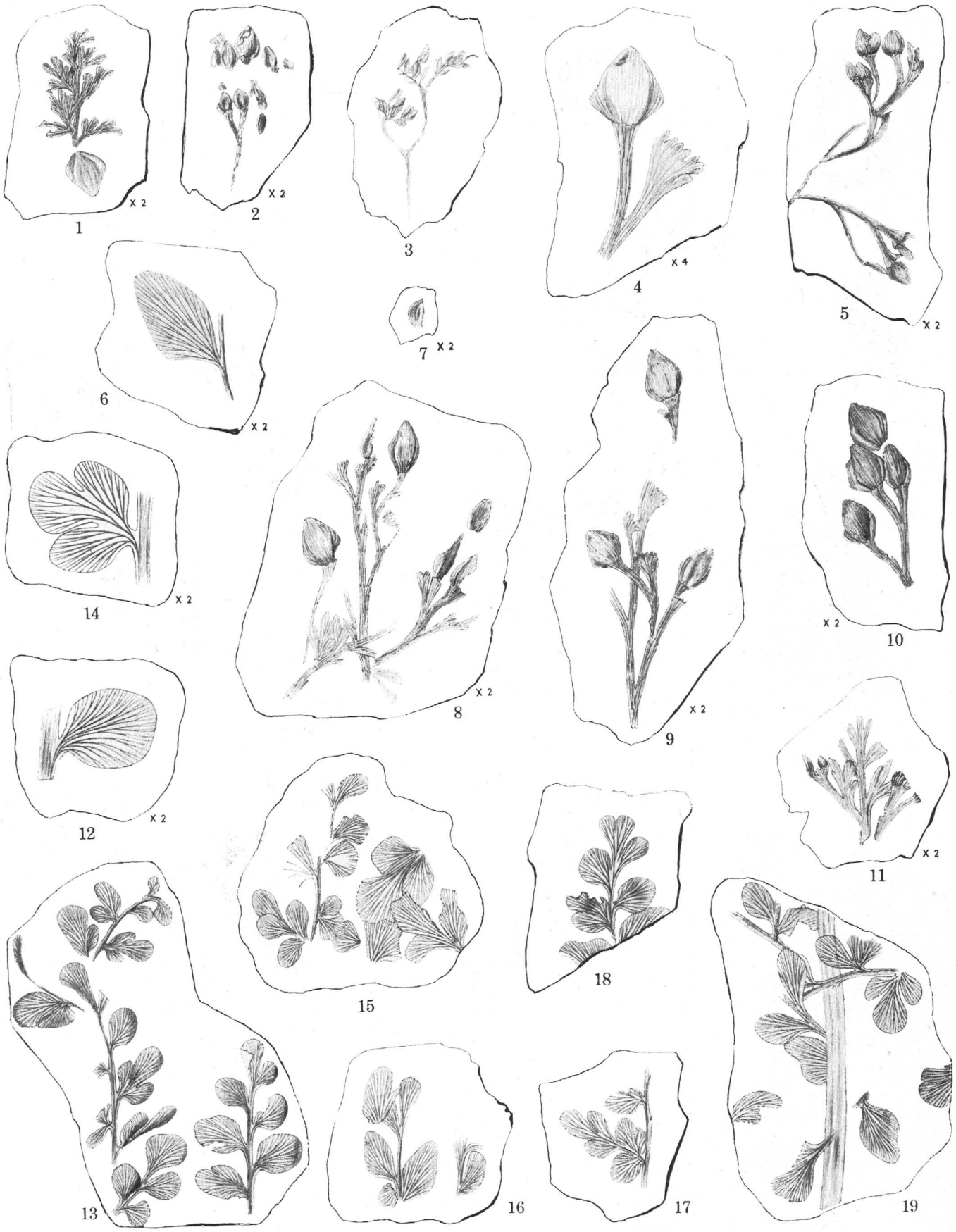
3–7. Fertile segments of the frond and seeds. Shales beneath heavy sandstone about 300 feet below the Nuttall seam, Quinnimont shale, Nuttallburg, W. Va. U. S. Nat. Mus. 40113a, b.

