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THE UPPER CRETACEOUS FLORAS OF ALASKA

BY

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WITH

A DESCRIPTION OF THE PLANT-BEARING BEDS

BY

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CONTENTS

ILLUSTRATIONS

INSERT

FOREWORD

By Philip S. Smith

Vestiges of former life preserved in the rocks as fossils have long interested laymen and aided scientists in reconstructing the events through which the earth has passed. Fossil plants are widespread in certain formations in Alaska, and because of their obvious vegetable origin they were early recognized, collected, and studied. Even the pioneer maritime explorers of Alaska, in the midst of their more immediate tasks, found time to collect specimens of rocks and fossils from many points and brought them back to be deposited in the museums of the world. Dr. W. H. Dall, the earliest American scientist to explore parts of Alaska, noted the presence of fossil plants in many places, and Prof. I. C. Russell, the first Federal geologist to visit Alaska, made several collections of fossil plants at localities on the Yukon. Later, in the course of the systematic surveys made by the United States Geological Survey, the amount of information and of material collected has increased manyfold. The resulting data are scattered through many volumes, which are not readily accessible, and heretofore many of the collections had not been studied and described in detail and little attempt had been made to discuss the broad aspects of certain related groups of rocks. To remedy this condition the present volume was undertaken to present in one place an adequate description of the fossil plants and general geology of the Upper Cretaceous epoch of Alaska. It is planned that from time to time similar descriptions of other systems or epochs will be prepared, and already Doctor Hollick has done considerable work on the manuscript for a report on the Tertiary floras of Alaska.

Doctor Hollick began his study of Alaskan floras by field examinations at a number of localities on Yukon River in 1903. Since that time he has examined not only his own material but also most of the collections made by other Alaskan geologists. Doctor Martin began his special studies of Alaska Mesozoic stratigraphy nearly 25 years ago, incidentally to his investigation of the coal and petroleum resources of the Territory. As an outcome of that study he has already written the most authoritative statement on the general stratigraphy of the Mesozoic rocks of Alaska,[1] in which he discusses at greater length all of the Mesozoic section as well as some of the details of the Upper Cretaceous section that are given only in abbreviated form in the present volume.

Although, as stated before, it was intended to make this volume complete, its publication has been so slow and the accumulation of new data has been so rapid that it has been impossible to maintain that ideal. The manuscript of the report was completed in 1924, just about the time that the Geological Survey undertook extensive explorations and new investigations in northern Alaska, which have lasted until now and have yielded additional Upper Cretaceous plants and other fossils. As revision of the manuscript to include these results would have still longer delayed publication, it has been sent forward without them. It is, therefore, complete only for the Upper Cretaceous floras and rocks south of the Brooks Range. It should, however, serve a useful and instructive purpose in bringing together information regarding this interesting epoch in the earth's history and regarding a group of rocks that are of much economic significance because of the coals that are found in them.

[1] Martin, G. C., The Mesozoic stratigraphy of Alaska: U. S. Geol. Survey Bull. 776, 493 pp., 1926.

THE UPPER CRETACEOUS FLORAS OF ALASKA

By Arthur Hollick

INTRODUCTION

OBJECT AND SCOPE OF THIS PAPER

The object of this paper is to describe and discuss the Upper Cretaceous floras of Alaska and to correlate them as closely as may be with equivalent floras of other regions. It is also designed to include references to previous records in which the fossil plants were mentioned or in which items of geologic importance or interest in relation to them were described and information regarding facts discovered in recent years, together with discussions of their geologic and botanic significance.

PREVIOUS INVESTIGATIONS OF ALASKAN UPPER CRETACEOUS PLANTS

HISTORICAL REVIEW OF PERIOD 1850 TO 1900

It is only within the present century that fossil plant remains of Cretaceous age were definitely known to occur in Alaska, although specimens of Cretaceous leaves were collected but not recognized as such at the time by several explorers before 1900. Certain of these specimens, subsequently shown to be of Cretaceous age, were at first erroneously identified as Tertiary species; and other specimens, subsequently determined to be of Jurassic age, were at first tentatively identified as Cretaceous species. References to these early errors of identification and subsequent corrections will be cited and discussed in their proper chronologic sequence.

During the period from 1850 to 1870 the Tertiary flora of Alaska was described and discussed by Grewingk, Goeppert, and Heer; but the earliest definite reference to the Cretaceous system in Alaska appears to have been made by Eichwald,[1] in 1871. No mention is made, however, of any Cretaceous species of plants, and the invertebrates described as Cretaceous are now known to be in large part Jurassic and probably most of the others are Tertiary.

In 1888 a number of notes on and descriptions of fossil plants, written by Lesquereux and compiled and prepared for publication by Knowlton,[2] were issued. In this paper 10 species are listed from "Cape Lisbourne, Alaska," 8 of which are referred to previously described Cretaceous species and 2 are described as new, and the opinion is expressed that their age is "probably Neocomian." These specimens, however, and others collected in the Cape Lisburne region, were subsequently studied and described by Fontaine,[3] who concluded that "the age of the formation yielding the Alaskan fossils, as indicated by them, is not older than the Lower Oolite, and not younger than the Lower Cretaceous, but is probably between them"; and, on the basis of this conclusion, Ward designated the age of the plants as "Jurasso-Cretaceous." Knowlton,[4] however, determined them, without reservation, to be Jurassic; and this view was reiterated and discussed, with additional supporting data, in a subsequent paper.[5]

In 1890 were published Russell's records of a trip made in 1889 from the delta to the headwaters of Yukon River.[6] No mention is made of fossil plants, but a few specimens were collected, which evidently came from the vicinity of Nulato, as indicated by the accompanying field labels; and those that are sufficiently well preserved for satisfactory study have been identified as Cretaceous species. (See pp. 83, 85; pl. 46, figs. 1, 2.)

In 1896 Dall[7] mentioned the occurrence of fossil plant remains at several localities in the "upper Yukon and Nulato" regions, where Cretaceous plants

[1] Eichwald, Eduard von, Die Miocän- und Kreideformation von Alaska und den Aleutischen Inseln: Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, St. Petersburg, 1871.

[2] Lesquereux, Leo, and Knowlton, F. H., Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc., with descriptions of new species: U. S. Nat. Mus. Proc., vol. 11, pp. 11–38, pls. 4–16, 1888.

[3] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, pp. 153–175, pls. 38–45, 1905.

[4] Knowlton, F. H., in Collier, A. J., Geology and coal resources of the Cape Lisburne region, Alaska: U. S. Geol. Survey Bull. 278, pp. 29, 30, 1906.

[5] Knowlton, F. H., The Jurassic flora of Cape Lisburne, Alaska: U. S. Geol. Survey Prof. Paper 85, pp. 39–64, pls. 5–8, 1914.

[6] Russell, I. C., Notes on the surface geology of Alaska: Geol. Soc. America Bull., vol. 1, pp. 99–162, pl. 2, 1890.

[7] Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 1, pp. 763–906, 1896.

were subsequently collected in abundance. No species are mentioned, however, nor are any from this region listed in Knowlton's accompanying report.[8]

A few specimens of fossil leaves were collected by Dall, who assured me that these were found at the locality described by him as "about 7 miles below Nulato," in connection with which he mentioned[9]

> a small bluff * * * at the extreme end of which the sandstones are nearly vertical. Here, between two contorted layers of shaly rock, a small coal seam was examined in December, 1866. * * * The shale contained obscure vegetable remains. * * * Near Melozikakat the bluffs appear also in the left bank. * * * Russell has also noted the leaf beds 15 or 20 miles below the mouth of the Melozikakat, on the right bank of the Yukon.

In 1898 three of the specimens collected by Dall were described and figured by Newberry[10] and erroneously referred to the Tertiary species *Pterospermites dentatus* Heer, probably in deference to the then prevailing opinion that all the plant-bearing strata of the Yukon region were of Tertiary age. These specimens, however, are now known to represent Cretaceous species. (See p. 86; pl. 58, figs. 1, 2; p. 94, pl. 71, figs. 1, 2; p. 95, pl. 72, figs. 1, 2.)

In 1898 Knowlton[11] gave a list of 10 plant localities on Yukon River, with identifications, mostly provisional, of nine species, all regarded as Tertiary. "A small fern somewhat resembling *Pecopteris arctica* Heer but probably representing a new species," collected "below Melozikakat," was thought to be Eocene, but inasmuch as this locality is in a region where Cretaceous plants only were subsequently found, the Cretaceous age of this specimen may be assumed with reasonable certainty, although, not having seen the specimen, I am unable to determine its specific identity. (See p. 3.) Another locality, described as "below Mission Creek," yielded four species, all of them assigned to the Tertiary. This locality, in a general way, is within a Cretaceous area, and the probability appears to be that the identifications were erroneous, as I have carefully examined the specimens included in this collection and find them all to be clearly referable to Cretaceous species. Unfortunately, however, there is no indication as to the particular specimens upon which Knowlton based his identifications.

In 1900 Schrader[12] noted the finding of Upper Cretaceous invertebrates but did not mention any identifications of fossil plants, although he stated that "such fossil plant remains as could be collected were examined by Dr. F. H. Knowlton." However, a considerable collection was made, and all the definitely identifiable material, recently examined, proves to be of Cretaceous age.

From the foregoing historical summary it may be realized that very little information relating to the Cretaceous flora of Alaska was recorded up to the end of 1900.

HISTORICAL REVIEW OF PERIOD SUBSEQUENT TO 1900

In 1902 Collier[13] made a geologic reconnaissance of the Yukon region and collected fossil plants at a number of localities. The collections were examined by Knowlton and later by me. Some were definitely identified as consisting of Tertiary species, and others were identified as definitely or probably Cretaceous. Certain of the collections also contained floral elements that appeared to indicate a possible Jurassic age.

In 1903 I was detailed to make further investigations in the Yukon region, with the special object of making collections of fossil plants at all available localities and determining, if possible, their correct stratigraphic relations. One of the results of these investigations was the collection of a large amount of paleobotanic material at some 40 localities on the banks of Yukon River between Eagle and Anvik, from 24 of which Cretaceous plants were identified.

In 1907 Atwood made further collections of Cretaceous plant remains at localities on the north bank of the Yukon, between Melozi telegraph station and Kaltag, and in 1913 Eakin[14] explored the region between Yukon and Koyukuk Rivers and determined the Cretaceous age of extensive rock exposures, in connection with which paleobotanic evidence was an important factor. Reports by Knowlton on Cretaceous plants collected by Atwood in 1907 are included in Eakin's discussion of the age and correlation of the Mesozoic sedimentary rocks,[15] and in 1914 Martin collected similar material on the south bank of the Yukon a short distance below Seventymile Creek. The specimens included in these several collections, together with those collected by Dall, Russell, Spurr, and Schrader, previously mentioned, constitute the source of information upon which the description of the Cretaceous flora of the Yukon River region is based.

In the meantime and also subsequently explorations and investigations on the Alaska Peninsula and the adjacent mainland, by Martin, Stanton, Stone, Paige, Atwood, Eakin, and others, resulted in the collection of a large amount of additional Cretaceous material, at a number of localities between Chignik Bay and

[8] Knowlton, F. H., Report on the fossil plants collected in Alaska in 1895, as well as an enumeration of those previously known from the same region, with a table showing their relative distribution: Idem, pp. 876–891, 1896.

[9] Dall, W. H., op. cit., pp. 817, 818.

[10] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 133, pl. 53, figs. 1, 2; pl. 54, fig. 4, 1898.

[11] Knowlton, F. H., Report on a collection of fossil plants from the Yukon River, Alaska, obtained by Mr. J. E. Spurr and party during the summer of 1896, in Spurr, J. E., Geology of the Yukon gold district, Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 194–196, 1898.

[12] Schrader, F. C., Preliminary report on a reconnaissance along the Chandlar and Koyukuk Rivers, Alaska, in 1899: U. S. Geol. Survey Twenty-first Ann. Rept., pt. 2, pp. 441–486, pls. 60–68, 1900.

[13] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, 1903.

[14] Eakin, H. M., The Yukon-Koyukuk region, Alaska: U. S. Geol. Survey Bull. 631, 1916.

[15] Idem, pp. 47–48.

Pavlof Bay. Preliminary reports on certain of these collections were made by Knowlton and by me.[16] Later, after more critical examination of all the specimens in the collections, certain of the identifications of species in these preliminary reports were determined to be erroneous, and some of the original conclusions in regard to their geologic age were changed or modified. These preliminary reports and recent critical examinations of all identifiable specimens in the collections have furnished the data for the description of the Cretaceous flora of the Alaska Peninsula region.

EARLIER LISTS OF SPECIES

Descriptions of all the localities where Cretaceous plants have been collected, with complete lists of the species at each locality as determined by me, are given by Martin in the tables on pages 15–16, 25–31. Preliminary lists of the species occurring at some of these localities, as determined by Knowlton, have been published by several authors. These lists are cited below, with comments.

Yukon River, about 25 miles below Mission Creek; Spurr, 1896 (lot 1555). This lot was originally determined to be of Tertiary age,[17] but when, subsequently, larger and better collections from this and near-by localities were examined the specimens were identified as Cretaceous species.

Yukon River, north bank, 10 miles below Melozi station; Atwood, 1907 (lot 4633, original No. 18). Preliminary identifications of material from this locality, by Knowlton,[18] were as follows:

- Ginkgo multinervis Heer.
- Podozamites? sp.
- Dicotyledonous fragments.

Yukon River, north bank, 12 miles below Melozi station; Atwood, 1907 (lot 4634, original No. 20). Preliminary identifications of material from this locality, by Knowlton,[19] were as follows:

- Platanus heerii Lesquereux.
- Zizyphus sp.
- Quercus sp.

Yukon River, north bank "below Melozikakat"; Spurr, 1896. A small collection of fossil plant remains from this locality was examined and reported upon by Knowlton,[20] who listed them as follows:

- Pecopteris arctica Heer.
- Dicotyledonous leaves, indeterminable.
- Wood.

In regard to these he remarked: "The only form from locality 9 (below Melozikakat) that I have been able to determine is a small fern somewhat resembling *Pecopteris arctica* Heer but probably representing a new species." The type of *Pecopteris arctica* Heer[21] was based upon a specimen from the Lower Cretaceous (Kome beds) of Greenland. The specimen, as figured, is shown associated with a twig of *Sequoia reichenbachi* (Geinitz) Heer, in a single piece of matrix. Heer was evidently not certain in regard to the generic or specific validity of the specimen and remarked, "Ist der *Gleichenia zippei* ähnlich." He also compared it with *Pecopteris borealis* Brongniart,[22] of which he reproduced Brongniart's figures for comparison,[23] and also figured two specimens from the Kome beds that he identified as this species. Brongniart's specimens came from Greenland, but he was under the impression they were of Carboniferous age and hence referred his species to the Paleozoic genus *Pecopteris*, and this generic name was adopted by Heer. Both *Pecopteris arctica* and *Pecopteris borealis* are suggestive of the genus *Gleichenia*, and they are also similar in appearance to *Anemia supercretacea conformis* n. var. (see p. 40, pl. 1, figs. 6, 7) and it appears to be probable that the "small fern somewhat resembling *Pecopteris arctica*," as identified by Knowlton, may have been a specimen of this new variety.

Yukon River, north bank, 5 miles above Louden station [Nahochatilton]; Atwood, 1907 (lots 4635, 4636; original Nos. 22, 22A). Preliminary identifications of material in lot 4635, by Knowlton,[24] were as follows:

- Dicksonia? sp.
- Podozamites lanceolatus (Lindley and Hutton).
- Zamites sp.
- Ginkgo sp.
- Sequoia sp.

Yukon River, north bank, "Fossil Bluff," 4¾ miles above Nahochatilton; Collier, 1902 (lot 2962; original No. 2AC238). Lots 2962, 3252, and 3536 represent fossil plants that were all collected within the area designated by the locality name "Fossil Bluff," and they may be regarded as representing a phytogeographic unit. Also, the general appearance of the matrix is identical in all of the three collections, consisting of a fine-grained calcareous sandstone, markedly different from any of the sandstones and shales of the plant-bearing beds elsewhere in the Yukon River region. The general floral facies is identical with that of the other collections from the region, but the flora shows a higher percentage of pteridophytes and gymnosperms. This fact may indicate that these three collections represent a horizon that is slightly older than any of the others, or that they may represent merely an environmental phase of the same period of deposition.

Yukon River, north bank, at Bishop Rock, near the mouth of Koyukuk River; Atwood, 1907 (lot 4637; original No. 24). This is a relatively isolated locality, at which only a very small collection was made. The matrix in which the plant remains occur is a grayish sandstone with a yellowish tinge, similar to sandstones at several of the localities in the district above and below on Yukon River. The plant remains are few, fragmentary, and difficult to identify satisfactorily. A preliminary examination of the material by Knowlton[25] was reported upon as follows: "One specimen only, *Sequoia subulata* Heer; Cretaceous." From a careful examination of all the available fossil plant remains the indications appear to be that the plant-bearing beds at this locality are Upper Cretaceous, and this view is strengthened by Stanton's identifications[26] of Upper Cretaceous mollusks from the same locality.

Andreafski River, east bank, 9.2 miles northeast of Andreafski; Harrington, 1916 (lot 7259; original No. 136). Prelimi-

[16] Knowlton, F. H., and Hollick, Arthur, in Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, pp. 44–45, 46, 54, 56–57, 1911.

[17] Knowlton, F. H., in Spurr, J. E., Geology of the Yukon gold district, Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, p. 194, 1898.

[18] Knowlton, F. H., in Eakin, H. M., The Yukon-Koyukuk region, Alaska: U. S. Geol. Survey Bull. 631, p. 47, 1916.

[19] Idem, p. 48.

[20] Knowlton, F. H., in Spurr, J. E., op. cit., pp. 194–196.

[21] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 80, pl. 43, fig. 5b, 1868.

[22] Brongniart, A. T., Histoire des végétaux fossiles, vol. 1, p. 354, pl. 119, figs. 1, 2, Paris, 1828–1836.

[23] Heer, Oswald, op. cit., pl. 1, figs. 13, 14.

[24] Knowlton, F. H., in Eakin, H. M., op. cit., p. 48.

[25] Idem, p. 48.

[26] Stanton, T. W., idem, p. 47.

nary identifications of material from this locality by Knowlton[27] were as follows:

Fragments of bark and wood.
Fragments of dicotyledons of two kinds, with little or no margins preserved.
Podozamites lanceolatus.
Taxodium sp.

Anchorage Bay, opposite Northwestern Fishery Co.'s cannery; Atwood, 1908 (lot 5294; original No. 48). This collection is tentatively regarded as Cretaceous, but the material available for study is very fragmentary. Knowlton[28] determined the age of the plant remains as Kenai, and I arrived at the same conclusion as a result of preliminary examination. More recent examination of all the available material, however, appears to indicate that the identifiable plant remains are of Cretaceous age.

Chignik Lagoon, south side, near entrance, Niggerhead series of beds; Atwood, 1908 (lot 5295; original No. 49). Preliminary identifications of material from this locality, by Knowlton,[29] were as follows:

Taxodium? sp.
Sequoia rigida Heer?
Pterophyllum lepidum? Heer.
Adiantum formosum Heer.
Ferns, two species.
Dicotyledons.

In 1904 Stanton[30] made a collection of fossil plants (lot 3521) at about the same locality, in which Knowlton identified the following species:

Osmunda arctica Heer.
Sequoia reichenbachi (Geinitz) Heer.
Sequoia rigida Heer.
Taxodium sp.
Torreya parvifolia Heer [erroneously printed T. brevifolia].
Anomozamites schmidtii Heer.
Zamites sp.
Myrica sp.
Quercus johnstrupi Heer.
Quercus n. sp.
Zizyphus sp.

Chignik River, just below Long Bay, Alaska Peninsula; Atwood, 1908 (lot 5296; original No. 54). Knowlton[31] identified *Trapa? microphylla* Lesquereux in the material included in this collection, in regard to which he remarked: "This form of *Trapa* * * * has now been found to have so wide a vertical range that it can not be employed in close fixation of age, though I should incline to think it probably Cretaceous."

Chignik River, just below Long Bay; Atwood, 1908 (lot 5297; original No. 55). Preliminary identifications of material from this locality, by Knowlton,[31] were as follows:

Pterophyllum lepidum? Heer.
Conifers, ferns, and dicotyledons.

This lot is from the same locality as lot 5296, but stratigraphically 30 feet above it. The matrix in all the collections from the Chignik Bay district is strikingly uniform in general lithologic character—a dark-gray to almost black shale that has the appearance of representing a single lithologic unit throughout.

[27] Knowlton, F. H., in Harrington, G. L., The Anvik-Andreafski region, Alaska: U. S. Geol. Survey Bull. 683, p. 33, 1918.

[28] Knowlton, F. H., in Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, p. 54, 1911.

[29] Idem, p. 44.

[30] Stanton, T. W., Geol. Soc. America Bull., vol. 16, p. 408, 1905; in Atwood, W. W., U. S. Geol. Survey Bull. 467, p. 45, 1911.

[31] Knowlton, F. H., in Atwood, W. W., op. cit., p. 44.

Port Moller, 2 miles up canyon west from Mud Bay; Atwood, 1908 (lot 5187; original No. 35). Preliminary identifications of material from this locality, by Knowlton,[32] were as follows:

Anomozamites sp.
Pterophyllum sp.
Nilssonia sp.
Hausmannia sp.
Ginkgo sp.
Quercus? sp.
Betula? sp.
Taxodium or Sequoia sp.

The matrix is a yellowish-gray, somewhat shaly sandstone, uniform in its character throughout the collection.