FIGURES 8, 11. *Aneimites* (*Wardia*) *tenuifolius* (Göppert) var. *difoliolatus* David White, n. var. 101

Sketches showing the aspect of this variety with its smaller pinnules and more marked difoliate or trifoliate lobation. Durham coal, Durham mines, Ringgold quadrangle, Ga. Cotype, U. S. Nat. Mus. 40114a.



SPECIES OF ANEIMITES FROM THE APPALACHIAN REGION.



SPECIES OF ANEIMITES FROM THE APPALACHIAN REGION.

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FIGURES 1–5, 7–11. *Aneimites* (*Wardia*) *fertilis* David White 101

Specimens showing the attached seeds (*Wardia*) referable to this form, together with the associated sterile leaf segments. Below second sandstone beneath Raleigh sandstone (360 feet below Raleigh sandstone), lower railroad cut, Nuttall, W. Va. Cotypes U. S. Nat. Mus. 40115a–f.

FIGURES 6, 15–18. *Aneimites pottsvillensis* David White, n. sp 102

Pinnae and pinnules showing form and venation. 6, 15, 16, Rock dump, old Lincoln Colliery, about 4 miles west of Tremont, Pa.; U. S. Nat. Mus. 40116a, b, 40117. 17, 18, Group of thin coals high in the series, Clark formation, north side of Clark's Gap, Great Flat Top Mountain, W. Va.; cotypes, U. S. Nat. Mus. 40118a, b.

FIGURES 12–14, 19. *Aneimites pottsvillensis* var. *intermedius* David White, n. var 102

Specimens showing the nature of this variety, which is more robust than the typical *A. pottsvillensis*. Durham coal, Durham mines, Ringgold quadrangle, Ga. Cotypes, U. S. Nat. Mus. 40119a–c.

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FIGURES 1–4, 19. *Aneimites* (*Wardia*) *cardiopteroides* David White, n. sp 103

Sketches showing the rounded *Cardiopteris*-like form of the pinnules and the associated seeds. Fifteen feet below cliff sandstone; near University mines, Suwanee, Tenn. Cotypes, U. S. Nat. Mus. 40120a-c.

FIGURES 5, 6, 9, 13, 15. *Aneimites* (*Wardia*) *pseudopecopteroides* David White, n. sp 103

Specimens showing the rather mariopterid or diplothmemoid appearance of the pinnules. Fire Creek seam, Rush Run, W. Va. Cotypes, U. S. Nat. Mus. 40121a, b.

FIGURES 7, 11, 16–18. *Aneimites polymorphus* David White, n. sp 103

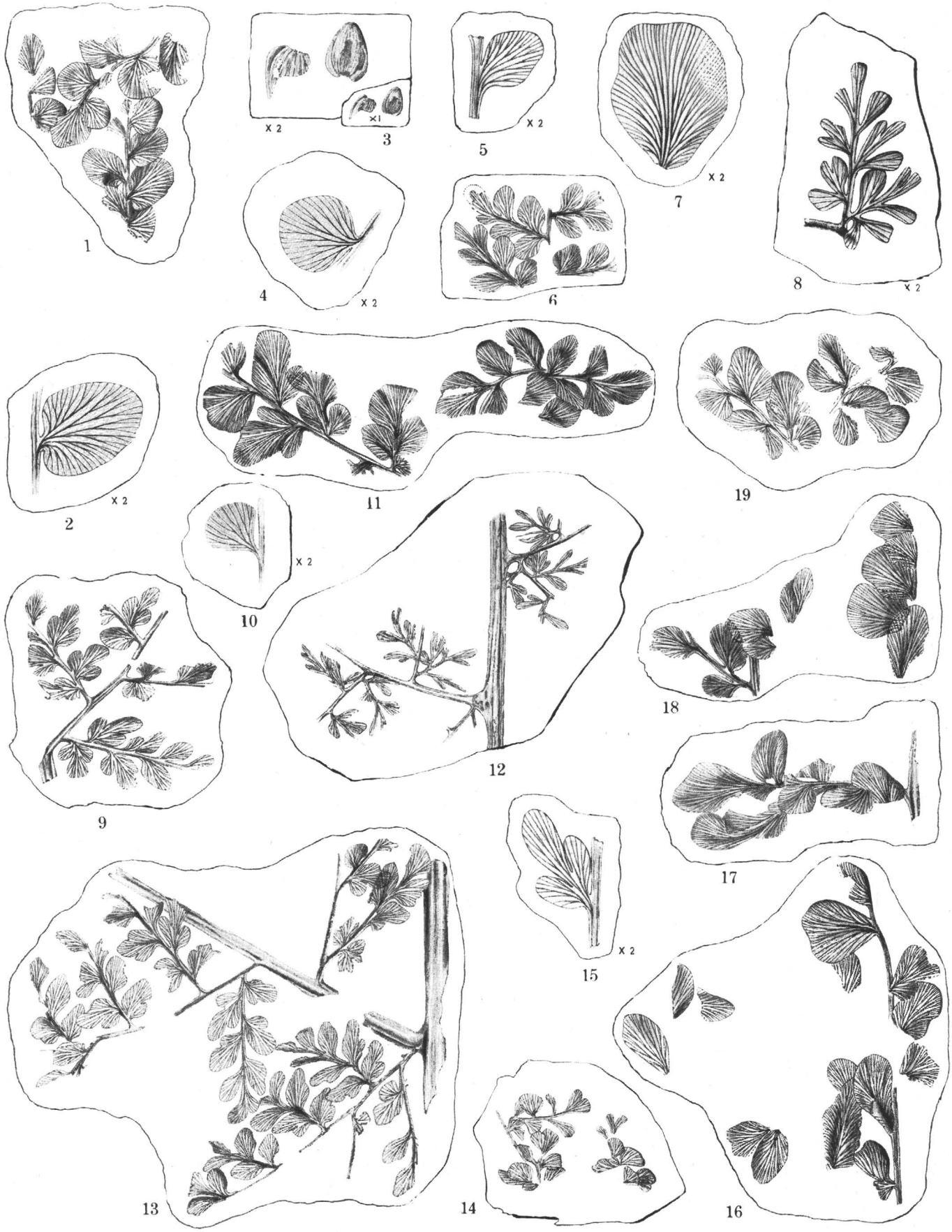
Specimens showing the variation in pinnules. Fire Creek seam, Rush Run, W. Va. Cotypes, U. S. Nat. Mus. 40122a-d.

FIGURES 8, 12. *Aneimites* (*Wardia*) *tenuifolius* var. *difoliolatus* David White, n. var 101