Coal mines in Coal Bluff, Herendeen Bay; Atwood, 1908 (lot 5185; original No. 31). This is, in certain aspects, a rather puzzling collection. Three distinct kinds of matrix are represented—a light-gray sandstone, a fine-grained calcareous sandstone, and a dark-gray shale. The floral elements also appear to be representative of different horizons, although only 3 in the list of 19 species from the locality are definitely identified as previously described species—two of which (*Nilssonia serotina*, from the Gyliakian of the Island of Sakhalin, and *Populus elliptica*, from the Dakota of Nebraska) are early Upper Cretaceous, and one (*Dryophyllum bruneri*, from the Montana group of Wyoming and Colorado) is late Upper Cretaceous. The principal part of the collection, represented by the light-gray sandstone matrix, includes a flora in which the angiosperms indicate an extreme Upper Cretaceous and the gymnosperms an early Upper Cretaceous age.

Coal Creek, right branch, below first side stream, Herendeen Bay; Paige, 1905 (lot 3708). Preliminary identifications, by Knowlton,[32] of material from this locality were as follows:

Anomozamites cf. A. schmidtii Heer.
Cone, probably of Sequoia.
Fragments of dicotyledons.

A locality designated "right bank of Coal Creek, first tunnel," Paige, 1905 (lot 3710?) yielded

Sequoia sp.?
Pterophyllum cf. P. concinnum Heer?

Coal Creek, right branch, 200 feet above forks, Herendeen Bay; Paige, 1905 (lot 3709). Preliminary identifications of material from this locality, by Knowlton,[32] were not conclusive as to species, and the geologic age of the plant-bearing beds was regarded as uncertain. Knowlton says: "The plant remains, aside from a fragment of a dicotyledon, consist almost entirely of delicate coniferous branchlets. This species was at first supposed to be *Taxodium distichum miocenum*, but more careful study appears to indicate that it is an undescribed species of *Sequoia*. The age of these beds is uncertain but is probably similar to that of the other lots [3708 and 3710]. None of the present lots contain any of the species found in the [Tertiary] material collected at Herendeen Bay by Townsend."

Mine [Coal?] Creek, Herendeen Bay, Alaska Peninsula; Eakin, 1908 (lot 5184; original No. 30). Preliminary identifications by Knowlton[32] of specimens from this locality were as follows:

Sequoia langsdorfii (Brongniart) Heer.
Fragments of dicotyledones, cf. Phaseolites formus Lesquereux.

"Coal measures of Herendeen Bay;" Locke, 1900. *Pterophyllum alaskense* Fontaine.[33]

[32] Idem, p. 46.

[33] Fontaine, W. M., in Ward, L. F., and others, Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, pt. 1, p. 152; pt. 2, pl. 38, figs. 19, 20, 1905.

Pavlof Bay, east side; Atwood 1908 (lot 5189; original No. 44). This collection, in its entirety, includes two distinct lots of specimens, both recorded from the same locality. Unfortunately all were listed under one number, and they could not be differentiated with certainty. Two kinds of matrix, however, may be readily recognized—a light-gray sandstone, similar to that of lot 5185, from Coal Bluff, Herendeen Bay, and a dark-colored shale. From a preliminary examination of all the material the age of one of the lots was determined by Knowlton [34] as "probably Kenai." The species listed are, with one exception (*Persea hayana* Lesquereux?, see p. 81), contained in the sandstone matrix. It is possible that two geologic horizons may be represented in the two lots collected at this locality and included under the one lot number.

GENERAL DISCUSSION OF THE FLORAS

STRATIGRAPHIC RELATIONS

The Cretaceous flora of Alaska, as described and discussed in this paper, consists of two quite distinct groups or assemblages, in each of which a distinguishing facies may be readily recognized. One is represented by the collections from the Yukon River region (see fig. 1), and the other by those from the Alaska Peninsula region; and an analysis of all the floral elements indicates that each group, or assemblage of collections, represents a more or less distinct geologic horizon—that of the Yukon River region being the older. Further, more critical analysis shows that the Yukon group includes three readily distinguishable floras—that of the fresh-water shales and sandstones, that of the marine shales and sandstones, and that of the coal-bearing rocks, as indicated in detail in the tables of distribution on pages 25–31.

There can be no question that the flora of the Yukon River region is early Upper Cretaceous and approximately equivalent to that of the Dakota sandstone, the number of Lower Cretaceous and late Upper Cretaceous species represented being negligible in proportion to those of early Upper Cretaceous age with which they are associated.

The species that may be regarded as especially indicative of the flora of the Yukon River region are *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun, which is represented in at least 11 of the collections, and the several species included under the genera *Credneria*, *Paracredneria*, *Pseudoprotophyllum*, and *Pseudoaspidiophyllum*, which are represented in 20 or more of the collections.

The age of the flora of Alaska Peninsula is more difficult to determine satisfactorily on account of the large number (about 75 per cent) of new species and the relatively few previously described species that are available for diagnostic purposes; but the presence of several late Upper Cretaceous species in certain of the collections, irrespective of any associated early Upper Cretaceous or Lower Cretaceous species, indicates that, for the most part, the flora is approximately of Montana age.

Incidentally, in this connection, it is accepted as a general principle that certain species commonly regarded as indicative of older geologic horizons occasionally persist and are elements in the floras of more recent horizons, but that the reverse of this principle does not hold.

The species that may be regarded as especially indicative of the prevailing flora of the Alaska Peninsula region are *Nilssonia serotina* Heer, which is found in at least seven of the collections, and *Ginkgo minor* Hollick, which is represented in five.

BOTANIC RELATIONS

The fossil plants described in this paper include 235 elements, of which 204 are regarded as species, 17 as varieties, and 14 are merely identified generically. For convenience, however, the flora will be discussed as consisting of 235 species, this term being intended to signify element or entity.

The Thallophyta and Bryophyta are represented by a single species each, the Pteridophyta by 13, and the Spermatophyta by 220. The three phyla first mentioned therefore constitute an insignificant feature of the floras, both actually and relatively, and none of the species possesses any special biologic or stratigraphic significance or importance.

The Spermatophyta, with a total of 220 species, is represented by 88 genera, 47 families, and 26 orders. The two classes, Gymnospermae and Angiospermae, include, respectively, 15 genera and 47 species, and 73 genera and 173 species.

In connection with the Gymnospermae the most striking feature is the extensive development of the genera *Nilssonia*, *Podozamites*, and *Ginkgo*. Opinions in regard to the probable botanic affinities of the genus *Nilssonia* have shifted at times from the cycads to the ferns and vice versa, according to the material that happened to be available for investigation and study; but the generally accepted opinion now is that it should be regarded as an extinct cycad genus of surficial fernlike appearance, possibly representing an extinct order, intermediate between the Cycadales and Ginkgoales.[35] It is not a typical Cretaceous genus, as its greatest development was in early Mesozoic time. About 80 species had been described, of which 33 were regarded as Triassic, 27 as Jurassic, and only 20 as Cretaceous; hence the discovery of five species in the Cretaceous flora of Alaska, whereas only six species had been previously recorded in the entire Cretaceous flora of North America, was a distinct sur-

[34] Knowlton, F. H., in Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, p. 57, 1911.

[35] Nathorst, A. G., Über die Gattung *Nilssonia* Brongn., mit besonderer Berücksichtigung schwedischer Arten: K. svenska Vetensk.-Akad. Handl., vol. 43, No. 12, 1909.

prise. Further than this, five of the six previously known species were of Lower Cretaceous age, and none were recorded in the Dakota, Raritan, or other flora of Upper Cretaceous age equivalent to either of the regional floras of Alaska. Apparently the genus had disappeared elsewhere on the North American continent at the time when it was still an important element in the Cretaceous flora of Alaska. Four of the five species of the genus here described are regarded as new to science. *Nilssonia serotina* Heer, the only one identified as a previously described species, possesses the greatest interest, however, and is worthy of special mention. It was originally described by Heer[36] as Tertiary, from the island of Sakhalin, and its discovery in Alaska, associated with an apparently Cretaceous flora, was a more or less disturbing factor in the early studies of this flora. In 1918, however, Kryshtofovich[37] published the results of his investigations of the stratigraphic relations of the plant-bearing beds of Sakhalin and presented satisfactory evidence of error in Heer's conclusions as to the Tertiary age of *Nilssonia serotina*, including it without question in the Gyliakian flora, regarded as "Middle Cretaceous." Its geographic distribution is also of interest, as it appears to be confined to the Pacific coastal regions of northeastern Asia and northwestern North America; and whereas it is an abundant and characteristic element in the Cretaceous flora of the Alaska Peninsula region it has not been found in any of the collections from the Yukon River region.

The genus *Podozamites* has also been a subject of discussion in connection with its probable nearest taxonomic relationships. In view of the form, arrangement, and nervation of the leaves, as far as these characters alone were studied, relationship with the Cycadales was generally accepted as strongly indicated, although several authors suggested its possible relationship with the Coniferales, especially with the genus *Agathis;* and Nathorst,[38] from a study of organs of fructification found in connection with certain *Podozamites* leaves, suggested that the genus might repre-

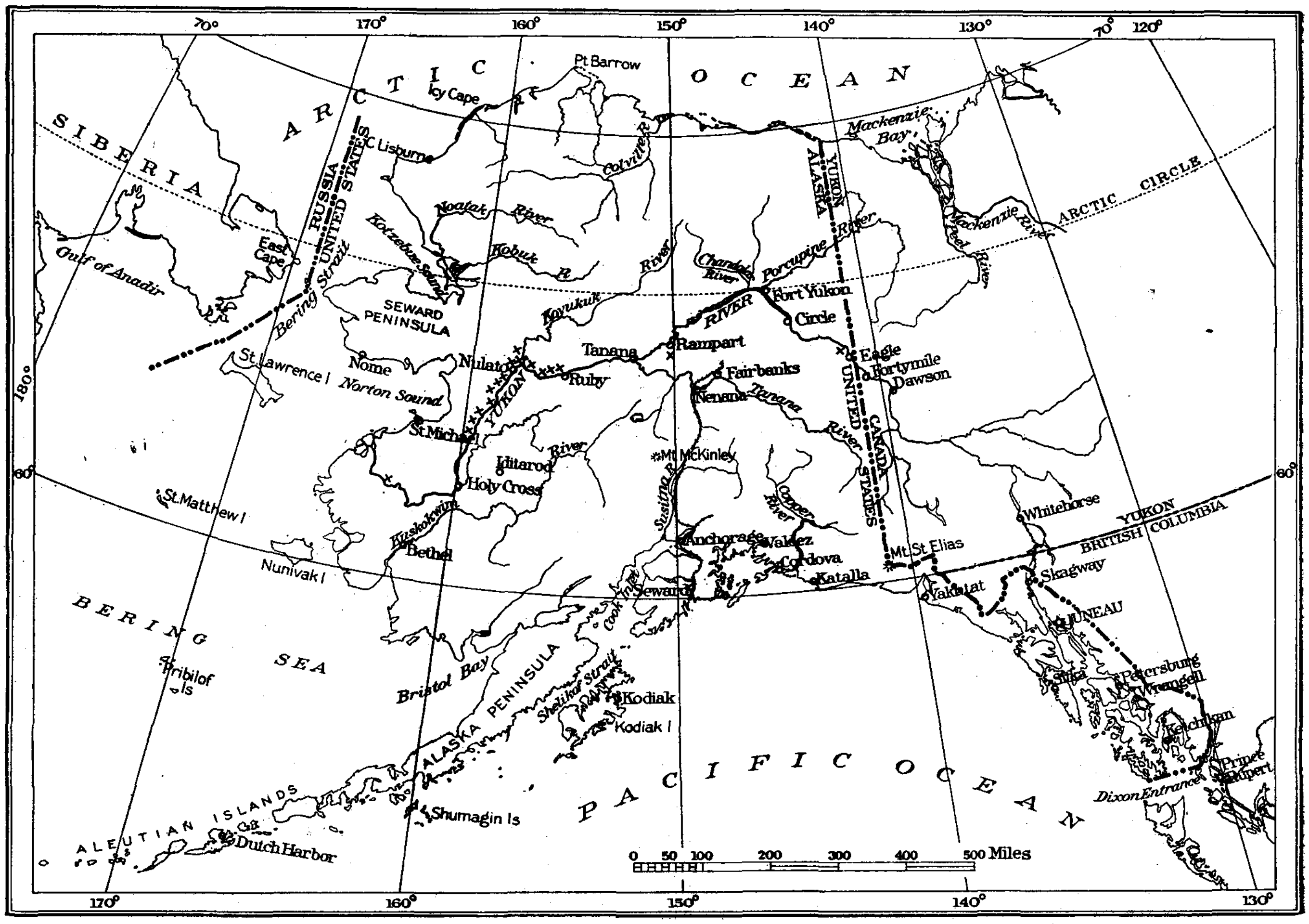

FIGURE 1.—Map of Alaska showing general position of localities of Upper Cretaceous plants in the Yukon region (×)

[36] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, No. 4, p. 19, pl. 2, figs. 1a, 2–5, 1878.

[37] Kryshtofovich, A. [N.]. On the Cretaceous flora of Russian Sakhalin: Tokyo Imp. Univ. Coll. Sci. Jour., vol. 40, article 8, 1918.

[38] Nathorst, A. G., Über die Gattung *Cycadocarpidium* Nathorst nebst einigen Bemerkungen über *Podozamites:* K. svenska Vetensk.-Akad. Handl., vol. 46, No. 8 (Paläobot. Mitth. 10), 1911.

sent an extinct order of plants, intermediate in taxonomic position between the Cycadales and the Coniferales. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun, in one or another of its many forms, is abundantly represented in at least eleven of the collections from the Yukon River region but is not, apparently, an element in the flora of the Alaska Peninsula region. In Cretaceous floras elsewhere it is only sparingly represented. It occurs in the Cenomanian of Bohemia, the Raritan formation of the eastern United States, and the Dakota sandstone of Kansas; but its most frequent occurrence, other than in the Yukon River region of Alaska, is in connection with floras of Jurassic age, especially in the western United States, northern Siberia, and Svalbard.[38a] It is a type of vegetation that persisted throughout a long period of geologic time and had a geographic distribution that was practically world-wide.

The abundance of the Ginkgoales as an element in the Cretaceous flora of Alaska is noteworthy, especially in view of the rarity of the genus *Ginkgo* in Cretaceous floras elsewhere. The Alaska flora has nine species referred to this genus, whereas the entire Cretaceous flora of North America, exclusive of Alaska, has but seven, and there is none in the relatively equivalent Dakota and Raritan or in the slightly younger Tuscaloosa and Magothy floras. Furthermore, the Alaska species include some that are apparently identical with Jurassic types and others that can hardly be distinguished from those of Tertiary age. The genus apparently persisted and flourished in Alaska after it had all but disappeared throughout the continental regions to the south and east.

These three genera, *Nilssonia*, *Podozamites*, and *Ginkgo*, represent three ancient types of vegetation that, in Alaska and northeastern Asia, made their last stand against unfavorable physiographic and climatic changes. The first two were exterminated, but *Ginkgo* survived in Asia in diminished numbers and is represented in our existing flora by the one remaining species *Ginkgo biloba* of Japan.

In the Angiospermae the Monocotyledonae are represented by only 2 genera and 2 species, the Dicotyledonae by 171 species, included in 71 genera, 36 families, and 21 orders. The Choripetalae number 156 species, the Gamopetalae 10, and the ordinal and family relationships of 5 species are undetermined. The Gamopetalae represent an insignificant element in the flora as a whole and in the subclass to which they belong. In the Choripetalae the Platanales, with 41 species, is the largest order, so far as specific elements are concerned. It also includes the three genera with the largest number of species each—*Platanus*, 11; *Credneria*, 11; and *Pseudoprotophyllum*, 10. The genus *Platanus* includes three well-known Cretaceous species and eight that are here described as new.

The extinct genera *Credneria*, *Paracredneria*, *Protophyllum*, *Pseudoprotophyllum*, and *Pseudoaspidiophyllum* constitute an interesting and noteworthy floral group, primarily for the reason that the family relationships of none of them have been satisfactorily determined; and the investigations of those who have studied the species representing the three genera first mentioned and the surficially similar genera *Pterospermites*, *Anisophyllum*, and *Aspidiophyllum* have resulted in relegating one or another, from time to time, to the Moraceae, Urticaceae, Menispermaceae, Platanaceae, Polygonaceae, Hamamelidaceae, Vitaceae, or Tiliaceae. The two newly described genera, *Pseudoprotophyllum* and *Pseudoaspidiophyllum*, fall naturally into the same category, and for reasons of convenience the five of the above-mentioned genera that are represented in the Cretaceous flora of Alaska are all grouped together, tentatively, under the Platanaceae, although this may or may not represent their correct taxonomic position, either as a group or individually.

Heer,[39] in his discussion of the problematic botanic relationships of *Pterospermites spectabilis*, included that genus and also the genus *Grewiopsis* in the same category and remarked as follows: "Die unter dem Namen von *Pterospermites*, *Credneria*, *Protophyllum* und *Grewiopsis* beschreibenen Blätter gehören sehr wahrscheinlich derselben Pflanzengruppe an, doch ist ihre systematische Stellung noch zweifelhaft."

The genus *Credneria* has been known in America heretofore only by two definitely recognized species, *C. macrophylla* Heer, from the Magothy formation of Long Island, N. Y., and *C. protophylloides* Knowlton, from the Vermejo formation of southeastern Colorado, and three others of doubtful generic identity. It was commonly regarded as an Old World type of vegetation, and the discovery of 11 new species of the genus in Alaska represented an interesting addition to our knowledge of its geographic distribution. Richter's comprehensive monograph[40] on the genus, issued in 1905, may be consulted for information as to what was inferred in regard to its botanic status and what was known, up to that time, in regard to its stratigraphic and areal distribution.

The genus *Paracredneria* was not known in America prior to the discovery of the four new species in Alaska; and these, together with the one in the genus *Protophyllum* and the fourteen in the new genera *Pseudoprotophyllum* and *Pseudoaspidiophyllum*, to-

[38a] The group of islands in the Arctic Ocean heretofore designated "Spitsbergen Archipelago" was placed under the dominion of Norway in 1920 by a treaty, and the name has been changed by Norway to Svalbard. (See U. S. Geog. Board Decisions, June 6, 1928.)

[39] Heer, Oswald, Beiträge zur miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, No. 3, p. 17, 1880.

[40] Richter, P. B., Die Gattung *Credneria* und einige seltnere Pflanzenreste: Beiträge zur Flora der oberen Kreide Quedlinburgs, pt. 1, Leipzig, 1905.

gether constitute a striking and characteristic florule, restricted to the Yukon River region. In fact not one of 41 species included in the Platanales as a whole has thus far been found in the Alaska Peninsula region.

Next to the Platanales the Ranales, with 18 species, is the most abundantly represented order. In this order the most interesting family is the Nymphaeaceae, in which are included one previously described genus, *Nymphaeites*, and two new genera, *Castaliites* and *Paleonuphar*—ancestors, apparently, of our living pond lilies represented by species of *Nymphaea* or *Castalia* and *Nuphar*.

PHYTOGEOGRAPHIC RELATIONS

An analysis of the 52 existing genera of Spermatophyta that are included in the flora as a whole indicates, as its principal phytogeographic feature, that in its general facies it is closely comparable with the existing flora of the Northern and Western Hemispheres. Four of these genera (*Sequoia*, *Hicoria*, *Asimina*, and *Rulac*) are restricted in their distribution to the North American continent; two (*Ginkgo* and *Glyptostrobus*) are restricted to eastern Asia; four (*Tumion*, *Taxodium*, *Magnolia*, and *Benzoin*) are restricted to North America and eastern Asia; 15 (*Pinus*, *Populus*, *Juglans*, *Betula*, *Quercus*, *Ulmus*, *Platanus*, *Tilia*, *Aralia*, and others) are common to North America and Eurasia; about a dozen others, whose distribution is mostly in the equatorial regions, such as *Piper*, *Ficus*, *Cinnamomum*, *Sapindus*, *Paullinia*, *Zizyphus*, *Sterculia*, *Grewia*, and *Myrsine*, are common to both the Northern and the Southern Hemispheres; and 11 (*Smilax*, *Myrica*, *Urtica*, *Alnus*, *Cassia*, *Celastrus*, *Acer*, *Sapindus*, *Rhamnus*, *Vitis*, and *Cornus*) are extra-equatorial in their northern and southern distribution in the Eastern and Western Hemispheres. Not a single generic type that is characteristic of the Southern Hemisphere alone is represented, and only seven (*Cinnamomum*, *Laurus*, *Colutea*, *Paliurus*, *Grewia*, *Pterospermum*, and *Trapa*) are of strictly Old World distribution.

If the generic elements are analyzed in connection with their climatic significance it may be seen that the flora as a whole was warm temperate in its major facies, with a conspicuous representation of subtropical and tropical elements.

It should be borne in mind, however, that inferences and conclusions can be satisfactorily based only upon such genera as may be identified with existing ones, whereas certain of the most abundant and characteristic elements of this flora are included in extinct genera whose family relationships have not been definitely determined. As examples of such genera may be mentioned *Nilssonia*, *Podozamites*, *Credneria*, *Paracredneria*, *Protophyllum*, *Pseudoprotophyllum*, and *Pseudoaspidiophyllum*, which together include about 35 species, or approximately 15 per cent of the flora. If the family relationships of these genera could be satisfactorily determined our inferences in regard to the number of temperate, subtropical, or tropical elements might be materially modified.

An association of such genera as *Ginkgo*, *Sequoia*, *Hicoria*, *Populus*, *Betula*, *Alnus*, *Platanus*, and *Acer*, without the inclusion of others of more tropical distribution, would indicate a temperate or north temperate zone climate, inasmuch as all are characteristic of regions in which temperate climatic conditions prevail, and certain of them, such as *Populus*, *Betula*, and *Alnus*, include species that range into the Arctic zone. On the other hand, however, the same genera also include species that range into warm temperate or subtropical regions; and the fact that associated with them are strictly subtropical and tropical genera, such as *Taxodium*, *Ficus*, *Cinnamomum*, *Sapindus*, *Paullinia*, and *Sterculia*, and the presumably cycadeoid genera *Cycadites*, *Podozamites*, *Pterophyllum*, and *Nilssonia*, none of which include any species that is other than tropical or subtropical in its distribution, appears to indicate beyond any reasonable doubt that the flora as a whole was representative of a subtropical climate, approximately equivalent to that of the southern United States, northern Mexico, and southern Japan at the present day.

If there was any climatic difference between the period when the earlier floras flourished, as represented by those of the Yukon Valley region, and the time when the later floras prevailed, in the Alaska Peninsula region, the available facts do not afford any conclusive evidence. An enumeration of the strictly subtropical and tropical elements in the flora of the Yukon River region shows 20 species included in 13 genera, four of which are referable to the Cycadales, with seven species, and the others to the genera *Ficus*, with four species; *Sapindus* and *Sterculia*, with two each; and *Piper*, *Cinnamomum*, *Paullinia*, *Zizyphus*, and *Myrsine*, with one each. In the flora of the Alaska Peninsula region the equivalent elements are represented by 10 species included in 6 genera—the Cycadales, one genus, with two species; *Zizyphus*, with three; *Ficus*, with two (one of doubtful validity); and *Pterospermum*, *Guajacum*, and *Grewia*, with one each. A feature that might be regarded as significant, however, is the apparently more extensive development of the Cycadales in the Yukon Valley flora. This type of vegetation, not only generically but also as an order, is so characteristically tropical that the presence of any of its elements in a flora at once proclaims its climatic environment. At the present day the farthest northward range of the order is represented by one species, *Cycas revoluta*, in southern Japan, two species of *Dioön* in northern Mexico, and several of *Zamia* in Florida. It might therefore be assumed, from this feature alone, that the earlier flora of the Yukon Valley region was perhaps somewhat more tropical in its facies than the later flora of the Alaska Peninsula region; but any such assumption should be regarded merely as a matter of opinion. It may also be argued that the Cretaceous cycadeoid plants, all of them generically different from those now in existence, may not have been affected by climatic influences to the same extent as the existing genera and species; but the general type is so characteristic and is so closely similar in both the extinct and living genera that it is impossible to think of them as differing from each other in any marked degree in any of their essential characteristics.

In regard to probable physiographic environment very little may be safely inferred from an analysis of the flora, except that arid conditions could not have prevailed where it flourished, in either of the phytogeographic regions. The general character of the arborescent vegetation and the occurrence of ferns and hepatics indicate a normal amount of moisture in the soil and atmosphere; and the presence of ponds or rivers and swamps is indicated by species of *Taxodium*, *Castaliites*, *Nymphaeites*, and *Paleonuphar*. The flora as a whole was of lowland facies; but this does not, of course, preclude the existence of a contemporaneous upland flora of which no remains were preserved. Contiguity to bodies of water, especially those that are still or relatively still, such as lakes, ponds, and estuaries, in which sediments and vegetable débris can accumulate, may be regarded as the major governing factor in connection with the preservation of plant remains; hence an upland flora, occupying a habitat in which that factor did not exist, would probably not have many, if any, of its elements represented in deposits that contained abundant remains of a contemporaneous lowland flora.

THE UPPER CRETACEOUS PLANT-BEARING BEDS OF ALASKA

By George C. Martin

SCOPE AND PURPOSE OF DESCRIPTION

The following account includes a general discussion of all the Cretaceous rocks of Alaska and a more detailed description of the Upper Cretaceous beds which have yielded the fossil plants that form the special subject of this volume. The general discussion is intended to show the broader relations, in place, time, and method of formation, of the rocks that contain the fossil floras to the other rocks, especially to the other Cretaceous rocks of the Territory.

The detailed descriptions include, for each district, complete references to previous descriptions, most of which are scattered through a large number of publications dealing chiefly with the general geologic features of mining districts or other regions; a description of the stratigraphy, which is given in as great detail as knowledge permits; and a discussion of age and correlation, which is based not only on the evidence of the fossil plants but on all other available evidence, including that of other fossils and of the stratigraphic and structural relations.

THE CRETACEOUS ROCKS OF ALASKA

DISTRIBUTION

Cretaceous rocks are widely distributed throughout all the major geographic provinces of Alaska and are the present surface rocks in several large areas, notably in the lower Yukon region and southwestern Alaska. A widespread marine transgression in early Cretaceous time carried the sea over most if not all of the area which is now Alaska. Doubtless the sea receded at different times during the Cretaceous period, for the equivalents of some of the characteristic major divisions of the Cretaceous have not been recognized in Alaska, but it must have advanced again from time to time, for horizons well distributed throughout the Cretaceous are widely represented in the Territory. In general it is believed that Lower Cretaceous deposits were laid down in all the larger geographic provinces but probably not over the entire area of the Territory. The extent of the Lower Cretaceous seas, so far as known, was not limited along the lines of any of the existing geographic features. Upper Cretaceous deposits are also widely distributed (see fig. 1) and crop out at present over large areas, but there are several districts in which Upper Cretaceous rocks are not known and, it is believed, were never deposited. The Upper Cretaceous marine transgressions were probably of lesser extent than those of the Lower Cretaceous and were excluded from most of the areas of the present mountain axes as well as from the upper parts of the present major valleys. In other words, the major geographic features seem to have been well outlined in Upper Cretaceous time, and the highest Cretaceous beds were restricted to coastal belts and to the present major valleys and included river deposits, and possible lake and land deposits laid down in estuaries, valleys, and plains that were the direct predecessors of the existing lowlands.

PRE-CRETACEOUS BASEMENT

The Upper Jurassic rocks, which normally belong immediately beneath the lowest known Cretaceous rocks of Alaska, are widely distributed throughout certain parts of the Territory, notably along the Pacific coast. There was a marine transgression in late Jurassic time which seemingly carried Upper Jurassic seas and deposits over all of Alaska south of the present axis of the Alaska Range. The sharp restriction of marine Jurassic deposits to the area south of the Alaska Range indicates that there was a shore line in about the present position of the Alaska Range throughout Jurassic time. The broader extension of the Lower Cretaceous sea might be interpreted to mean gradual marine transgression beginning in the Jurassic, terminating in the Cretaceous, and bridging the two systems. As the equivalents of neither the highest Jurassic nor the lowest Cretaceous beds of other regions have been clearly recognized in Alaska, and as the distribution of the Cretaceous rocks is so much wider than that of the Jurassic rocks, the writer suspects that Jurassic time ended coincidently with some violent event which abruptly terminated the long-continued stand of the shore along the present mountain axis, and that there may be an important unrecognized unconformity between the Jurassic and Cretaceous, the nonrecognition of unconformity and the difficulty of distinguishing the strata and faunas being due in part to the undoubted general similarities and in part to the present lack of critical detailed studies of the rocks and faunas.

The lowest known Cretaceous rocks of Alaska, south of the Alaska Range, rest on Upper Jurassic sediments which are not known to have been eroded or folded between the date of their deposition and that of their covering by the Cretaceous deposits. In the region north of the Alaska Range the lowest known Cretaceous rocks rest on Devonian, Carboniferous and Triassic sedimentary rocks or on metamorphic rocks of undetermined (probably early Paleozoic) age.

CRETACEOUS STRATIGRAPHIC SEQUENCE

The Cretaceous rocks of Alaska comprise strata belonging in both the Lower and the Upper Cretaceous. They include, in addition to the plant-bearing Upper Cretaceous strata, which are the special subject of this volume, other formations which are not known to contain fossil plants but of which a consideration is necessary for a full understanding of the Upper Cretaceous plant-bearing beds. A general description of all the known Cretaceous rocks of Alaska will accordingly be given first, a more complete detailed description of the Upper Cretaceous plant-bearing beds being reserved for a later section.

The Lower Cretaceous rocks of Alaska consist of shales, sandstones, limestones, and conglomerates, which have been recognized at many localities throughout much of the Pacific coastal region and of the Yukon and Kuskokwim Valleys and at more isolated localities in northern Alaska. The rocks that have been referred to the Lower Cretaceous include the Staniukovich shale and the Herendeen limestone of the Alaska Peninsula;[41] conglomeratic tuff and arkose and the overlying Nelchina limestone of the upper Matanuska Valley;[42] the shale, sandstone, and conglomerate of the Kennicott formation of the Chitina Valley;[43] some of the *Aucella*-bearing shale and graywacke of Chisana and White Rivers;[44] some of the *Aucella*-bearing slate and associated rocks of southeastern Alaska;[45] the *Aucella*-bearing shale and sandstone of the upper Yukon[46] and Rampart-Tanana[47] districts; the limestone, chert, and arkose of the "Oklune series" of the region north of Bristol Bay;[48] the limestone, shale, and sandstone of the Koyukuk group of the Koyukuk Valley;[49] and the sandstone, shale, and conglomerate of the Anaktuvuk group of northern Alaska.[50]

In the Pacific coastal belt the Lower Cretaceous rocks rest, for the most part, on Upper Jurassic sedimentary rocks. In the interior region, where Jurassic rocks are absent, they rest either on Triassic beds, on various Paleozoic sedimentary formations, or on schists of undetermined age. In northern Alaska the basal relations of the Cretaceous rocks are not known.

The Lower Cretaceous rocks contain a scanty marine fauna which has not been thoroughly studied but which contains two or more species of *Aucella* related to *Aucella crassicollis* Keyserling and *Aucella piochii* Gabb, together with a few other fossils, most of which are not known to be characteristic of definite horizons.

The Upper Cretaceous rocks of Alaska consist of shales, sandstones, and conglomerates, some of which are marine and some nonmarine. The nonmarine rocks contain coal beds and the fossil plants described in this volume. The Upper Cretaceous rocks cover smaller areas than the Lower Cretaceous rocks but nevertheless are widely distributed throughout many parts of the Territory, including much of the Pacific

[41] Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, pp. 25, 38–41, pl. 8, 1911.

[42] Paige, Sidney, and Knopf, Adolph, Geologic reconnaissance in the Matanuska and Talkeetna Basins, Alaska: U. S. Geol. Survey Bull. 327, p. 10, pl. 2, 1907.

[43] Moffit, F. H., and Capps, S. R., Geology and mineral resources of the Nizina district, Alaska: U. S. Geol. Survey Bull. 448, pp. 31–43, 1911. Moffit, F. H., The upper Chitina Valley, Alaska: U. S. Geol. Survey Bull. 675, pp. 27–45, 1918.

[44] Capps, S. R., The Chisana-White River district, Alaska: U. S. Geol. Survey Bull. 630, pp. 29, 47–53, pl. 2, 1916.

[45] Wright, C. W., A reconnaissance of Admiralty Island: U. S. Geol. Survey Bull. 287, pp. 143–144, 1906.

[46] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the upper Yukon, Alaska: Geol. Soc. America Bull., vol. 19, pp. 305–307, 1908.

[47] Eakin, H. M., A geologic reconnaissance of a part of the Rampart quadrangle, Alaska: U. S. Geol. Survey Bull. 535, pp. 20–21, 1913.

[48] Spurr, J. E., A reconnaissance in southwestern Alaska in 1898: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, pp. 133–134, 163–169, 181–182, 1900.

[49] Schrader, F. C., A reconnaissance in northern Alaska: U. S. Geol. Survey Prof. Paper 20, pp. 53, 77, 97, pl. 3, 1904. Smith, P. S., The Noatak-Kobuk region, Alaska: U. S. Geol. Survey Bull. 536, pp. 55, 80–82, 1913.

[50] Schrader, F. C., A reconnaissance in northern Alaska: U. S. Geol. Survey Prof. Paper 20, pp. 53, 74–76, pl. 3, 1904.

coastal belt exclusive of southeastern Alaska, much of the Yukon and Kuskokwim Valleys, especially in their lower and middle parts, and some localities in northern Alaska.

The rocks that have been referred to the Upper Cretaceous include the marine and terrestrial (coal-bearing) shale, sandstone, and conglomerate of the Chignik formation of the Alaska Peninsula,[51] which contain some of the fossil plants described in this volume; the marine shale and sandstone of the Matanuska formation of the Matanuska Valley;[52] the marine shale, sandstone, arkose, and conglomerate of the Chitina Valley;[53] the nonmarine shale and sandstone exposed in the banks of the Yukon near Seventymile,[54] which were previously regarded as Tertiary and which contain some of the fossil plants described in this volume; a marine sandstone near Wolverine Mountain, in the Rampart district;[55] the marine and terrestrial (coal-bearing) shale, sandstone, and conglomerate of the lower Yukon[56] and Nulato-Norton Bay[57] districts, which contain some of the fossil plants described in this volume; some of the shale and sandstone of the Innoko Valley;[58] the sandstone, limestone, and shale of the "Holiknuk series"[59] and some of the rocks of the "Kolmakof series"[60] of the Kuskokwim Valley; the shale, sandstone, and conglomerate of the lower Koyukuk Valley;[61] possibly the shale, sandstone, and conglomerate of the Bergman group of the upper Koyukuk Valley;[62] and the sandstone, limestone, and shale of the Nanushuk formation of the Arctic slope.[63]

The Upper Cretaceous rocks throughout Alaska rest in general upon the Lower Cretaceous *Aucella*-bearing beds, except in the lower Yukon region and in parts of the neighboring Kuskokwim, lower Koyukuk, and Norton Sound districts, where the Lower Cretaceous *Aucella*-bearing beds are absent and the Upper Cretaceous strata rest upon Paleozoic rocks. There are of course many localities in other parts of Alaska where the unconformity at the base of the Upper Cretaceous causes the Upper Cretaceous rocks to be in stratigraphic contact with other pre-Upper Cretaceous formations in addition to the Lower Cretaceous beds.

The Upper Cretaceous strata contain two very distinct fossil floras described in this volume, one or more marine faunas, and some brackish-water or fresh-water fossils. The plant-bearing shale and sandstone of the lower Yukon region are interbedded with strata containing marine and brackish-water or fresh-water fossils. This marine fauna has not been exhaustively studied but according to Stanton is "probably not higher than the middle of the Upper Cretaceous." This determination is in reasonably close accordance with the evidence of the fossil plants, which Hollick believes to indicate that the beds are basal Upper Cretaceous, approximately equivalent to the Dakota sandstone. The plant-bearing beds of the Chignik formation on the Alaska Peninsula are underlain by and interbedded with marine fossiliferous strata. Most of the marine fossils were obtained from the lower member of the Chignik formation—that is, from rocks beneath the plant-bearing beds. This fauna, according to Stanton, is related to that of the Chico of California. This opinion also is in reasonable accord with the evidence of the plants from the overlying beds, which Hollick believes to be possibly approximately equivalent to the Montana group.

Marine faunas that are possibly of the same age as that of the lower member of the Chignik formation but are more extensive, at least so far as the present collections indicate, have been found in sandstone and shale of the Matanuska Valley and in the shale of Young Creek in the Chitina Valley.

POST-CRETACEOUS COVER

The beds succeeding the Upper Cretaceous rocks in the Alaska Peninsula, the Matanuska Valley, the Chitina Valley, the upper Yukon district, the Rampart-Tanana district, and on the Arctic slope are Tertiary (probably Eocene) coal-bearing shales, sandstones, and conglomerates with no recognized members of marine origin, except at one locality on the Alaska Peninsula. In the Nutzotin Mountains and in southeastern Alaska, where no Upper Cretaceous rocks are known, these Tertiary deposits succeed the Lower Cretaceous rocks. The writer believes that there is unconformity between the Cretaceous and the Tertiary rocks in all these districts. In several of the districts direct proof of unconformity is lacking, the Tertiary rocks not having been observed in actual contact with the Cretaceous rocks. The fact, however, that the Ter-

[51] Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, pp. 25, 38–41, pl. 8, 1911.

[52] Martin, G. C., and Katz, F. J., Geology and coal fields of the lower Matanuska Valley, Alaska: U. S. Geol. Survey Bull. 500, pp. 15, 23, 34–39, pls. 3, 5, 1912.

[53] Moffit, F. H., The upper Chitina Valley, Alaska: U. S. Geol. Survey Bull. 675, pp. 29–45, 1918.

[54] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, p. 28, 1903.

[55] Prindle, L. M., A geologic reconnaissance of the Fairbanks quadrangle, Alaska: U. S. Geol. Survey Bull. 525, pp. 33, 34, 47–48, 1913.

[56] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, pp. 15, 17, 19–20, 46–58, 65, 1903.

[57] Smith, P. S., and Eakin, H. M., A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska: U. S. Geol. Survey Bull. 449, pp. 54–60, 1911.

[58] Eakin, H. M., The Iditarod-Ruby region, Alaska: U. S. Geol. Survey Bull. 578, pp. 23–24, pl. 3, 1914.

[59] Spurr, J. E., A reconnaissance in southwestern Alaska in 1898: U. S. Geol. Survey Twentieth Ann. Rept., pt. 7, pp. 125–128, 159–161, 182, 1900. Smith, P. S., The Lake Clark-central Kuskokwim region, Alaska: U. S. Geol. Survey Bull. 655, pp. 57–84, 1917.

[60] Spurr, J. E., op. cit., pp. 130–131, 161–163, 182–183.

[61] Schrader, F. C., Preliminary report on a reconnaissance along the Chandlar and Koyukuk River, Alaska, in 1899: U. S. Geol. Survey Twenty-first Ann. Rept., pt. 2, p. 478, pl. 60, 1900.

[62] Schrader, F. C., A reconnaissance in northern Alaska: U. S. Geol. Survey Prof. Paper 20, pp. 53, 77–79, 97, pl. 3, 1904.

[63] Idem, pp. 53, 79–81, pl. 3.

tiary rocks rest upon other than the Cretaceous rocks which should normally underlie them is in itself an indication of unconformity at the base of the Tertiary.

In late Cretaceous time there was a gradual withdrawal of marine waters from the Alaskan region, accompanied by the local deposition of nonmarine sediments containing coal beds and terrestrial plants. This movement is believed to have reached its culmination at the end of Cretaceous time. The earliest recorded event of Tertiary time, except possibly the deposition of marine Eocene beds at one locality on the Alaska Peninsula, was the widespread deposition of wholly nonmarine strata containing lignite and terrestrial plants. These strata may be accompanied by a few marine sediments, but there is no suggestion of them except at a few localities close to the present shore line. Most of the Tertiary coal-bearing rocks of Alaska are certainly not interbedded with or underlain by any marine Tertiary deposits. The known marine Tertiary beds of Alaska, except possibly the marine Eocene rocks of the Alaska Peninsula, are chiefly, if not wholly, younger than the Tertiary coal-bearing beds.

DETAILS OF THE UPPER CRETACEOUS PLANT-BEARING BEDS

ALASKA PENINSULA

GENERAL FEATURES

The best known and, so far as present information goes, the most complete section of Cretaceous rocks in Alaska is on the Alaska Peninsula, where both Lower and Upper Cretaceous strata are present and where the contacts with the underlying Jurassic and the overlying Tertiary beds have been observed. The Lower Cretaceous rocks carry marine faunas; the Upper Cretaceous beds have yielded not only characteristic marine invertebrate fossils but fossil plants. The general character and sequence of the Cretaceous rocks of the Alaska Peninsula is as follows:

General section of Cretaceous rocks on Alaska Peninsula

	Feet
Upper Cretaceous (overlain unconformably (?) by Eocene strata):	
Chignik formation:	
Upper member (conglomerate, sandstone, and shale with marine invertebrates and fossil plants)	300–500
Middle member (shale with many coal beds and some sandstone; contains fossil plants)	300+
Lower member (shale with marine fossils)	200±
Lower Cretaceous:	
Herendeen limestone (arenaceous limestone with *Aucella crassicollis*)	800
Stan'ukovich shale (thin-bedded shale, interbedded with thin strata of sandstone and with some conglomerate; contains *Aucella piochii*); underlain conformably (?) by Upper Jurassic strata	1,000+

The Lower Cretaceous strata of the Alaska Peninsula overlie the Upper Jurassic rocks with apparent conformity. They are known only in the vicinity of Herendeen Bay, near the west end of the peninsula. Farther east they are absent at some places, as at Chignik, where the Upper Cretaceous rocks rest unconformably upon the Upper Jurassic rocks. At other places, as along the coast from Cold Bay to Cape Douglas, it is highly probable that they are absent, although positive proof is lacking. At still other places, as along the coast from Chignik Bay to Cold Bay and throughout the greater part of the interior of the peninsula, information is very scanty, and no definite statement can be made as to what formations are present, although there are reasons for believing that there may be areas of Lower Cretaceous rocks. The writer believes that the Lower Cretaceous formations were deposited over broad areas in southwestern Alaska and that the small size of the areas of their present occurrence is due to subsequent erosion or burial.

Upper Cretaceous beds are known at several localities at both the east and the west ends of the Alaska Peninsula. They overlie the Lower Cretaceous beds with a possible unconformity, and where the Lower Cretaceous rocks are absent they rest unconformably upon the Upper Jurassic rocks. They are overlain, unconformably in at least some places, by Tertiary beds.