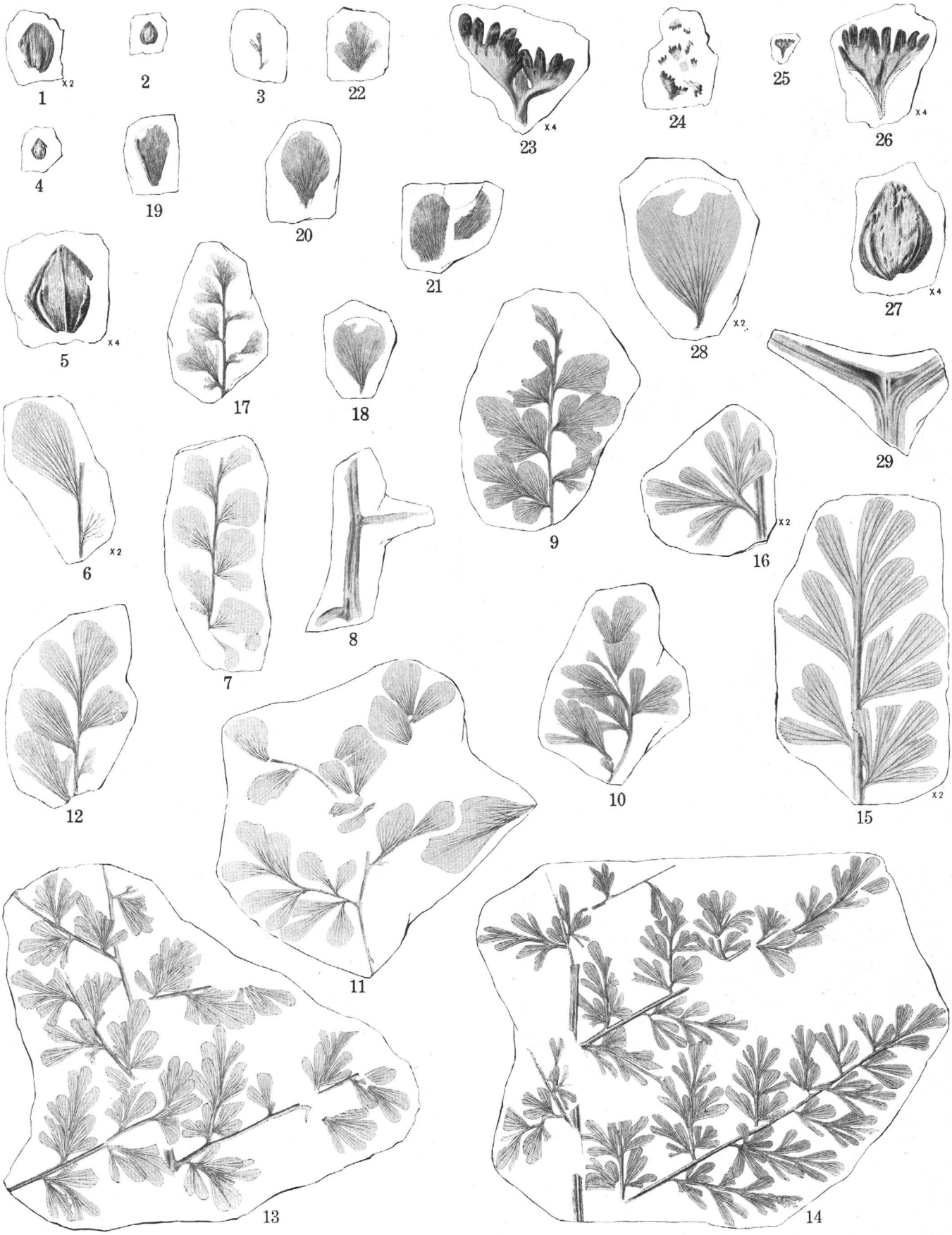
Specimens showing dissected and frequently bilobed or trilobed pinnules. Durham coal, Durham mines, Ringgold quadrangle, Ga. Cotypes, U. S. Nat. Mus. 40114b, c.

FIGURES 10, 14. *Aneimites* (*Wardia*) *tenuifolius* (Göppert) David White, n. comb 101

The typical form given for comparison with var. *difoliolatus*. Near supposed Pocahontas coal horizon, 500 feet above base of lower Piney Creek conglomerate, road to Quinnimont mine, Quinnimont, W. Va. U. S. Nat. Mus. 40123.



SPECIES OF ANEIMITES FROM THE APPALACHIAN REGION.



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FIGURES 1–12, 17–29. *Aneimites* (*Wardia*) *virginianus* David White, n. sp. 101

Seeds, cupules, and sterile segments of the fronds showing pinnule form. 1, 17–22, 28, Pocahontas formation, shales between the sandstones south of block signal south of station, Norfolk & Western Railroad, Bluestone Junction, 3 miles southeast of Pocahontas, W. Va.; cotypes, U. S. Nat. Mus. 2–12, 23–27, 29, New River formation, just below the falls of Mill Creek, Buckhannon quadrangle, W. Va.; U. S. Nat. Mus.

FIGURES 13–16. *Ancimites* (*Wardia*) *fertilis* David White 101

Fragments of the fronds showing pinnule form. Below second sandstone beneath Raleigh sandstone (360 feet below Raleigh sandstone), lower railroad cut, Nuttall, W. Va. Cotypes, U. S. Nat. Mus. 40124a, b.

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