CHIGNIK FORMATION

HISTORICAL REVIEW

The Upper Cretaceous rocks of the Alaska Peninsula were described by Atwood [64] as the Chignik formation, so named from its typical development on Chignik Bay.

The coal beds and inclosing strata on Chignik River, which belong in this formation, had previously been described briefly by Dall,[65] but his account deals chiefly with the coal and includes only a brief mention of the rocks, which at that time had not been named and were not known to be Cretaceous.

Dall gave a brief description also of the coal beds on Herendeen Bay,[66] which probably belong in this formation and which may possibly include also beds that yielded some of the fossil plants (see p. 4) collected by Townsend, at what is said to be nearly the same locality as the coal, but which have been described by Knowlton [67] as Tertiary.

[64] Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, pp. 24, 41–48, 97–98, 100–103, 109–114, pls. 7, 8, 1911.

[65] Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 1, pp. 801–803, 1896.

[66] Idem, pp. 805–807.

[67] Knowlton, F. H., A review of the fossil flora of Alaska, with descriptions of new species: U. S. Nat. Mus. Proc., vol. 17, No. 998, pp. 207–240, 1894.

The coal beds of the Chignik formation at Chignik Bay were described by Stone,[68] who made only brief references to the character of the rocks but who pointed out that they included marine fossiliferous Upper Cretaceous beds.

The Upper Cretaceous rocks at Chignik Bay were described by Stanton and Martin,[69] who gave, in addition to the brief description of the rocks, a list of fossil plants identified by F. H. Knowlton, lists of marine mollusks identified by T. W. Stanton, and a discussion of the correlation of these rocks with the Upper Cretaceous of other regions. Brief mention was made also of the occurrence of marine Upper Cretaceous beds near the east end of the Alaska Peninsula.

The Chignik formation includes the Upper Cretaceous beds of Herendeen Bay that were described by Paige,[70] who collected the first fossils to be recognized as Upper Cretaceous from this locality. This account includes a very brief general description of the rocks, a discussion of their field relations, and lists and discussions of the plant and invertebrate fossils by F. H. Knowlton and by T. W. Stanton.

The account of the Chignik formation by Atwood [71] includes detailed descriptions, with stratigraphic sections, of Upper Cretaceous rocks in the Chignik Bay and Herendeen Bay districts, lists of the invertebrate and plant fossils with discussions of their age and correlation by T. W. Stanton and by F. H. Knowlton, a general discussion of the stratigraphic relations, and descriptions of the occurrence and character of the coal.

A brief general description of the Chignik formation by Smith and Baker [72] was based partly on previous descriptions and partly on observations in a portion of the area by Smith in 1922.

STRATIGRAPHIC DESCRIPTION

The general character of the Chignik formation on Chignik Bay has been described by Atwood [73] as follows:

In the Chignik Bay region the Chignik formation consists of a series of sandstones, shales, conglomerates, and some valuable coal seams. The sandstones range from fine, even-grained sediments to grits. Many of the sandstones in this formation, as exposed in Nigger and Chignik Heads, have a light-green color when fresh, but weather to black or to shades of brown in the cliffs. Ripple marks are not uncommon on the bedding planes, and in some of the strata there are large concretions. The conglomerates are conspicuous members in the series, for they are firmly cemented and form cliffs, or even, in some places, overhanging ledges. These conglomerates in Chignik Head contain pebbles of granite, quartz, greenstones, and flint as large as 2 inches in diameter. Near the entrance to Chignik Lagoon there is a coarse conglomerate that for convenience in the field was spoken of as the cobble conglomerate. The stones in this conglomerate are commonly 3 or 4 inches in diameter, but some of the boulders found in it were 2 feet in diameter. This conglomerate is poorly bedded and in some places has a volcanic matrix. The stones include granites, basalts, quartz, and shale. There are lenses of sandstone and shale in the midst of the conglomeratic layer.

According to Atwood's geologic map of Chignik Bay and vicinity [74] the Chignik formation is composed of three unnamed members, the middle one of which contains coal beds. No complete section of the formation has been measured, nor have the character and relations of the members been described in detail. The following section, which was measured by Atwood [75] on the south shore of Chignik Bay and Chignik Lagoon from a point near Nigger Head to a point about 200 yards southwest of the native village, apparently represents the upper member of the formation:

Section of part of Chignik formation near Nigger Head, Chignik Bay

	Feet
1. Black shale (yielded collection 5797, invertebrates)	100
2. Cobble conglomerate	150
3. Shale with interbedded conglomerate	60
4. Sandstone and shale at Nigger Head (the shale yielded collection 5295, plants)	200
	510

The Chignik formation of the type area overlies the Upper Jurassic rocks of the Naknek formation unconformably, the Lower Cretaceous rocks being absent. It is overlain by Tertiary rocks, and the contact has been described as conformable,[76] but the writer believes that there is strong evidence of a marked unconformity.

The Chignik formation in the vicinity of Herendeen Bay was described by Atwood [77] as having the following general section.

Section of Chignik formation on Mine Creek

	Feet
Conglomerate	300+
Coal measures	300+
Shales	200±

The section given below, which was also measured by Atwood [78] at nearly the same place, shows the character of the coal-bearing beds in detail. It is evident from the thickness as given in these two sections that all of the detailed section below the uppermost conglomerate belongs in the coal-bearing member of the

[68] Stone, R. W., Coal resources of southwestern Alaska: U. S. Geol. Survey Bull. 259, pp. 163–166, 1905.

[69] Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet, and Alaska Peninsula: Geol. Soc. America Bull., vol. 16, pp. 408–410, 1905.

[70] Paige, Sidney, The Herendeen Bay coal field: U. S. Geol. Survey Bull. 284, pp. 102–106, 1906.

[71] Atwood, W. W., op. cit., pp. 24, 41–48, 97–98, 100–103, 109–114, pls. 7, 8.

[72] Smith, W. R., and Baker, A. A., The Cold Bay-Chignik district, Alaska: U. S. Geol. Survey Bull. 755, pp. 184–185, 1924.

[73] Atwood, W. W., op. cit., p. 41.

[74] Idem, pl. 7.

[75] Idem, p. 42.

[76] Idem, p. 58.

[77] Idem, p. 42.

[78] Idem, pp. 100–101.

formation, or in the "coal measures" of the general section.

Section of coal-bearing rocks of Chignik formation on the south slope of Mine Creek Valley, Herendeen Bay

	Ft.	in.
Conglomerate	300	
Sandstone, coarse, cross-bedded, with huge sandstone concretions weathering brown from abundance of limonite	50	
Sandy shale	20	
Coal seam, medium grade	3	
Sandstone, firm, cross-bedded, with fossil leaves	3	
Shale	5	
Coal		10
Shale	2	6
Shaly coal		6
Shale, with sandstone concretions	3	
Coal	1	
Shales	4	
Coal	1	2
Shaly sandstone, with sandstone concretions	4	
Coal		10
Shales	4	
Coaly shales	1	6
Shales	3	
Carbonaceous shales	1	
Shales	2	
Coal	1	
Shales	2	
Coaly shales, with shale partings	2	3
Coal, with bony partings and shaly bed	7	
Shales	1	8
Shaly coal	1	2
Shale	2	6
Coal	1	1
Shales	3	
Coal	2	
Shales	3	6
Coal	1	2
Shales		6
Coal	1	5
Shales, with sandstone concretions	4	
Coal	1	8
Shales and sandstone interbedded	15	
Coal		8
Shales	5	
Shaly sandstone	2	
Shales	50	
Coal	1	2
Shales	6	
Coaly shale		4
Shales	7	
Coal	1	
Shales	3	
Coal	1	
Shales, with sandstone concretions	40	
Coarse cross-bedded sandstone and conglomerates	15	
Shales and sandstones.		

The dip of these measures is 30° N., and the strike N. 91° E

The base of the Chignik formation in the Herendeen Bay district is a surface of unconformity, the Chignik formation resting in some places on the Upper Jurassic rocks of the Naknek formation and in other places on the Lower Cretaceous rocks of the Herendeen limestone. This transgression, which, without making any allowance for the Jurassic strata involved, is at least 1,800 feet within a horizontal distance of 2 miles, or the equivalent of an average angular unconformity of 10°, is altogether too much to be accounted for as mere overlap. The contact of the Chignik formation with the overlying Tertiary rocks is stated by Atwood to be conformable.

AGE AND CORRELATION

The fossils from the Upper Cretaceous Chignik formation of the Alaska Peninsula are listed in the accompanying table. The collections from the type area of the Chignik formation are arranged approximately in stratigraphic sequence, beginning with the lowest. The first six lots from this area (5796, 11362, 5799, 3116, 5795, and 11361) are from the lower member, eight lots (5793, 3525, 3115, 3521, 5295, 3114, 5294, and 5797) are from the upper member, and the other two lots (5296 and 5297) are probably from the upper member. The lower member has yielded only marine invertebrate fossils, the middle member has yielded no fossils, and the upper member has yielded both plants and marine invertebrates.

The fossils from the Chignik formation of Herendeen Bay can not be assigned to a position within the formation with as much confidence as the fossils from Chignik Bay. The lots from Mine Creek (3708, 3485, 3490, 3709, S. P. (c), 5184, and 539), all came from the general vicinity of the coal beds and probably from the middle member ("coal measures") or possibly from the lower part of the upper member. However, the locality descriptions are vague, and it is possible that some of these fossils came from the lower member. These collections include both marine invertebrates and plants, but the shells and leaves were apparently not obtained from the same beds, nor have the relations of the plant beds to the strata carrying the marine shells been determined. The marine shells, according to Stanton, are clearly of Upper Cretaceous age. Some of the collections of plants have been regarded as Cretaceous and others as Tertiary, but most of them have previously been considered doubtful. The middle member yielded also lots 5185 and 5187, containing fossil leaves. The marine invertebrates in lots 5580, 5588, and 5577 were obtained not far below the Tertiary rocks, presumably from the upper member. They are, according to Stanton, undoubtedly Upper Cretaceous.

Lots 3121 and 5189 contain marine invertebrates and plants from two outlying localities near the east end of the Alaska Peninsula and on Pavlof Bay, respectively. Their position in the Upper Cretaceous sequence has not been determined, but they are believed to be in the upper member.

Fossils from the Chignik formation

	Lower member						Middle member									Upper (?) member							Upper member						
	5796	11362	5799	3116	5798	11361	3485	3490	3709	3708	S. P. (c)	5184	539	5185	5187	5296	5297	5580	5588	5577	3121	5189	5793	3525	3115, 3521	5295	3114	5797	5294
Cladophlebis septentrionalis Hollick, n. sp.															a										a				
Phegopteris alaskensis Hollick, n. sp.																										a			
Pteris nitida Hollick, n. sp.																	a												
Sagenopteris suspecta Hollick, n. sp.														a															
Sagenopteris paucireticulata Hollick, n. sp.														a															
Nilssonia serotina Heer										a				a	a		a							a	a	a			
Nilssonia alaskana Hollick, n. sp.														a															
Ginkgo minor Hollick, n. sp.													a	a	a		a								a	a			
Nageiopsis zamioides Fontaine?																										a			
Phyllocladites dubiosus Hollick, n. sp.																									a				
Cephalotaxopsis intermedia Hollick, n. sp.																									a				a
Cephalotaxopsis microphylla laxa Hollick, n. var.															a		a								a				
Tumion? suspectum Hollick, n. sp.															a										a				
Sequoia rigida Heer?															a														
Sequoia obovata Knowlton									a								a					a							
Glyptostrobus? sp.																									a				
Smilax herendeenensis Hollick, n. sp.														a															
Populus hyperborea Heer?															a														
Populus pseudostygia Hollick, n. sp.																	a												
Populus elliptica Newberry														a															
Populus pseudoelliptica Hollick, n. sp.																	a												
Hicoria duriuscula Hollick, n. sp.														a															
Alnus pyramidalis Hollick, n. sp.																									a				
Quercus pseudomarioni Hollick, n. sp.																	a												
Quercus chignikensis Hollick, n. sp.																									a				
Quercus paleoilicoides Hollick, n. sp.																									a				
Quercus turbulenta Hollick, n. sp.														a															
Dryophyllum bruneri Ward														a															
Ulmus oblongifolia Hollick, n. sp.																									a				
Ulmus alnoides Hollick, n. sp.														a															
Ficus laurophylla Lesquereux																						a							
Ficus? juglandifolia Hollick, n. sp.																						a							
Urtica alaskana Hollick, n. sp.																										a			
Urtica exemplaris Hollick, n. sp.															a		a												
Castaliites acutidentatus Hollick, n. sp.														a															
Castaliites crenatidentatus Hollick, n. sp.														a															
Magnolia palaeauriculata Hollick, n. sp.																	a												
Persea hayana Lesquereux?																						a							
Sorbus alaskana Hollick, n. sp.																									a				
Colutea primordialis Heer																						a							
Guajacum informe Hollick, n. sp.														a															
Celastrus herendeenensis Hollick, n. sp.														a															
Celastrus pseudocurvinervis Hollick, n. sp.														a															
Rulac quercifolium Hollick, n. sp.															a										a	a			
Rhamnus herendeenensis Hollick, n. sp.												a													a				
Paliurus visibilis Hollick, n. sp.																									a				
Paliurus pseudopinsonensis Hollick, n. sp.																									a				
Zizyphus pseudomeeki Hollick, n. sp.																									a				
Zizyphus varietas Hollick, n. sp.																									a				
Zizyphus electilis Hollick, n. sp.																									a				
Vitis populoides Hollick, n. sp.																									a				
Grewia alaskana Hollick, n. sp.														a															
Apeibopsis atwoodi Hollick, n. sp.														a															
Pterospermum *conforme* Hollick, n. sp.															a														
Trapa? microphylla Lesquereux																a													
Aralia pseudoplatanoidea Hollick, n. sp.																						a							
Hedera macclurii Heer?																	a												
Hedera curva Hollick, n. sp.																	a												
Cornus forchhammeri Heer																	a												
Cornus rhamnoides Hollick, n. sp.												a																	
Cornus benjamini Hollick, n. sp.																									a				
Cornus ceterus Hollick, n. sp.																	a												
Diospyros steenstrupi Heer																									a				
Diospyros cornifolius Hollick, n. sp.																									a				
Viburnum simile Knowlton?																									a				
Viburnum sp.														a															
Phytoradicularia dubia Hollick, n. sp.										a																			
Rhynchonella?																											b	b	
Nucula n. sp.																											b		
Nucula																												b	
Yoldia n. sp.																											b	b	
Glycimeris veatchii (Gabb)	b	b	b		b																								
Inoceramus undulatoplicatus Roemer			b		b														b										
Inoceramus undulatoplicatus var. *chignikensis* Smith	b	b			b																								
Inoceramus (small species)		b																											
Inoceramus				c		b	c	c			c									b	c		c				b	c	
Unio?																									c				
Trigonia leana? Gabb				b																									
Trigonia																											b	c	
Pecten																													

Fossils from the Chignik formation—Continued

	Lower member						Middle member									Upper (?) member							Upper member						
	5796	11362	5799	3116	5795	11361	3485	3490	3709	3708	S. P. (c)	5184	539	5185	5187	5296	5297	5580	5588	5577	3121	5189	5793	3525	3115, 3521	5295	3114	5797	5294
Anomia n. sp.	b	b	b		b																								
Anomia				b															b										
Thracia?																											c		
Clisocolus cordatus Whiteaves	b																												
Meretrix n. sp.					b																								
Meretrix nitida Gabb	b	b	b		b																								
Tellina nanaimoensis Whiteaves?	b																												
Tellina n. sp.					b																								
Mactra (Cymbophoria) ashburnerii Gabb	b	b																											
Corbula?																											b		
Pelecypods																											b	b	
Dentalium																											b	b	
Margarita n. sp.	b	b	b																										
Perissolax brevirostris Gabb	c				c																								
Fusus kingii (Gabb) Whiteaves var.	b																												
Volutoderma	c																												
Cinulia																											c		
Desmoceras? cf. D. subquadratum Anderson																					c								
Pachydiscus cf. P. multisulcatus Whiteaves																		c											
Pachydiscus newberryanus Meek var.	b																												
Pachydiscus			b																										
Hamites?																												c	
Anisoceras																											b		

a, Identified by Arthur Hollick; b, identified by W. R. Smith; c, identified by T. W. Stanton.

5796 (52). North side of Chignik Bay, 1 mile north of base of sand spit. W. W. Atwood, 1908.

11362 (36). Same locality as 5796. W. R. Smith, 1922.

5799 (58). Chignik Lagoon, nearly opposite Alaska Packers Association cannery. W. W. Atwood, 1908.

3116 (959). Whalers Creek, about 1½ or 2 miles from the shore of Chignik Lagoon. Sandstone underlying the coal-bearing beds. T. W. Stanton and R. W. Stone, 1904.

5795 (51). Whalers Creek, about 2 miles from Chignik Lagoon. Series of sandstone about 100 feet below the coal. W. W. Atwood. 1908.

11361 (35) Head of creek that flows into Hook Bay. W. R. Smith, 1922.

3485 (a). Big exposure on left fork of Mine Creek, Herendeen Bay, just above coal. Sidney Paige, 1905.

3490 (b). About 200 yards above left fork of Mine Creek, Herendeen Bay. Sidney Paige, 1905.

3709. Right branch of Mine Creek, 200 feet above fork. Herendeen Bay. Sidney Paige, 1905.

3708 (4). Mine Creek, right branch below first side stream. Herendeen Bay. Sidney Paige, 1905.

S. P. (c). Just above Johnson tunnel, Herendeen Bay. Sidney Paige, 1905.

5184 (30). Mine Creek, Herendeen Bay. "Coal series." W. W. Atwood, 1908.

539. Cut on tramway, about a mile from the head of Mine Harbor, Herendeen Bay, within a few hundred yards of the mine. C. H. Townsend, 1890.

5185 (31). Coal Bluff, east shore of Herendeen Bay. "Coal series." W. W. Atwood, 1908.

5187 (35). Canyon 2 miles west of mouth of creek about the middle of the west shore of Mud Bay, Port Moller. Shale bed. W. W. Atwood, 1908.

5296 (5). North shore of Chignik River, just below Long Bay. W. W. Atwood, 1908.

5297 (55). North shore of Chignik River, just below Long Bay. About 30 feet above 5296. W. W. Atwood, 1908.

5580 (23). Canyon on east face of Pinnacle Mountain, near summit, near head of Herendeen Bay. W. W. Atwood, 1908.

5588 (38). West side of Buck Valley, about 1½ miles from shore of Herendeen Bay. W. W. Atwood, 1908.

5577 (18). Canyon north of Pyramid Peak, about 4 miles south of Herendeen Bay. W. W. Atwood, 1908.

3121. North shore of Kaguyak Bay, 1 mile east of mouth of river. G. C. Martin, 1904.

5189 (44). East side of Pavlof Bay. W. W. Atwood, 1908.

5793 (45). South shore of Chignik Bay just west of end of Chignik Head. W. W. Atwood, 1908.

3525 (963). East shore of Doris Cove, Chignik Bay. T. W. Stanton and R. W. Stone, 1904.

3521 (958). South shore of Chignik Bay, 2 miles northeast of Alaska Packers Association cannery, opposite end of sand spit. Talus which evidently came from one of the shaly layers not far above the base of the exposure. T. W. Stanton and R. W. Stone, 1904.

3115 (958a). Same locality as 3521. Sandstone fragments in talus. T. W. Stanton and R. W. Stone, 1904.

5295 (49). South shore of Chignik Lagoon nearly opposite the end of the sand spit. Bed 4 of section on p. 13. W. W. Atwood, 1908.

3114 (957). South shore of Chignik Lagoon, 200 yards southwest of native village, about 1 mile northeast of Alaska Packers Association cannery. Dark shale. T. W. Stanton and R. W. Stone, 1904.

5797 (53). South shore of Chignik Lagoon, about 200 yards southwest of native village. Bed 1 of section on p. 13. W. W. Atwood, 1908.

5294 (48). Anchorage Bay, opposite Northwestern Fisheries cannery. W. W. Atwood, 1908.

The preceding table shows that the lower member of the Chignik formation has yielded only marine invertebrate fossils, the middle member has yielded fossil plants and a few marine mollusks (*Inoceramus*), and the upper member has yielded a considerable variety both of plants and marine invertebrates. The faunas and floras of the several members are distinctive. Only one species among the invertebrates extends over from one member into another. Among the fossil plants 68 per cent of all the species in the middle member, or 81 per cent of the angiosperms, and 78 per cent of all the species in the upper member, or 91 per cent of the angiosperms, are characteristic of the members.

Of the fossils from the lower member the following have been found in other formations:

Glycimeris veatchi, in the Chico and Martinez.
Inoceramus undulatoplicatus, in the Austin and Niobrara.
Trigonia leana, *Mactra* (*Cymbophoria*) *ashburnerii*, and *Perissolax brevirostris*, in the Chico.
Clisocolus cordatus and *Tellina nanaimoensis*, in the Nanaimo.
Meretrix nitida, *Fusus kingii* var., and *Pachydiscus newberryanus* var., in the Chico and Nanaimo.

The fauna of the lower member, according to Stanton,[79] is certainly Upper Cretaceous and is "the Chico fauna of the Pacific coast, especially as developed in the Nanaimo formation of Vancouver Island." Concerning another collection of fossils from one of the same localities in the lower member Stanton[80] said:

These fossils indicate correlation with a horizon in the Chico as developed in California and in the Nanaimo of Vancouver Island, which include practically all of the Upper Cretaceous, but the beds at Chignik are probably not older than basal Senonian.

Stanton[81] adds in explanation of this statement that he correlates the Niobrara formation of the Great Plains and the Austin chalk of Texas with the basal Senonian. Both of these formations contain *Inoceramus undulatoplicatus* Roemer, which is probably specifically identical with the form usually identified as *I. digitatus*.

The middle member of the Chignik formation has yielded the fossils listed in the table on pages 15–16. The only marine invertebrate species is an unidentified species of *Inoceramus*, which occurs more abundantly in the lower member and may occur also in the upper member. The fossil plants belong for the most part to species hitherto undescribed and do not furnish conclusive evidence as to the age of the member. The species that are known outside of the formation occur in rocks ranging in age from Potomac to Montana, but most of them are cycads and conifers, from which a close determination of age can not be expected. The evidence of the fossil plants is not out of harmony with Stanton's assignment of the fauna of the lower member to a horizon in the Chico. Of the fossils listed in the table, the following have been found in other formations:

Nilssonia serotina, in the Gyliakian of Sakhalin.
Nilssonia alaskana and *Cephalotaxopsis microphylla laxa*, in the Nulato and Kaltag.
Sequoia rigida, in the Potomac, Kome, Lower Atane, and Melozi.
Sequoia obovata, in the Montana and Vermejo.
Populus hyperborea and *Populus elliptica*, in the Dakota.
Dryophyllum bruneri, in the Mesaverde.

The upper member of the Chignik formation has yielded a large number of fossils, including both plants and marine invertebrates, which are listed in the table on pages 15–16. The fauna of the upper member is quite distinct from that of the lower member, only *Inoceramus undulatoplicatus* and an unidentified species of *Anomia* being possibly in common. Lot 5797, according to Stanton,[82] is "certainly Mesozoic and presumably Upper Cretaceous. The fossils indicate a different horizon, or at least a different facies, from the one represented at neighboring localities [in the upper member] from which Cretaceous collections were obtained." The flora of the upper member includes a large number of new species which are of little present value in correlating. About half of the previously described species are known elsewhere in rocks of approximately Montana age, and the other half in rocks of older Cretaceous formations. The evidence of the fossil plants therefore suggests that the upper member of the Chignik formation belongs well up in the Upper Cretaceous, an assignment which is in harmony with the evidence of the marine invertebrates. The fossils of the upper member known in other formations are listed below.

Nilssonia serotina, in the Gyliakian of Sakhalin.
Nageiopsis zamioides, in the Potomac.
Cephalotaxopsis intermedia, in the Melozi.
Cephalotaxopsis microphylla laxa, in the Melozi and Kaltag.
Sequoia obovata, in the Montana and Vermejo.
Ficus laurophylla and *Persea hayana*, in the Dakota.
Colutea primordialis and *Cornus forchhammeri*, in the Magothy and lower Atane.
Trapa? microphylla, in the Montana and Fort Union.
Hedera macclurii, in the Orokan of Sakhalin.
Diospyros steenstrupi, in the Patoot.
Viburnum simile, in the Vermejo.
Inoceramus undulatoplicatus, in the Austin and Niobrara.
Desmoceras? cf. *D. subquadratum*, in the upper part of the Horsetown.
Pachydiscus cf. *P. multisulcatus*, in the Nanaimo.

UPPER YUKON REGION

GENERAL FEATURES

The Cretaceous rocks of the upper Yukon region are known only in the banks of the Yukon and its tributaries between Eagle and Woodchopper Creek. They include marine Lower Cretaceous rocks, chiefly slate and quartzite, and nonmarine plant-bearing Upper Cretaceous shale, sandstone, and conglomerate. The Lower Cretaceous rocks are believed to rest unconformably on Triassic and Paleozoic formations, are probably several thousand feet thick, and carry a marine invertebrate fauna, including *Aucella* cf. *A. crassicollis*, which indicates a general correlation with the Lower Cretaceous *Aucella*-bearing beds of southern Alaska. The Upper Cretaceous rocks rest unconformably on Carboniferous rocks, are at least several hundred feet thick, and carry a terrestrial flora that indicates a correlation with the Upper Cretaceous plant-bearing beds of the lower Yukon region and with the Dakota sandstone. The Upper Cretaceous rocks are believed to be overlain unconformably by Tertiary (Eocene) plant-bearing beds.

[79] Stanton, T. W., cited by Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, p. 43, 1911.
[80] Stanton, T. W., and Martin, G. C., Mesozoic section on Cook Inlet and Alaska Peninsula: Geol. Soc. America Bull., vol. 16, p. 408, 1905.
[81] Stanton, T. W., personal note.
[82] Stanton, T. W., cited by Atwood, W. W., op. cit., p. 44.

SHALE, SANDSTONE, AND CONGLOMERATE NEAR SEVENTYMILE RIVER

HISTORICAL REVIEW

The Upper Cretaceous rocks of the upper Yukon region were included by Spurr [83] as part of the rocks which he described as the Kenai "series." The part of these beds which is now known to be Upper Cretaceous comprises those "about 25 miles below Mission Creek." Spurr's description of the rocks at this locality is very brief, consisting merely of a statement that there is conglomerate associated with shale and sandstone containing abundant leaf impressions. A list of species determined by F. H. Knowlton is given, and a discussion by Knowlton [84] of the plants from this and other localities, part of which are Tertiary.

These rocks were included by Brooks [85] in the "Tertiary rocks" without specific mention of the beds now known to be Upper Cretaceous, other than a citation of Spurr's description of the basal member near the mouth of Mission Creek.

The Upper Cretaceous locality at the mouth of Seventymile River was visited in 1902 by Collier, who collected plants now known to be Upper Cretaceous. The rocks at this locality were not then recognized as Cretaceous and were included by Collier in the general description [86] of the Tertiary rocks of the district, with an additional statement [87] that "a great thickness of Kenai sandstone, not known to be coal bearing, is exposed at the mouth of Seventymile River."

The description of the section on the upper Yukon by Brooks and Kindle contains no specific mention of any known Upper Cretaceous rocks, but the account of the Tertiary rocks [88] contains a suggestion that the rocks described as Tertiary may include some Cretaceous beds. It is also stated [89] that "in some instances the rocks are well indurated, being made up of hard conglomerate, sandstone, and sandy and clayey shales or slates, while in others the sandstones are almost unconsolidated and the argillites very little indurated." This statement suggests to the writer a possible unrecognized unconformity between more indurated Upper Cretaceous and less indurated Tertiary rocks. The writer also believes that some of the rocks referred to the Nation River formation by Brooks and Kindle, which are said [89] to resemble the more indurated Tertiary conglomerate, sandstone, and shale, may possibly be Upper Cretaceous.

The description by Prindle [90] of the Tertiary rocks of the Fortymile quadrangle, in which the Upper Cretaceous locality near the mouth of Seventymile River lies, contains no mention of the rocks at the Upper Cretaceous locality, but describes the other more indurated supposed Tertiary rocks of the quadrangle, part of which, as suggested above, may possibly be Upper Cretaceous. The same belt of Tertiary rocks extends westward into the Circle quadrangle and has been described by Prindle.[91] The rocks of this part of the belt may perhaps also contain some undifferentiated Upper Cretaceous members, but there is no special reason to suspect their presence, except that some of the beds are described as more thoroughly indurated than the others. The same publication contains a description [92] of a few areas of conglomerate and arkosic sandstone near the main divide of Charley, Goodpaster, and Salcha Rivers, which Prindle believes to be possibly Upper Cretaceous. No conclusive evidence of the age of these rocks was obtained. They are not known to contain any fossils except "poorly preserved plant remains," which were apparently not collected.

STRATIGRAPHIC DESCRIPTION

The Upper Cretaceous rocks of the upper Yukon region are exposed in the cliffs on the south bank of the Yukon just below the mouth of Seventymile River. These cliffs are composed of shale, sandstone, and conglomerate striking northwest and dipping about 40° S. The rocks consist for the most part of an alternation of thin beds of sandy shale and sandstone, but there are some beds of conglomerate 10 feet or more thick. The shale contains abundant fossil plant remains, of which collections were made at the mouth of the small creek 1½ miles below the mouth of Seventymile River and at several neighboring localities on the bank of the Yukon. At the north end of the cliffs there are exposures of supposed Carboniferous limestone, which appears to underlie the Cretaceous rocks unconformably. At the south end of the cliffs there are also exposures of supposed Carboniferous limestone having an attitude discordant with that of the Cretaceous rocks, the limestone striking N. 25° E. and dipping 25° SE. There is evidently either a fault or an overturning of the rocks at this place—probably a fault.

A belt of Tertiary clay, sandstone, shale, and conglomerate that are also plant bearing lies in the valley

[83] Spurr, J. E., Geology of the Yukon gold district, Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 185, 192, 1898.

[84] Knowlton, F. H., Report on a collection of fossil plants from the Yukon River, Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 194–196, 1898.

[85] Brooks, A. H., The coal resources of Alaska: U. S. Geol. Survey Twenty-second Ann. Rept., pt. 3, p. 536, 1902.

[86] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, pp. 15–17, 1903.

[87] Idem, p. 28.

[88] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the upper Yukon, Alaska: Geol. Soc. America Bull., vol. 19, pp. 307–309, 1908.

[89] Idem, p. 308.

[90] Prindle, L. M., The Fortymile quadrangle, Yukon-Tanana region, Alaska: U. S. Geol. Survey Bull. 375, pp. 23–26, 1909.

[91] Prindle, L. M., A geologic reconnaissance of the Circle quadrangle, Alaska: U. S. Geol. Survey Bull. 538, pp. 33–34, 1913.

[92] Idem, p. 32.

of Seventymile River not far west of these Cretaceous rocks and possibly adjoins them, but the intervening area has not been examined, and the relation of the Cretaceous to the Tertiary rocks is not known. The Tertiary rocks of Seventymile River have been described by Brooks and Kindle[93] and also by Prindle[94] as including beds that differ very much in degree of induration. Possibly the more indurated of the supposed Tertiary rocks of Seventymile River may be the western extension of these Upper Cretaceous beds.

AGE AND CORRELATION

The Upper Cretaceous rocks near Seventymile River have yielded no fossils other than the plants which are described and discussed by Hollick in this volume and are listed in the following table. These plants indicate a correlation with the Kaltag formation, which constitutes the upper coal-bearing division of the Upper Cretaceous section on the lower Yukon.

Upper Cretaceous fossils from upper Yukon region[a]

	1555	2973	3243	6815	7407	7408
Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun			×	×	×	×
Ginkgo sp		×				
Cephalotaxopsis microphylla laxa Hollick	×			×		
Cephalotaxopsis sp		×			×	×
Nymphaeites exemplaris Hollick			×			
Castaliites sp						×
Menispermites septentrionalis Hollick	×					
Platanus sp					×	×
Credneria? parva Hollick			×			
Protophyllum? sp	×					
Pseudoaspidiophyllum latifolium Hollick			×			
Pseudoaspidiophyllum platanoides Hollick				×		
Pseudoprotophyllum comparabile Hollick			×			
Pseudoprotophyllum dentatum Hollick	×					
Pseudoprotophyllum emarginatum Hollick			×			
Pseudoprotophyllum venustum Hollick			×			
Pseudoprotophyllum viburnifolium Hollick			×			
Pseudoprotophyllum sp					×	
Hedera platanoidea Lesquereux				×		

[a] Identified by Arthur Hollick.

1555. Yukon River, 25 miles below Mission Creek. J. E. Spurr, 1896.
2973 (57). Left (south) bank of Yukon River, 2 miles below mouth of Seventymile River. A. J. Collier, 1902.
3243 (3 AH 4). Left (south) bank of Yukon River just below Seventymile River. Arthur Hollick, 1903.
6815. South bank of Yukon River at mouth of draw, 1½ miles below Seventymile River. G. C. Martin, 1914.
7407. Same locality as 6815. G. C. Martin, 1919.
7408. South bank of Yukon River, half a mile below next gulch below Seventymile River. G. C. Martin, 1919.

RAMPART-TANANA DISTRICT

GENERAL FEATURES

The Cretaceous rocks of the Rampart-Tanana district include marine Lower Cretaceous quartzite and slate and marine Upper Cretaceous sandy shale. The Lower Cretaceous rocks overlie Silurian and Devonian metamorphic rocks, are of undetermined thickness, and have yielded only a few fragmentary fossils, chiefly *Aucella*. The Upper Cretaceous rocks probably rest unconformably on the Lower Cretaceous slate and quartzite, consist of black, rather massive carbonaceous sandy shale, probably 200 or 300 feet thick, and contain marine mollusks and poorly preserved plant remains. Tertiary rocks, although present elsewhere in the district, are absent at this locality, and the only beds known to overlie the Upper Cretaceous rocks are Recent unconsolidated deposits.

[93] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the upper Yukon, Alaska: Geol. Soc. America Bull., vol. 19, p. 310, 1908.

[94] Prindle, L. M., The Fortymile quadrangle, Yukon-Tanana region, Alaska: U. S. Geol. Survey Bull. 375, p. 25, 1909.

SHALE NEAR WOLVERINE MOUNTAIN

HISTORICAL REVIEW

The Cretaceous rocks in the Rampart district were first recognized by Prindle, who described[95] the sandstone and shale of Wolverine and Lynx Mountains. The description states that the rocks are "black, rather massive, impure sandstones and shales," contain "fragments of dicotyledonous leaves and part of an indeterminable bivalve;" "rest on the upturned edges of the older Silurian or Devonian rocks and have themselves undergone considerable deformation," "resemble the Upper Cretaceous rocks which occur lower down the Yukon," and "are entirely different from the Kenai rocks near Rampart and are referred provisionally to the Cretaceous."

A subsequent description of these rocks, based on additional field studies by Prindle[96] in 1907, contains a brief statement of the lithologic character of the rocks, accompanied by lists and a discussion by Stanton of marine invertebrate fossils from Wolverine Mountain and Quail Creek. A brief reference to the occurrence of these rocks was made by Brooks and Kindle.[97] A later description by Prindle[98] contains no mention of the rocks on Lynx Mountain, which had previously been erroneously correlated on lithologic grounds with the rocks on Wolverine Mountain. A brief description of these rocks, based on the observations of Prindle, has been given by Brooks,[99] and a brief mention of them was made by Eakin,[1] who suggested that they may extend southwestward from Wolverine Mountain into the Rampart quadrangle.

STRATIGRAPHIC DESCRIPTION

The Upper Cretaceous rocks of Wolverine Mountain include a basal conglomerate about 10 feet thick, con-

[95] Prindle, L. M., Geography and geology [of the Rampart gold placer region, Alaska]: U. S. Geol. Survey Bull. 280, pp. 17, 22, 1906.

[96] Prindle, L. M., The Fairbanks and Rampart quadrangles, Yukon-Tanana region, Alaska: U. S. Geol. Survey Bull. 337, pp. 16, 23–24, 1908.

[97] Brooks, A. H., and Kindle, E. M., Paleozoic and associated rocks of the Upper Yukon, Alaska: Geol. Soc. America Bull., vol. 19, p. 307, 1908.

[98] Prindle, L. M., A geologic reconnaissance of the Fairbanks quadrangle, Alaska: U. S. Geol. Survey Bull. 525, pp. 33, 34, 47–48, 1913.

[99] Brooks, A. H., The Mount McKinley region, Alaska: U. S. Geol. Survey Prof. Paper 70, pp. 51, 55, 93, 130, 1911.

[1] Eakin, H. M., A geologic reconnaissance of part of the Rampart quadrangle, Alaska: U. S. Geol. Survey Bull. 535, pp. 21, 24, 1913.

taining pebbles of quartzite and black slate, overlain by several hundred feet of rather massive black sandy shale, fine-grained black shale, and sandstone. The underlying rocks are quartzite and shale that are regarded by Prindle as Paleozoic and by Eakin as probably mainly Lower Cretaceous. These divergent opinions are based on the presence, in near-by localities, of both Lower Cretaceous and Devonian or Silurian fossils. There is no question that the rocks surrounding Wolverine Mountain include both Lower Cretaceous and Devonian or Silurian beds. No conclusive evidence is at hand as to whether the Lower Cretaceous or the Paleozoic beds immediately underlie the Upper Cretaceous rocks. The only rocks that are younger than these Upper Cretaceous beds and are in contact with them are igneous intrusives. Tertiary strata are present in the district, but they do not overlie the Upper Cretaceous beds.

AGE AND CORRELATION

The fauna and flora of the Upper Cretaceous rocks of Wolverine Mountain, represented in the following table, include some marine invertebrates and a few poorly preserved plants. Fragments of dicotyledonous leaves and a part of an indeterminable bivalve were collected by Prindle from these rocks in 1904. Partly on that basis and partly on their lithologic character he assigned them to the Cretaceous. In 1907 Prindle obtained additional fossils, including both marine invertebrates and plants. No report on these fossil plants or on those collected in 1904 has been published. The following statement concerning the marine invertebrates collected by Prindle in 1907 was furnished by Stanton:[2]

> While the fossils are fairly well preserved, they have been considerably distorted, so that it is not practicable to make specific determination. The better preserved forms appear to be undescribed. The following list will show the forms recognized in each lot. * * *
>
> These fossils evidently all belong to practically a single horizon, which is confidently referred to the Upper Cretaceous. * * * The species of *Inoceramus* is very likely one that has been previously found on the Yukon, but the specimens in the present collection are too imperfect to serve as the basis for a positive identification. The most important forms are ammonites, which make up the bulk of the collection and which I have referred, in some cases doubtfully, to the genus *Pachydiscus*. These are unquestionably Upper Cretaceous types.

The presence of *Sequoia reichenbachi* and *Inoceramus* cf. *I. labiatus* indicates that the Upper Cretaceous rocks of Wolverine Mountain may be correlated with the Nulato formation of the lower Yukon.

[2] Stanton, T. W., cited by Prindle, L. M., The Fairbanks and Rampart quadrangles, Yukon-Tanana region, Alaska: U. S. Geol. Survey Bull. 337, p. 24, 1908.

Upper Cretaceous fossils from Rampart-Tanana district[a]

	4AP306	7AP263	4278	4279	4280	8900	7577, 11392	7576
Fern							a	
Podozamites lanceolatus eichwaldi Heer?								a
Ginkgo			b					
Sequoia reichenbachi (Geinitz) Heer?								a
Taxodium?			b					
Populus	b							
Viburnum								a
Dicotyledons			b					
Stems or bark	b							
Vegetable fragments		b						
Hemiaster?			c	c		c		
Nucula						c		
Nemodon						c		
Cucullaea			c	c				
Inoceramus cf. I. labiatus Schlotheim			c					
Pecten			c			c		
Pleuromya			c					
Lucina			c					
Natica						c		
Pachydiscus			c	c	c			
Pachydiscus?			c	c		c		
Ammonite							c	

[a] a, Identified by Arthur Hollick; b, identified by F. H. Knowlton; c, identified by T. W. Stanton.

4AP306. Southeast spur of Wolverine Mountain, 2.92 miles S. 58° W. of mouth of Quail Creek. L. M. Prindle, 1904.

7AP263. Near Wolverine Mountain? L. M. Prindle, 1907.

4278 (7AP271). Southeast spur of Wolverine Mountain, 2.6 miles S. 53° W. of mouth of Quail Creek. L. M. Prindle, 1907.

4279 (7AP278). Ridge on left side of south fork of Quail Creek. L. M. Prindle, 1907.

4280 (7AP279). Right side of south fork of Quail Creek. L. M. Prindle, 1907.

8900. South fork of Quail Creek about 1 mile above main forks. G. C. Martin, 1914.

7577 (22AMt105b). About 3⅛ miles S. 69° W. of mouth of Quail Creek. J. B. Mertie, 1922.

11392 (22AMt105a). Same locality as 7577. J. B. Mertie, 1922.

7576 (22AMt79). About 7⅔ miles N. 44° E. of Eureka. J. B. Mertie, 1922.

LOWER YUKON REGION

GENERAL FEATURES

The Cretaceous rocks of the lower Yukon region are exposed at many localities in the north bank of the Yukon between Melozi and Andreafski. (See pl. 87, in pocket.) They consist of probably several thousand feet of Upper Cretaceous shale, sandstone, and conglomerate, some of which are marine and some of which are of brackish or fresh water origin and include coal-bearing members. The stratigraphic sequence is believed to be as follows:

Generalized section of Upper Cretaceous rocks on lower Yukon River

	Feet
Kaltag formation: Coal-bearing rocks consisting of fresh-water sandstone, shale, and coal beds with possibly some thin marine members. Contains fossil plants, fresh-water invertebrates, and perhaps a few marine invertebrates	800+

	Feet
Nulato formation: Marine sandstone and shale. Contains marine invertebrates and a few plants	3,000—
Melozi formation: Fresh-water shale and sandstone. Contains fossil plants and fresh-water invertebrates	1,000+
Ungalik conglomerate: Conglomerate, sandstone and sandy shale. Contains worm tubes, trails, and vegetable detritus	3,000

In the northern part of the region the Upper Cretaceous rocks adjoin and are believed to rest directly upon early Paleozoic metamorphic rocks. In the southern part of the region they overlie upper Carboniferous greenstone and associated sediments. The beds that have been observed to overlie the Upper Cretaceous rocks are unconsolidated Quaternary deposits, but supposed Tertiary volcanic rocks occur near some of the Upper Cretaceous rocks and are believed to be the next succeeding formation.

UPPER CRETACEOUS ROCKS ON THE LOWER YUKON

HISTORICAL REVIEW

The first mention of the rocks of the lower Yukon region, now referred to the Upper Cretaceous, is contained in a short article by Dall,[3] in which there are statements of the kinds of rock exposed in the river bank, with mention of the presence of fossil mollusks and vegetable remains. In a later article [4] Dall states that the brown sandstone with marine fossils at Nulato and the underlying leaf-bearing shale are Miocene. A brief description of the rocks exposed in the bank of the Yukon below the mouth of Melozi River has been given by Russell.[5] In a subsequent, more extensive discussion of these rocks Dall and Harris [6] described them as consisting of the Nulato sandstone and the Kenai "group." The Nulato sandstone was described as a brownish marine sandstone which extends along the river from Kaltag to Koyukuk Mountain and which lies conformably on the bluish sandstone of the Kenai "group." This description was later repeated by Dall [7] with little change.

Additional observations on the Upper Cretaceous rocks of the lower Yukon region were made by Spurr in 1896. Spurr described these rocks as the Kenai "series" [8] and the Nulato sandstones,[9] both of which he referred to the Tertiary. The description contains a detailed record of local observations by Spurr and is accompanied by a statement by Knowlton [10] on some fossil plants.

The exposures in the bank of the Yukon between Nulato and the mouth of the Koyukuk were observed by Schrader in 1899, and marine mollusks, which were determined by Stanton as Upper Cretaceous, were collected. Schrader's report [11] makes mere mention of the fact that Upper Cretaceous fossils were recognized. The Nulato sandstone, from which these fossils were obtained, and some of the contained coal beds are briefly mentioned,[12] but no reference is made to the fact that the fossils show the Nulato sandstone to be Upper Cretaceous and not Miocene. In a later report Schrader gave a list of these fossils,[13] without a description of their precise occurrence, under the heading "Upper Cretaceous on the Koyukuk." He subsequently gave the list again,[14] with a correct statement of their occurrence, in a discussion of the correlation of the Nanushuk "series" of the Arctic coast. Further reference to the Upper Cretaceous fossils collected by Schrader near the mouth of the Koyukuk was made by Brooks,[15] who gave a list of the fossils as determined by Stanton and stated that the Nulato sandstone is "closely associated with Upper Cretaceous beds" and that "the horizon of the coals in the vicinity of Nulato has not been definitely determined."

The Upper Cretaceous coal-bearing rocks of the Yukon were studied in considerable detail in 1902 by Collier, who collected fossils, including plants and marine and fresh or brackish water invertebrates, at many localities. The marine invertebrates and some of the plants were at once recognized as Upper Cretaceous. Some of the plants were for a time regarded as Tertiary and others as possibly Lower Cretaceous, but they are now all regarded as Upper Cretaceous. The fresh or brackish water fossils collected by Collier are not distinctive, but they too are doubtless Upper Cretaceous, as they occur interbedded with the other forms.

In a preliminary report [16] on his investigations, dealing chiefly with the occurrence and character of the coal beds, Collier states that the coal-bearing beds of the lower Yukon consist "of sandstones, shales, and conglomerates, which probably form an uninterrupted sedimentary series, ranging in age from the Middle

[3] Dall, W. H., Explorations in Russian America: Am. Jour. Sci., 2d ser., vol. 45, pp. 96–99, 1868.

[4] Dall, W. H., Note on Alaska Tertiary deposits: Am. Jour. Sci., 3d ser., vol. 24, pp. 67–68, 1882.

[5] Russell, I. C., Notes on the surface geology of Alaska: Geol. Soc. America Bull., vol. 1, p. 108, 1890.

[6] Dall, W. H., and Harris, G. D., Correlation papers—Neocene: U. S. Geol. Survey Bull. 84, pp. 233, 246–248, 253–254, 258, 1892.

[7] Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey Seventeenth Ann. Rept., pt. 1, pp. 817–818, 838, 844–845, 849, 860, 862, 1896.

[8] Spurr, J. E., Geology of the Yukon gold district, Alaska: U. S. Geol. Survey Eighteenth Ann. Rept., pt. 3, pp. 189–191, 193, 194, 1898.

[9] Idem, p. 196.

[10] Knowlton, F. H., Report on a collection of fossil plants from the Yukon River: Idem, pp. 194–196.

[11] Schrader, F. C., Preliminary report on a reconnaissance along the Chandlar and Koyukuk Rivers, Alaska, in 1899: U. S. Geol Survey Twenty-first Ann. Rept., pt. 2, p. 477, 1900.

[12] Idem, pp. 478, 485–486.

[13] Schrader, F. C., Geological section of the Rocky Mountains in northern Alaska: Geol. Soc. America Bull., vol. 13, p. 248, 1902.

[14] Schrader, F. C., A reconnaissance in northern Alaska: U. S. Geol. Survey Prof. Paper 20, p. 81, 1904.

[15] Brooks, A. H., The coal resources of Alaska: U. S. Geol. Survey Twenty-second Ann. Rept., pt. 3, pp. 529, 535, 555–556, 1902.

[16] Collier, A. J., Coal resources of the Yukon Basin, Alaska: U. S. Geol. Survey Bull. 213, pp. 276–283, 1903.

Cretaceous to the upper Eocene, and hence include both the Nulato and the Kenai series." In a later report these rocks are described by Collier [17] as including three divisions—fresh-water cycad-bearing beds near Nulato, which are "probably assignable to the Lower Cretaceous"; Upper Cretaceous marine and fresh-water (coal-bearing) sandstone, conglomerate, and shale with "a marine invertebrate fauna of Upper Cretaceous age" and fossil plants "assigned by Doctor Knowlton to the Upper Cretaceous"; and a succeeding division, "called the Kenai series," of upper Eocene age, with abundant plant remains, extensively developed near Nulato, where "its relation to the Upper Cretaceous seems to be one of conformity." In this report Collier also gave detailed descriptions [18] of the strata exposed at and near the known coal beds.

As the result of a preliminary study of the fossil plants collected by Collier and of additional collections made by Hollick in 1903, Knowlton [19] stated that the fossil plants obtained below Rampart "indicate that the age is either undoubted Cretaceous or doubtful Tertiary. The Cretaceous plants include cycads of several genera, conifers, and many dicotyledons, the combination resembling mostly the Middle and Upper Cretaceous flora of Bohemia." A summary of the results of the field investigations of Collier and Hollick and of the studies of their collections by Stanton and Knowlton has been given by Brooks.[20]

Additional field studies and collections of fossils were made by W. W. Atwood and H. M. Eakin in 1907, but no complete report on the work has yet been published, although some of the results have been used by the writers cited below, notably by Eakin and by Smith and Eakin, as well as by the writer in this volume.

As a result of his earlier laboratory studies of all the fossil plants collected from the Cretaceous rocks of this region, Hollick [21] discussed briefly the broader aspects of the floras, without local details, and also made a general preliminary statement [22] dealing chiefly with the age and correlation of the flora. He also referred to the Cretaceous plants in a discussion of the Tertiary flora of Alaska.[23]

A geologic reconnaissance from Nulato to the head of Norton Bay was made by P. S. Smith and H. M. Eakin in 1909. Their report contains much information concerning the Upper Cretaceous rocks,[24] not only of the area between Yukon River and the head of Norton Bay, which was the special field of the investigation, but of the exposures along the Yukon, especially between Melozi and Kaltag. In the description of the latter area the observations of previous investigators were largely used. The Cretaceous rocks described by Smith and Eakin are divided into two named units—"a basal conglomerate called * * * the Ungalik conglomerate; and an overlying group of sandstones and shales called the Shaktolik group. The Shaktolik group is separated into two divisions—the lower, distinguished by a preponderance of sandstones over shale, and the upper, in which shales are in excess."

Brief mention of the Cretaceous rocks exposed along the Yukon between Melozi and Nulato was made by Eakin,[25] who derived his information from his own observations in 1907 but gave no details.

In 1913 Eakin made a geologic reconnaissance of the region between Yukon and Koyukuk Rivers. The account of this investigation contains a rather extensive general description of the Cretaceous rocks,[26] which is based not only on Eakin's field studies in 1913 but also, so far as the area lying along the Yukon is concerned, on previous investigations, including his own observations in 1907. Reports by T. W. Stanton and F. H. Knowlton on fossils collected by Atwood and Eakin in 1907 between Melozi and the mouth of the Koyukuk are published for the first time.[27] Although the section exposed along the Yukon is believed to be wholly Upper Cretaceous, the northern part of the area, along the Koyukuk, contains some Lower Cretaceous rocks.

The Upper Cretaceous rocks west of the Yukon between Anvik and Andreafski have been described by Harrington.[28] The description includes general accounts of the areal distribution, lithology and stratigraphy, structure, and age and correlation of the Cretaceous rocks of the whole region, together with detailed statements of their local features in each of the separate areas. The account of age and correlation includes statements by F. H. Knowlton and J. B. Reeside, jr., concerning the fossil plants and mollusks collected by Harrington and a general statement by

[17] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, pp. 15, 17, 1903.

[18] Idem, pp. 19–20, 46–58, 65.

[19] Knowlton, F. H., Fossil floras of the Yukon: Science, new ser., vol. 19, pp. 733–734, 1904.

[20] Brooks, A. H., The geography and geology of Alaska: U. S. Geol. Survey Prof. Paper 45, pp. 236, 241–242, 1906.

[21] Hollick, Arthur, Discussion of the Cretaceous and Tertiary floras of Alaska: Washington Acad. Sci. Jour., vol. 1, p. 142, 1911.

[22] Hollick, Arthur, Preliminary correlation of the Cretaceous and Tertiary floras of Alaska: Geol. Soc. America Bull., vol. 24, p. 116, 1913.

[23] Hollick, Arthur, Results of a preliminary study of the so-called Kenai flora of Alaska: Am. Jour. Sci., 4th ser., vol. 31, pp. 327–330, 1911.

[24] Smith, P. S., and Eakin, H. M., A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska: U. S. Geol. Survey Bull. 449, pp. 54–60, 1911.

[25] Eakin, H. M., The Iditarod-Ruby region, Alaska: U. S. Geol. Survey Bull. 578, pp. 23–24, 1914.

[26] Eakin, H. M., The Yukon-Koyukuk region, Alaska: U. S. Geol. Survey Bull. 631, pp. 41–50, 1916.

[27] Idem, pp. 47–48.

[28] Harrington, G. L., The Anvik-Andreafski region, Alaska: U. S. Geol. Survey Bull, 683, pp. 22–23, 26–35, 51, 1918.

Arthur Hollick concerning the fossil plants from all the localities on the lower Yukon.

The Upper Cretaceous section exposed between Melozi and Anvik was critically examined in 1921 by the writer, who also made some observations in the vicinity of Holy Cross in 1920. The results of these investigations were published in 1926.[29]

STRATIGRAPHIC DESCRIPTION

The Upper Cretaceous rocks exposed along Yukon River between Melozi and Andreafski consist of sandstone, conglomerate, and shale having an aggregate thickness of perhaps 8,000 feet. These beds include both marine and fresh-water members, and the latter contain some coal beds. The complete sequence is not exposed in any one section, there being numerous broad areas with no exposures, so that the full succession and thickness must be inferred from incomplete evidence. It is believed, however, that the rocks may be subdivided into the four formations shown in the table on pages 20–21. (See figs. 2–5.)

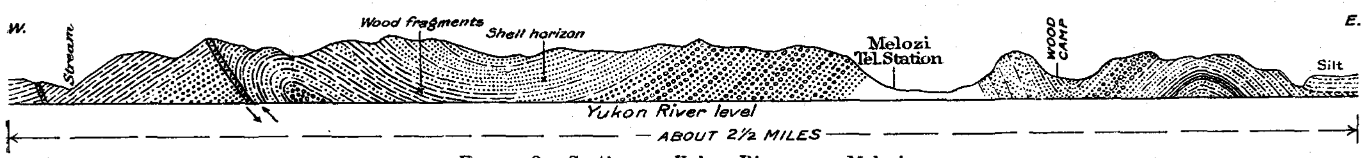

FIGURE 2.—Section on Yukon River near Melozi

The Ungalik conglomerate, which is the basal division of the Upper Cretaceous rocks of the lower Yukon region, consists of conglomerate, sandstone, and sandy shale having an aggregate thickness of probably about 3,000 feet. It was described by Smith and Eakin[30] from exposures on Ungalik River east of Norton Bay. The only fossils found in it are undetermined marine pelecypods, worm tubes, trails, and indeterminate vegetable detritus.

The Melozi formation, named[31] from exposures on the north bank of the Yukon from 8 to 20 miles below Melozi telegraph station, overlies the Ungalik conglomerate with apparent conformity. It consists of fresh-water shale and sandstone at least 1,000 and possibly several thousand feet thick. It contains fossil plants and fresh-water invertebrates. (See fig. 2.)

The Nulato formation, which overlies the Melozi formation with apparent conformity, consists of marine sandstone and shale probably about 3,000 feet thick. It is typically exposed in the northwest bank of the Yukon for 2 to 10 miles above Nulato. It includes the rocks which Dall[32] described as the Nulato sandstone. The Nulato formation contains marine invertebrates and a few fossil plants. (See figs. 3–4.)

The Kaltag formation, named[33] from exposures on the northwest bank of the Yukon between Kaltag and the Williams mine, consists of coal-bearing rocks, including fresh-water sandstone, shale, and coal beds, with possibly some thin marine members. It overlies the Nulato formation with apparent conformity and is at least 800 feet thick. It contains fossil plants, fresh-water invertebrates, and perhaps a few marine invertebrates.

These formations are described in detail in Bulletin 776.

AGE AND CORRELATION

The Upper Cretaceous rocks of the lower Yukon are not known to be in contact with any formations other than the supposed Paleozoic rocks that underlie them and the supposed Tertiary volcanic beds that may overlie them. There is consequently no evidence as to the precise age of the Upper Cretaceous rocks, except that afforded by the contained fossils, which have been found in all four of the Upper Cretaceous formations.

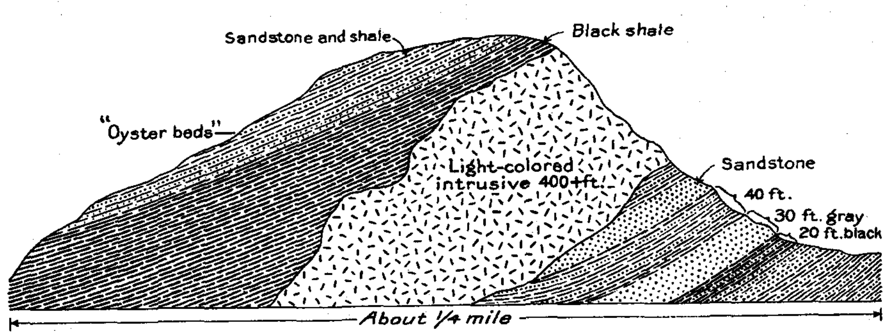

FIGURE 3.—Section on Yukon River near Fossil Bluff

The lower conglomeratic formation (Ungalik conglomerate) has yielded only some fragmentary plants and some indeterminate pelecypods, none of which gives conclusive evidence as to the age. As these conglomeratic beds appear to underlie the other Upper Cretaceous rocks conformably, there is little if any doubt that they too are Upper Cretaceous.

[29] Martin, G. C., The Mesozoic stratigraphy of Alaska: U. S. Geol. Survey Bull. 776, pp. 400–411, 1926.

[30] Smith, P. S., and Eakin, H. M., A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska: U. S. Geol. Survey Bull. 449, pp. 55–57, 1911.

[31] Martin, G. C., op. cit., p. 400.

[32] Dall, W. H., and Harris, G. D., Correlation papers—Neocene: U. S. Geol. Survey Bull. 84, pp. 233, 246–248, 253–254, 258, 1892.

[33] Martin, G. C., op. cit., p. 400.

The fresh-water shale and sandstone (Melozi formation) have yielded both fossil plants and fresh-water mollusks. The shells include chiefly some unidentified species of *Unio*, which afford no evidence as to the age of the rocks.

The marine sandstone and shale (Nulato formation) have yielded both fossil plants and marine invertebrates. Some fresh-water pelecypods (*Unio*) have been collected at one locality within the area of these rocks, but they were not obtained in place and are believed to have been derived from the underlying fresh-water shale and sandstone of the Melozi formation. Most of the marine invertebrates belong to unidentified species and have not been critically studied.[34] They indicate, according to Stanton,[35] "that the horizon is within the Upper Cretaceous but probably not higher than the middle of the Upper Cretaceous."

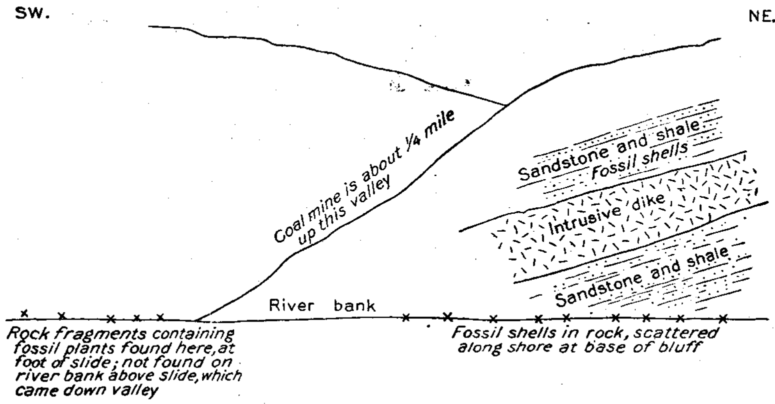

FIGURE 4.—Sketch showing position of fossiliferous beds near Fossil Bluff

The coal-bearing rocks (Kaltag formation) contain abundant fossil plants, some fresh or brackish water mollusks, and probably a few marine mollusks. It is possible that all the marine fossils that have been listed as coming from these beds were derived from older rocks that have been erroneously correlated with these beds. These marine fossils represent only a few genera and apparently do not include any species that have not been recognized in the underlying marine sandstone and shale. The fresh or brackish water fossils include oysters and several genera of fresh-water mollusks that have not been recognized in the older fresh-water shale and sandstone.

The occurrence of all the fossil plants has been given by Hollick in the systematic descriptions of the species on pages 37–116. The evidence yielded by the fossil plants concerning the age of the Upper Cretaceous flora of the Yukon as a whole is discussed by Hollick on pages 5–9, where it is shown that the flora is with little doubt approximately of Dakota age. This conclusion is practically in accordance with the evidence yielded by the marine invertebrates and is accepted without question.

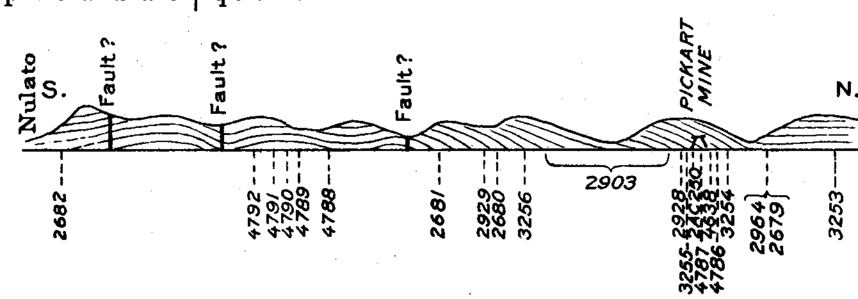

FIGURE 5.—Section showing general relations of Upper Cretaceous rocks between Pickart mine and Nulato

In order to determine the character and significance of the floras of the several formations into which the writer has separated the Upper Cretaceous rocks of the lower Yukon, the distribution of the fossils is given in the following tables. In these tables the localities are grouped by stratigraphic subdivisions, and all the fossils, including the marine and fresh-water shells as well as the plants, are tabulated.

[34] After this paper was practically finished a critical study of the Upper Cretaceous invertebrate fossils of Alaska was undertaken by W. R. Smith. The results of that study have not been published, but preliminary lists of fossils identified by Smith have been used in making up the tables of fossils on pp. 24–30.

[35] Stanton, T. W., unpublished statement.

Fossils from the Melozi formation [a]

	4782	2975	2976	4633	7715	1554	2963	3248	4634, 4783	3249	3250	3251	2922, 3251a	2675	2923
Asplenium foersteri Debey and Ettingshausen?							a								
"Pecopteris arctica Heer"?						b									
Anemia supercretacea conformis Hollick, n. var							a								
Nilssonia yukonensis Hollick, n. sp								a							
Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun								a							
Ginkgo digitata (Brongniart) Heer								a							
Ginkgo pseudoadiantoides Hollick, n. sp				a				a							
Protophyllocladus polymorphus (Lesquereux) Berry							a								
Cephalotaxopsis heterophylla Hollick, n. sp								a							
Cephalotaxopsis magnifolia successiva Hollick, n. var				a											
Cephalotaxopsis intermedia Hollick, n. sp				a											
Cephalotaxopsis microphylla laxa Hollick, n. var								a							
Cephalotaxopsis electilis Hollick, n. sp									a						
Tumion gracillimum Hollick, n. sp				a				a							

[a] a, Identified by Arthur Hollick; b, identified by F. H. Knowlton; c, identified by W. R. Smith; d, identified by T. W. Stanton.

Fossils from the Melozi formation—Continued

	4782	2975	2976	4633	7715	1554	2963	3248	4634, 4783	3249	3250	3251	2922, 3251a	2675	2923
Pinus?										a					
Sequoia cf. S. ambigua Heer		a													
Sequoia fastigiata (Sternberg) Heer										a					
Sequoia concinna Heer										a					
Sequoia reichenbachi (Geinitz) Heer								a							
Sequoia rigida Heer?												a			
Sequoia subulata Heer?								a							
Sequoia? (cones)								a		a					
Sphenolepis			a												
Populus praelatior Hollick, n. sp.										a					
Populites vitiformis Hollick, n. sp.									a	a					
Populites platanoides Hollick, n. sp.							a		a						
Populites spatiosus Hollick, n. sp.							a			a					
Populites? captiosus Hollick, n. sp.									a						
Populites mirabilis Hollick, n. sp.								a							
Myrica? trifoliata Newberry?										a					
Quercus eamesi Trelease?										a					
Ficus daphnogenoides (Heer) Berry										a	a				
Macclintockia electilis Hollick, n. sp.												a			
Aristolochia paigei Hollick, n. sp.											a				
Castaliites flabelliformis Hollick, n. sp.							a								
Menispermites reniformis Dawson								a							
Menispermites hederaeoides Hollick, n. sp.								a							
Menispermites communis Hollick, n. sp.									a						
Magnolia amplifolia Heer											a				
Magnolia lacoeana Lesquereux											a				
Benzoin venustum alaskanum Hollick, n. var.											a				
Daphnogene cocculoides Hollick, n. sp.									a						
Daphnophyllum dakotense Lesquereux?								a							
Cinnamomum dubiosum Hollick, n. sp.											a				
Platanus? newberryana Heer					a				a						
Platanus? newberryana conditionalis Hollick, n. var.									a						
Platanus latior (Lesquereux) Knowlton								a							
Platanus latior intermedia Hollick, n. var.							a								
Platanus heerii Lesquereux					a				a						
Platanus			a										a		
Credneria inordinata Hollick, n. sp.								a							
Credneria longifolia Hollick, n. sp.								a							
Credneria mixta Hollick, n. sp.								a							
Credneria intermedia Hollick, n. sp.								a							
Credneria basinervosa Hollick, n. sp.							a								
Pseudoprotophyllum crenulatum Hollick, n. sp.								a							
Pseudoprotophyllum comparabile Hollick, n. sp.								a							
Pseudoprotophyllum magnum Hollick, n. sp.								a							
Pseudoaspidiophyllum latifolium Hollick, n. sp.								a							
Pseudoaspidiophyllum singulare Hollick, n. sp.								a							
Cotinus cretacea Hollick, n. sp.								a							
Sapindus morrisoni Lesquereux MS., Heer								a							
Sapindus apiculatus Velenovsky										a					
Paullinia minutidenticulata Hollick, n. sp.										a					
Vitis venusta Hollick, n. sp.							a								
Cissites comparabilis Hollick, n. sp.											a				
Cissites yukonensis Hollick, n. sp.								a							
Grewiopsis yukonensis Hollick, n. sp.								a							
Sterculia basiauriculata Hollick, n. sp.							a								
Trails	d					d									
Ostrea													c		
Unio, n. sp.													c	c	c
Unio															d
Pelecypods									d						
Viviparus? or Campeloma?															d

4782 (19). Yukon River, north bank, about 9 (?) miles below Melozi. Argillite associated with coarse conglomerate. W. W. Atwood, 1907.

2975 (2AC234). Yukon River, north bank, about 9 miles below Melozi. Thin bed of carbonaceous shale with "knife edge" coal seams. A. J. Collier, 1902.

2976 (2AC235). Yukon River, north bank, about 10 miles below Melozi. Talus at foot of bluff. A. J. Collier, 1902.

4633 (18). Yukon River, north bank, about 10 miles below Melozi. Soft shale dipping into hillside. W. W. Atwood, 1907.

7715. Yukon River, north bank, 15 or 20 miles below the mouth of the Melozi. I. C. Russell, 1889.

1554 (9). "Below Melozikakat" [probably about 19 miles below Melozi River], J. E. Spurr, 1896.

2963 (2AC236). Yukon River, north bank, 10 to 11 miles below Melozi. "Collected for about a mile along the foot of the cliff." A. J. Collier, 1902.

3248 (3AH11). Yukon River, north bank, about 12 miles below Melozi. Shaly sandstone about 300 feet above the river and talus on river bank. Arthur Hollick, 1903.

4634 (20). Yukon River, north bank, about 12 miles below Melozi. Sandstone and shale. W. W. Atwood, 1907.

4783 (21). Yukon River, north bank, about 12 miles below Melozi. Sandstone and shale. Same locality as 4634. W. W. Atwood, 1907.

3249 (3AH12). Yukon River, north bank, about 12½ miles below Melozi. Talus on the river bank. Arthur Hollick, 1903.

3249 (3AH12). Yukon River, north bank, about 12½ miles below Melozi. Sandstone a short distance below small draw. Arthur Hollick, 1903.

3251 (3AH14). Yukon River, north bank, about 2 miles above Good Island or about 14 miles below Melozi. Talus. Arthur Hollick, 1903.

3251a (3AH14a). Yukon River, north bank, just above upper end of Good Island. Gray sandstone. Arthur Hollick, 1903.

2922 (3AH14a). Same locality as 3251a. Arthur Hollick, 1903.

2675 (2AC237). Yukon River, north bank, behind Good Island. Sandstone pebbles at mouth of creek. A. J. Collier, 1902.

2923 (3AH14b). Same locality as 2675. Loose rock on the river bank. Arthur Hollick, 1903.

Fossils from the Nulato formation [a]

	2924	2676	2925	4784	2977, 2678	2926	2927, 3257	4637, 4785	4787	2677	3255	2928	2930	3256	2680	2929	2681	4788	4789	4790	4791	4792	2179, 7471	3264	2931	2982	3265	2983	3266	3267	4793
Fucus irregularis Hollick, n. sp.											a																				
Dryopteris oerstedi (Heer) Knowlton?																										a					
Nilssonia alaskana Hollick, n. sp.																													a		
Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun											a																		a		
Cephalotaxopsis heterophylla Hollick, n. sp.														a															a		
Cephalotaxopsis magnifolia successiva Hollick, n. var.																								a							
Cephalotaxopsis																										a					
Sequoia ambigua Heer											a													a							
Sequoia reichenbachi (Geinitz) Heer								a																							
Sequoia sp.? (cones)																														a	
Castaliites cordatus Hollick, n. sp.																											a				
Menispermites reniformis Dawson																							a								
Platanus heerii Lesquereux																							a								
Credneria mixta Hollick, n. sp.																													a		
Acer collieri Hollick, n. sp.																												a			
Cissites comparabilis Hollick, n. sp.														a																	
Hedera vera Hollick, n. sp.																											a				
Viburnum grossecrenatum Hollick, n. sp.											a																				
Hemiaster																															d
Worm burrows					d	d						d																			
Nucula? n. sp.																			c												
Leda, n. sp.										c																					
Cucullaea mathewsoni Gabb							c																								
Cucullaea truncata Gabb?					c																										
Cucullaea?								d																							
Pinna																															d
Inoceramus cf. I. labiatus Schlotheim			d							d		d										d									d
Ostrea, n. sp.	c	c	c	c	c								c					c				c	c								c
Ostrea, n. sp.		c								c												c									
Ostrea, n. sp.							c																								
Ostrea sp.		c		c					d						d																
Unio, n. sp.	c																														
Trigonia leana Gabb			c		c		c						c				d	c				c	c								
Trigonia newcombei Packard?					c																										
Trigonia, n. sp.					c																										
Trigonia		d																													
Anomia			d																			d	d								
Mytilus																							d								
Pleuromya, n. sp.																															c
Pholadomya, n. sp.													c		c	c															
Pholadomya																			d												
Thracia sp.					c	c	c			c		c																			
Thracia? n. sp.					c	c	c																								
Thracia?																d															
Astarte, n. sp.		c																													
Astarte							d																								
Astarte? n. sp.				d																											
Astarte?					c																										
Opis?																							d								
Venericardia							d																								
Lucina, n. sp.					c	c	c					c											c								
Lucina?																															d
Cardium (Trachydium), n. sp.										c			c		c	c		c	c		c	c	c								
Protocardia, n. sp.																	c	c													
Protocardia, n. sp.																							c								
Protocardia		d											d								d										
Veneridae					d				d			d					d														
Meretrix, n. sp.		c																													c
Meretrix	d		d																			d			d						
Meretrix?																		d		d											
Tellina cf. T. ashburnerii Gabb															c																
Tellina?		d																													
Corbula																							d								
Panope, n. sp.										c																					
Panope concentrica (Gabb) Whiteaves var.				c					c											c											
Panopea sp.					d		d	d	d			d										d									
Panopea?																			d												
Pelecypods			d																												
Viviparus, n. sp.										c																					
Turritella																				d											
Actaeonella (Volvalina), n. sp.																							c								
Actaeonella		d																													
Actaeonella?																									d						
Anchura cf. A. transversa Gabb							d																								
Sonneratia?					d	d	d																								
Ammonites					d																										
Crustacea (large macruran)												d																			

[a] a, Identified by Arthur Hollick; b, identified by F. H. Knowlton; c, identified by W. R. Smith; d, identified by T. W. Stanton.

2924 (3AH15). Yukon River, north bank, just above Fossil Bluff, about 5 miles above Louden. Rock fragments on beach. Arthur Hollick, 1903.

2676 (2AC238). Yukon River, north bank, at Fossil Bluff, 5 miles above Louden. Massive sandstone. A. J. Collier, 1902.

2925 (3AH15a). Yukon River, north bank, at Fossil Bluff, 5 miles above Louden. Sandstone and shale overlying "intrusive dike." Arthur Hollick, 1903.

4784 (23). Yukon River, north bank, 5 miles above Louden. Sandstone and shale overlying "intrusive lava." In place. Probably same locality as 2676 and 2925. W. W. Atwood, 1907.

2977, 2678 (2AC244), Yukon River, north bank, at Bishop Mountain. A. J. Collier, 1902.

2926 (3AH17). Yukon River, north bank, at Bishop Rock. Crest of fold at upper end of exposure. Arthur Hollick, 1903.

2927, 3257 (3AH17a). Same locality as 2926. Talus at lower end of exposure. Arthur Hollick, 1903.

4637, 4785 (24). Yukon River, north bank, at Bishop Rock. W. W. Atwood, 1907.

4787 (27). Yukon River, north bank, near Pickart mine. Sandstone (see fig. 5, p. 24) about 130 feet below the coal. W. W. Atwood, 1907.

2677 (2AC250). Yukon River, north bank, below Pickart coal mine. A. J. Collier, 1902.

3255 (3AH18b). Yukon River, north bank, just below Pickart mine. Massive sandstone below the coal. Arthur Hollick, 1903.

2928 (3AH18c). Yukon River, north bank, a short distance below Pickart mine. Shale conformably beneath the sandstone that yielded lot 3255. Arthur Hollick, 1903.

2930 (3AH18d). Yukon River, north bank, about 2 miles below locality 2928. Float. Arthur Hollick, 1903.

3256 (3AH18d). Yukon River, north bank, just below 2930. Sandstone. Arthur Hollick, 1903.

2680 (2AC251). Yukon River, north bank, about 3 miles below Pickart mine. A. J. Collier, 1902.

2929 (3AH18e). Yukon River, north bank, opposite head of first island below Pickart mine. Sandstone. Arthur Hollick, 1903.

2681 (2AC252). Yukon River, north bank, 6 miles above Nulato. Massive sandstone. A. J. Collier, 1902.

4788 (28). Yukon River, north bank, 5⅓ miles below Pickart mine, Talus below sandstone cliff. W. W. Atwood, 1907.

4789 (29). Yukon River, north bank, 6 miles below Pickart mine. Sandstone near lens of coaly stringers. W. W. Atwood, 1907.

4790 (30). Yukon River, north bank, 6¼ miles below Pickart mine. W. W. Atwood, 1907.

4791 (31). Yukon River, north bank, 6½ miles below Pickart mine. W. W. Atwood, 1907.

4792 (32). Yukon River, north bank, 6¾ miles below Pickart mine. Sandstone above 4788 to 4791. W. W. Atwood, 1907.

2179, 7471 (358). Yukon River, north bank, between Pickart mine and Nulato. F. C. Schrader, 1899.

3264 (3AH25). Yukon River, west bank, at upper end of Bluff Point, 24 miles below Nulato. Sandstone and shale. Arthur Hollick, 1903.

2931 (3AH25a). Yukon River, west bank at end of Bluff Point. Coarse sandstone. Arthur Hollick, 1903.

2982 (2AC263). Yukon River, west bank, 1 mile below Bluff Point. Sandstone. A. J. Collier, 1902.

3265 (3AH26). Yukon River, west bank, about 3 miles below Bluff Point. Shale. Arthur Hollick, 1903.

2983 (2AC264). Yukon River, west bank, about 4½ miles below Bluff Point. Massive sandstone. A. J. Collier, 1902.

3266 (3AH27). Yukon River, west bank, about 4½ miles below Bluff Point. Shale near 2983? Arthur Hollick, 1903.

3267 (3AH28). Yukon River, west bank, 3 miles above Kaltag. Shale associated with thin bed of coal. Arthur Hollick, 1903.

4793 (34). Yukon River, west bank, 3 miles above Kaltag. Thick sandstone. W. W. Atwood, 1907.

Fossils from the Kaltag formation[a]

	2962	4636	3252	4635	3253	2679, 2964	3254	4786	4638	2682	2AC	2978	7122	3258	3260	2980	3259	3261	4639	2683, 2981	2932, 3262	3263	2984	4640	3268	2684	4642	4794	2685	3269	2933	4641	4795	2985	2986	3270	3271	4643	9774	7259, 9775	9776
Marchantia yukonensis Hollick, n. sp.			a																																						
Asplenium foersteri Debey and Ettingshausen?	a		a	a																																					
Asplenium johnstrupi (Heer) Heer?	a		a																																						
Cladophlebis browniana infirma Hollick, n. var.			a																																						
Onychiopsis nervosa (Fontaine) Berry	a																																								
Anemia supercretacea conformis Hollick, n. var.																																a									
Stachypteris inenarrabilis Hollick, n. sp.			a																																						
Sagenopteris variabilis (Velenovsky) Velenovsky																					a																				
Cycadites?																					a																				
Nilssonia yukonensis Hollick, n. sp.			a																																						
Nilssonia comptula approximata Hollick, n. var.																	a		a																						
Nilssonia pseudopterophylloides Hollick, n. sp.		a																																							
Nilssonia alaskana Hollick, n. sp.	a	a	a	a															a																						
Pterophyllum validum Hollick, n. sp.																																					a				
Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun	a	a	a	a													a	a	a																						
Ginkgo concinna Heer																	a		a																						
Ginkgo digitata (Brongniart) Heer	a																		a																						
Ginkgo laramiensis Ward?																					a																				
Ginkgo?				a																	a																				
Ginkgo reniformis Hollick, n. sp.																					a						a										a				
Ginkgo crenulata Hollick, n. sp.														a																a											
Ginkgo pseudoadiantoides Hollick, n. sp.																											a														
Ginkgo pseudoadiantoides major Hollick, n. var.														a																											
Nageiopsis angustifolia Fontaine																	a																								
Protophyllocladus obesus Hollick, n. sp.																														a											
Protophyllocladus subintegrifolius (Lesquereux) Berry																							a		a																
Protophyllocladus simplex Hollick, n. sp.																							a																		
Cephalotaxopsis heterophylla Hollick, n. sp.	a		a						a														a	a								a		a							
Cephalotaxopsis magnifolia successiva Hollick, n. var.		a	a																															a							
Cephalotaxopsis microphylla laxa Hollick, n. var.				a																																					
Cephalotaxopsis																a							a											a							
Tumion gracillimum Hollick, n. sp.	a		a	a		a											a				a																				
Sequoia fastigiata (Sternberg) Heer						a																																			
Sequoia concinna Heer									a								a		a																						
Sequoia rigida spinifolia Hollick, n. var.																											a														
Sequoia				a								b								a																a					
Sequoia? (cones)							a										a		a		a																				
Sphenolepis sternbergiana (Dunker) Schenk			a																				a																		
Taxodium sp. Knowlton																																								b	
Glyptostrobus grönlandicus Heer				a					a												a																				
Glyptostrobus specialis Hollick, n. sp.																	a				a																				
Zingiberites alaskensis Hollick, n. sp.																																		a							
Piper arcuatile Hollick, n. sp.														a				a																							
Populites pseudoelegans Hollick, n. sp.									a																																
Populites pseudolancastriensis Hollick, n. sp.																											a														

[a] a, Identified by Arthur Hollick; b, identified by F. H. Knowlton; c, identified by W. R. Smith; d, identified by T. W. Stanton.

Populites vitiformis Hollick, n. sp.	a																																								
Juglans arctica Heer				a					a																																
Betula beatricina conformis Hollick, n. var.																								a																	
Betulites rugosus apiculatus Hollick, n. var.																								a																	
Ficus lesquereuxii lata Hollick, n. var.			a																																						
Ficus melanophylla Lesquereux?			a																																						
Ficus dictyodroma Hollick, n. sp.	a																																								
Macclintockia alaskana Hollick, n. sp.														a																											
Paleonuphar inopina Hollick, n. sp.			a																																						
Castaliites ordinarius Hollick, n. sp.																																		a							
~~Castaliites inordinatus~~ Hollick, n. sp.																																		a							
Castaliites																																		a							
Menispermites cordifolius Hollick, n. sp.																																a									
Menispermites septentrionalis Hollick, n. sp.																			a																						
Liriodendropsis simplex (Newberry) Newberry																											a														
Asimina knowltoniana Hollick, n. sp.														a																											
Laurus antecedens Lesquereux			a																								a														
Benzoin venustum alaskanum Hollick, n. var.																						a																			
Persea spatulata Hollick, n. sp.	a																																								
Daphnogene turbulenta Hollick, n. sp.																			a																						
Platanus heerii Lesquereux																						a													a						
Platanus? newberryana Heer																	a																								
Platanus septentrionalis Hollick, n. sp.					a																																				
Platanus valida Hollick, n. sp.																									a																
Platanus latibasalis Hollick, n. sp.			a																																						
Platanus alata Hollick, n. sp.									a					a																											
Platanus? sp.	a																		a																						
Platanus? grewiopsoides Hollick, n. sp.	a		a																																						
Credneria inordinata Hollick, n. sp.																									a																
Credneria inordinata maxima Hollick, n. var.													a																												
Credneria spatiosa Hollick, n. sp.														a																											
Credneria grewiopsoides Hollick, n. sp.			a				a																																		
Credneria elegans Hollick, n. sp.																									a																
Credneria comparabilis Hollick, n. sp.																			a																						
Paracredneria *crednerioides* Hollick, n. sp.					a																																				
Paracredneria alaskana Hollick, n. sp.															a																										
Paracredneria? platanoidea Hollick, n. sp.																	a																								
Paracredneria? sp.															a																										
Pseudoprotophyllum emarginatum Hollick, n. sp.			a																																						
Pseudoprotophyllum viburnifolium Hollick, n. sp.																																a									
Pseudoprotophyllum dentatum Hollick, n. sp.																			a								a			a											
Pseudoprotophyllum crassum Hollick, n. sp.						a																																			
Pseudoprotophyllum comparabile Hollick, n. sp.							a						a						a																						
Pseudoprotophyllum dalli Hollick, n. sp.													a																												
Pseudoprotophyllum magnum Hollick, n. sp.			a										a				a								a																
Pseudoprotophyllum? basielongatum Hollick, n. sp.				a																																					
Pseudoprotophyllum																																		a							
Pseudoaspidiophyllum memorabile Hollick, n. sp.															a																										
Leguminosites yukonensis Hollick, n. sp.	a		a																																						
Cassia alaskana Hollick, n. sp.	a																																					a			

Fossils from the Kaltag formation—Continued

	2962	4636	3252	4635	3253	2679, 2964	3254	4786	4638	2682	2AC	2978	7122	3258	3260	2980	3259	3261	4639	2683, 2981	2932, 3262	3263	2984	4640	3268	2684	4642	4794	2685	3269	2933	4641	4795	2985	2986	3270	3271	4643	9774	7259, 9775	9776
Acerites multiformis Lesquereux			a																																						
Rhamnites cornifolius Hollick, n. sp.							a																																		
Zizyphus abnormalis Hollick, n. sp.	a																																								
Vitis inequilateralis Hollick, n. sp.														a																											
Vitis paleotruncata Hollick, n. sp.				a																																					
Cissites pseudoplatanus Hollick, n. sp.																														a											
Ampelopsis? multesima Hollick, n. sp.																																						a			
Tilia cretacea Hollick, n. sp.																											a														
Sterculia atwoodi Hollick, n. sp.									a																																
Aralia wellingtoniana Lesquereux																																						a			
Aralia parvidens Hollick, n. sp.																																						a			
Aralia polymorpha Newberry														a																											
Andromeda?																						a																			
Myrsine gaudini (Lesquereux) Berry			a																																						
Sapotacites alaskensis Hollick, n. sp.														a																											
Viburnum grossecrenatum Hollick, n. sp.					a																																				
Viburnum zizyphoides Hollick, n. sp.	a																																								
Viburnum arcuatile Hollick, n. sp.																								a																	
Viburnum																							a													a					
Phyllites crassus Hollick, n. sp.			a																																						
Phyllites			a																																						
Inoceramus?																																									d
Ostrea, n. sp.						c																																			
Ostrea										c																d		d													d
Unio, n. sp.																													c		c										
Unio								d																									d						d	d	
Pecten, n. sp.						c																																			
Thracia?											d																														
Corbicula?																				d	d																				
Sphaerium?																																								d	
Panopea																												d													
Viviparus, n. sp.								c																																	
Viviparus (Tulotoma), n. sp.								c																																	
Viviparus																				d	d								d		d		d								
Campeloma?																				d	d																				
Goniobasis																				d																				d	
Goniobasis?								d													d																				

2962 (2AC239). Yukon River, north bank, 4¾ miles above Louden. Hanging wall of coal bed about a quarter of a mile from the river and from the foot of a slide extending from the coal bed to the river. A. J. Collier, 1902.

4636 (22A). Yukon River, north bank, about 5 miles above Louden Bedrock, in place. W. W. Atwood, 1907.

3252 (3AH16). Yukon River, north bank, about 4¾ miles above Louden. Slide that came down from vicinity of coal mine. Arthur Hollick, 1903.

4635 (22). Yukon River, north bank, about 5 miles above Louden. Probably same locality as 2926 and 3252. Weathered material. W. W. Atwood, 1907.

3253 (3AH18). Yukon River, north bank, about 2 miles above Pickart mine. Sandstone. Arthur Hollick, 1903.

2679 (2AC249). Yukon River, north bank, above Pickart coal mine. A. J. Collier, 1902.

2964 (2AC249). Yukon River, north bank, 10 miles above Nulato. Strata above Pickart coal mine. A. J. Collier, 1902.

3254 (3AH18a). Yukon River, north bank, just above Pickart mine. Shale and sandstone overlying the coal. Arthur Hollick, 1903.

4786 (25). Yukon River, north bank, above Pickart mine. Sandstone (see fig. 5, p. 24) about 665 feet above the coal. W. W. Atwood, 1907.

4638 (26). Yukon River, north bank, above Pickart mine. Shale and sandstone (see fig. 5, p. 24) about 168 feet above the coal. W. W. Atwood, 1907.

2682 (2AC253). Yukon River, north bank, at Nulato. A. J. Collier, 1902.

(2AC ——). "Front Street, Nulato." A. J. Collier, 1902.

2978 (2AC255). Yukon River, west bank, 6 miles below Nulato. Shale and thin-bedded sandstone. A. J. Collier, 1902.

7122. Yukon River, west bank, "about 7 miles below Nulato." Probably near Blatchford mine. W. H. Dall, 1866.

3258 (3AH19). Yukon River, west bank, at Blatchford coal mine, 9 miles below Nulato. Shale and sandstone underneath the coal. Arthur Hollick, 1903.

3260 (3AH21). Yukon River, west bank, 3 miles below Blatchford mine. Sandstone. Arthur Hollick, 1903.

2980 (2AC260). Yukon River, west bank, about 15 miles below Nulato, or 4½ miles below Blatchford mine. Landslide. A. J. Collier, 1902.

3259 (3AH20). Yukon River, west bank, 2 to 10 miles below Blatchford mine. Float along shore. Arthur Hollick, 1903.

3261 (3AG22). Yukon River, west bank, 6 miles below Blatchford mine. Shaly sandstone. Arthur Hollick, 1903.

4639 (33). Same locality as 3261. Shale and sandstone. W. W. Atwood, 1907.

2683, 2981 (2AC262). Yukon River, west bank, about 20 miles below Nulato, or 3½ miles above Bluff Point, at foot of slide. A. J. Collier, 1902.

2932, 3262 (3AH23). Same locality as 2683. Arthur Hollick, 1903.

3263 (3AH24). Yukon River, west bank, about 22 miles below Nulato. Sandstone overlain and underlain by shale. Arthur Hollick, 1903.

2984 (2AC266). Yukon River, west bank, about 8 miles below Kaltag. A. J. Collier, 1902.

4640 (35). Yukon River, west bank, about 8 miles below Kaltag. Shale and sandstone. W. W. Atwood, 1907.

3268 (3AH29). Yukon River, west bank, about 8 miles below Kaltag. Sandstone and shale. Arthur Hollick, 1903.

2684 (2AC272). Yukon River, west bank, 18 or 20 miles below Kaltag. Loose pieces lying on dark shale. A. J. Collier, 1902.

4642 (36). Yukon River, west bank, 1½ miles above Williams coal mine. W. W. Atwood, 1907.

4794 (37). Yukon River, west bank, 1¼ miles above Williams mine. W. W. Atwood, 1907.

2685 (2AC282). Yukon River, west bank, 1 mile above Williams mine. Black shale. A. J. Collier, 1902.

3269 (3AH30). Yukon River, west bank, about 1 mile above Williams mine, near 2685. Sandstone. Arthur Hollick, 1903.

2933 (3AH30). Yukon River, west bank, about 1 mile above Williams mine, a few yards below 3269. Arthur Hollick, 1903.

4641 (38), 4795 (39). Yukon River, west bank, 1 mile above Williams mine. W. W. Atwood, 1907.

2985 (2AC284). Yukon River, west bank, at Williams coal mine. "Fossils mostly taken from sandstone immediately above coal bed." A. J. Collier, 1902.

2986 (2AC289). Yukon River, west bank, just below "mine No. 1." Cross-bedded sandstone, the base of which is 28 feet above the coal. A. J. Collier, 1902.

3270 (3AH31). Yukon River, west bank, near "mine No. 1." Shale. Arthur Hollick, 1903.

3271 (3AH32). Yukon River, west bank, about 18 miles below mine No. 1. Float at outcrop of sandstone and shale with thin coal bed. Arthur Hollick, 1903.

4643 (40). Yukon River, west bank, about 18 miles below mine No. 1. W. W. Atwood, 1907.

9774 (16AHa134). Andreafski River, east bank, 9 miles northeast of Andreafski. G. L. Harrington, 1916.

7259, 9775 (16AHa136), Andreafski River, east bank, 9⅙ miles northeast of Andreafski. G. L. Harrington, 1916.

9776 (16AHa140). Andreafski River, west bank, 1⅓ miles below Andreafski. G. L. Harrington, 1916.

The following list shows that a relatively large proportion of the ferns and gymnosperms range throughout two or more of the formations but that most of the angiosperms are restricted to one formation. This difference evidently means that the angiosperms, being more highly organized, were more sensitive to changes in environment and consequently are better horizon markers. It is shown statistically by the fact that, among the angiosperms, 80 per cent of those in the fresh-water shale and sandstone, 37½ per cent of those in the marine sandstone and shale, and 86 per cent of those in the coal-bearing rocks are characteristic of one formation; whereas among the gymnosperms and lower plants only 24 per cent of those in the fresh-water shale and sandstone, 33 per cent of those in the marine sandstone and shale, and 56 per cent of those in the coal-bearing rocks are characteristic of one formation.

A similar difference between the angiosperms and the lower plants is shown in the stratigraphic range of those species which occur in other regions. Although most of the species of fossil plants from these beds that are known in other regions occur in the Dakota sandstone or in beds that have been correlated with it, there are about a dozen species which have been generally regarded as characteristic of the Lower Cretaceous as well as a few species that have been regarded as Montana or possibly Laramie. All these supposed Lower Cretaceous and late Upper Cretaceous species are among the gymnosperms or lower plants, whereas all the previously described species of angiosperms that have been found in the Upper Cretaceous rocks of this region are known elsewhere only in the Dakota sandstone or in rocks of approximately equivalent age.

The stratigraphic range in other regions of previously described Upper Cretaceous fossils from the lower Yukon is shown below:

Dryopteris oerstedi	Lower Cretaceous.
Asplenium foersteri	Raritan, Atane.
Asplenium johnstrupi	Lower Cretaceous.
Onychiopsis nervosa	Lower Cretaceous.
Sagenopteris variabilis	Magothy.
Podozamites lanceolatus	Dakota?
Ginkgo concinna	Lower Cretaceous.
Ginkgo digitata	Lower Cretaceous.
Ginkgo laramiensis	Laramie, Nanaimo, etc.
Nageiopsis angustifolia	Lower Cretaceous.
Protophyllocladus polymorphus	Laramie.

Protophyllocladus subintegrifolius	Dakota.
Sequoia ambigua	Magothy, Kome, etc.
Sequoia fastigiata	Dakota.
Sequoia concinna	Magothy, Patoot.
Sequoia reichenbachi	Dakota.
Sequoia rigida	Lower Cretaceous.
Sequoia subulata	Lower Cretaceous.
Sphenolepis sternbergiana	Lower Cretaceous.
Glyptostrobus grönlandicus	Lower Cretaceous.
Myrica? trifoliata	Dakota.
Juglans arctica	Dakota.
Quercus eamesi	Dakota.
Ficus daphnogenoides	Dakota.
Ficus melanophylla	Dakota.
Menispermites reniformis	British Columbia?
Magnolia amplifolia	Dakota.
Magnolia lacoeana	Dakota.
Liriodendropsis simplex	Raritan, Magothy.
Laurus antecedens	Dakota.
Daphnophyllum dakotense	Dakota.
Platanus? newberryana	Dakota.
Platanus latior	Dakota.
Platanus heerii	Dakota.
Acerites multiformis	Dakota.
Sapindus morrisoni	Dakota.
Sapindus apiculatus	Magothy?
Aralia wellingtoniana	Dakota.
Aralia polymorpha	Raritan.
Myrsine gaudini	Dakota, Magothy.
Cucullaea mathewsoni	Eocene (Martinez).
Cucullaea truncata	Chico.
Inoceramus cf. I. labiatus	Chico, Colorado group.
Trigonia leana	Chico.
Trigonia newcombei	Haida.
Tellina cf. T. ashburnerii	Chico.
Panope concentrica	Chico.
Anchura cf. A. transversa	Chico.

In conclusion it may be stated that the Upper Cretaceous rocks of the lower Yukon region appear to correspond in age, in a general way, approximately with the Dakota sandstone. The evidence of the plants and of the marine mollusks is practically in accord, most of the previously described species of plants occurring in the Dakota sandstone and the marine mollusks indicating "that the horizon is within the Upper Cretaceous but probably not higher than the middle of the Upper Cretaceous." The writer believes, however, that these rocks probably have a considerably greater range in age than the Dakota sandstone. This is indicated by the thickness of the rocks, which probably exceeds 8,000 feet; by their divisibility into four distinct formations; and by the fact that a large proportion of the plants, including almost all the angiosperms, do not range up from one of the stratigraphic divisions into another. If it were possible to make a comparison of the floras with modern lists of fossil plants occurring at successive horizons throughout the Upper Cretaceous of a near-by region, the comparison would probably indicate that a considerable part, very likely the lower half or two-thirds, of the Upper Cretaceous is represented by the Upper Cretaceous rocks of the lower Yukon.

KOYUKUK VALLEY

GENERAL FEATURES

The Cretaceous rocks of the Koyukuk Valley include the Lower Cretaceous limestone, lava, and tuff, of the Koyukuk group; the Upper Cretaceous shale, sandstone, and conglomerate near the mouth of the river; and the Upper Cretaceous (?) sandstone, arkose, grit, and conglomerate of the Bergman group. The base of the Koyukuk group has not been recognized, and the rocks which may underlie it are not known. The writer suspects that the lava and tuff that have been described as part of the Koyukuk group may belong to an underlying formation. The Bergman group, which is supposed to rest upon the Koyukuk group where that group is present, directly overlies Paleozoic rocks along the northern border of its area. The Upper Cretaceous rocks in this district are not overlain by any strata other than unconsolidated Quaternary deposits, unless the coal-bearing beds at Tramway Bar, which have been tentatively included in the Bergman group, should prove to be Tertiary deposits younger than the Bergman.

SHALE AND SANDSTONE ON THE LOWER KOYUKUK

HISTORICAL REVIEW

On the lower reaches of Koyukuk River, between Kateel River and the mouth of the Koyukuk, Schrader observed some sedimentary and associated igneous rocks which have proved to be in part Upper Cretaceous. These rocks are not described specifically in Schrader's text but are referred to in the statement [36] that "the Nulato sandstone probably also covers a considerable area in the lower part of the Koyukuk Basin, near the mouth of the river." The map [37] accompanying Schrader's report indicates "sandstone, arkose, grit, conglomerate, limestone, shale, mud rock with plant remains, volcanic tuff, breccia, and altered igneous rocks" as exposed along the lower part of the river. The sedimentary rocks of this area were mapped by Smith and Eakin [38] as the Shaktolik group, and the volcanic rocks as Tertiary or Recent basalt, but no description was given of the exposures on the Koyukuk.

STRATIGRAPHIC DESCRIPTION

The Upper Cretaceous rocks on the lower Koyukuk were described by Schrader as including sandstone, shale, conglomerate, and limestone. No information concerning the details of the stratigraphy is available,

[36] Schrader, F. C., Preliminary report on a reconnaissance along the Chandlar and Koyukuk Rivers, Alaska, in 1899: U. S. Geol. Survey Twenty-first Ann. Rept., pt. 2, p. 478, 1900.
[37] Idem, pl. 60.
[38] Smith, P. S., and Eakin, H. M., A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, Alaska: U. S. Geol. Survey Bull. 449, pl. 5, 1911.

but it is believed that they probably include the equivalent of several and perhaps all of the members of the Upper Cretaceous section exposed on the Yukon between Melozi and Louden. The exposures next below Kateel River include grit and conglomerate that probably are the equivalent of the lower conglomeratic member near Melozi. The igneous rocks exposed along the lower 30 miles of the Koyukuk are the northern extension of some of the post-Cretaceous volcanic rocks of the Yukon. The intervening exposures are possibly the equivalent of one or more of the subdivisions of the Upper Cretaceous on the Yukon. No estimate of the thickness of the Upper Cretaceous rocks on the lower Koyukuk has been made. Their base has not been recognized, but it is believed that basal conglomerate rests upon pre-Upper Cretaceous rocks near the mouth of Kateel River. Their upper contact is probably beneath the Quaternary silt in the high bluff about 20 miles (35 or 40 miles by the river) north of Koyukuk Village. This bluff separates exposures of Upper Cretaceous plant-bearing sandstone and shale from exposures of the supposed Tertiary volcanic rocks, which are probably the next younger consolidated rocks.

AGE AND CORRELATION

Fossils have been obtained from the Upper Cretaceous rocks on the lower Koyukuk at only one locality. These fossils include two plants and a marine invertebrate, as listed below, and are too few to give any conclusive evidence on the precise position of these beds relative to the section on the Yukon. One of the plants is known only at this locality; the other occurs in the lower fresh-water shale and sandstone (Melozi formation) of the Yukon section. The marine invertebrate indicates that the beds may correspond to either the marine sandstone and shale of the Nulato formation or to one of the marine beds in the Kaltag formation of the Yukon section.

7472 (333). West bank of Koyukuk River about 40 miles above mouth. Sandstone and shale. F. C. Schrader, 1899. *Hedera schraderi* Hollick, *Platanus newberryana conditionalis* Hollick. Identified by Arthur Hollick.

2183 (334). Same locality as 7472. F. C. Schrader, 1899. *Mya?* Identified by T. W. Stanton.

SUMMARY

STRATIGRAPHY

The Upper Cretaceous beds of Alaska which have yielded the fossil plants that are described in this volume include the middle and upper members of the Chignik formation of the Alaska Peninsula; the four formations of Upper Cretaceous shale, sandstone, and conglomerate of the lower Yukon region, some of which extend into the lower part of the Koyukuk Valley; and the shale, sandstone, and conglomerate near Seventymile River on the upper Yukon. Fossil plants are known to occur also in the Upper Cretaceous shale and sandstone near Wolverine Mountain, south of Rampart, but no determinable specimens have been available for exhaustive study. Marine Upper Cretaceous rocks, in which no determinable fossil plants have yet been found, are known in the Matanuska, Chitina, Innoko, Kuskokwim, and Anaktuvuk Valleys.

The Upper Cretaceous rocks of the Alaska Peninsula have been described as the Chignik formation, which includes a lower member about 200 feet thick that consists of shale with marine fossils and no known fossil plants; a middle member about 300 feet thick that consists of shale with many coal beds and some sandstone and that contains fossil plants with a few marine mollusks; and an upper member, 300 to 500 feet thick, that consists of conglomerate, sandstone, and shale with fossil plants and marine invertebrates. The Chignik formation rests in some places upon Lower Cretaceous limestone with possible unconformity, and where the Lower Cretaceous limestone is absent it rests unconformably upon Upper Jurassic rocks. It is overlain, unconformably in at least some places, by Tertiary strata.

The Upper Cretaceous rocks of the lower Yukon region consist of sandstone, conglomerate, and shale that have an aggregate thickness of perhaps 8,000 feet. They have been separated into four formations, named,[39] from the base upward, the Ungalik conglomerate, consisting of conglomerate, sandstone, and sandy shale, about 3,000 feet thick, and containing no known fossils except a few worm tubes, trails, and unidentifiable shells and vegetable remains; the Melozi formation, consisting of fresh-water shale and sandstone, at least 1,000 feet thick, and containing fossil plants and fresh-water mollusks; the Nulato formation, consisting of marine sandstone and shale, perhaps 3,000 feet thick, and containing marine invertebrates and a few fossil plants; and the Kaltag formation, consisting of coal-bearing rocks, at least 800 feet thick, that comprise fresh-water sandstone, shale, and coal beds with possibly some thin marine members, and containing fossil plants, fresh-water mollusks, and perhaps a few marine fossils. The Upper Cretaceous rocks of the lower Yukon are underlain by Paleozoic rocks and are believed to be overlain in some places by Tertiary volcanic rocks.

The Upper Cretaceous rocks exposed on the lower Koyukuk are the northern extension of the Upper Cretaceous rocks of the lower Yukon and may include all the formations exposed on the Yukon. They have yielded only a few fossils, and these do not furnish sufficient evidence as to which of the formations exposed on the Yukon may be represented.

[39] Martin, G. C., The Mesozoic stratigraphy of Alaska: U. S. Geol. Survey Bull. 776, pp. 399–400, 1926.

The Upper Cretaceous rocks of the upper Yukon region consist of shale, sandstone, and conglomerate at least several hundred feet thick, which are believed to be underlain unconformably by Carboniferous limestone and which may be overlain by Tertiary coal-bearing rocks. The only fossils that have been obtained from these Upper Cretaceous rocks are fossil plants which indicate a correlation with the upper coal-bearing division (Kaltag formation) of the section on the lower Yukon.

CORRELATION

The probable relations of the Upper Cretaceous plant-bearing beds of the several Alaskan districts to one another, to the non plant-bearing Cretaceous rocks of Alaska, and to the Cretaceous rocks of other regions is indicated in the table facing this page. The evidence for these correlations, so far as the plant-bearing beds are concerned, is discussed by Hollick on pages 5–8 and by the writer on pages 12–33.

The Upper Cretaceous plant-bearing beds of Alaska represent two distinct horizons. Those of the Yukon Valley are low in the Upper Cretaceous, including at least the approximate horizon of the Dakota sandstone and perhaps the entire lower half (Colorado group) of the Upper Cretaceous, and those of the Alaska Peninsula are somewhat higher in the Upper Cretaceous, including the equivalent of part or all of the Montana group.

The most comprehensive section of the older plant-bearing beds is found on the lower Yukon, where the rocks have been separated into four formations, of which the upper three contain floras of the same general type but specifically distinct, especially in so far as the numerous new species of angiosperms are concerned. All three formations contain species that occur elsewhere in the Dakota flora as well as some more persistent species, notably of ferns and gymnosperms, part of which range elsewhere down into the Lower Cretaceous and Jurassic or up into the Eocene. The great thickness of these plant-bearing beds and the specific distinctness of the floras of the several formations suggest that these rocks may represent considerably more than the Dakota sandstone, possibly the entire lower half or two-thirds of the Upper Cretaceous.

The section on the lower Koyukuk, which is the northward continuation of the section on the lower Yukon, is very imperfectly known and may represent either part or all of the lower Yukon section. The fossils that it has yielded are neither abundant nor distinctive. They clearly indicate the presence of floras and faunas of the general type and age of those on the lower Yukon, but are not sufficient to show which of the formations of the lower Yukon section may be represented at the fossiliferous localities on the Koyukuk.

The section on the upper Yukon contains no Upper Cretaceous fossils other than plants. Its flora clearly represents that of the upper coal-bearing division (Kaltag formation) of the section on the lower Yukon. The writer believes that the upper part of the Yukon Valley did not receive Upper Cretaceous sediments for a long time after the beginning of Upper Cretaceous sedimentation on the lower Yukon, and that the Upper Cretaceous sea never extended up the Yukon as far as the Seventymile district.

The Chignik formation of the Alaska Peninsula includes three members. The lower member has yielded no fossils except marine invertebrates, which, according to Stanton, "indicate correlation with a horizon in the Chico as developed in California and in the Nanaimo of Vancouver Island, * * * but the beds at Chignik are probably not older than basal Senonian." The middle member has yielded fossil plants and a few marine mollusks. Neither the mollusks nor the plants are indicative of the precise horizon. The upper member has yielded both plants and marine invertebrates. The fauna suggests a correlation with the upper part of the Colorado group, but the flora contains elements suggestive of the Montana group.

CHRONOLOGIC RECORD OF LATE CRETACEOUS TIME

Before describing in detail the events of Upper Cretaceous time in the area which is now Alaska, it is necessary to consider the preceding conditions that furnished the setting and, to a large extent, determined the details of the Upper Cretaceous history.

In Pennsylvanian or early Permian time there was a widespread marine submergence which carried the sea and spread deposits of limestone in all parts of Alaska if not over the entire area. The fact that there are no extended areas in which these deposits have not been found and the absence of any known lithologic or faunal facies in these deposits indicate that the orogenic features which exist to-day and of which we find indications throughout the deposits of Mesozoic and Tertiary time probably had not been outlined before the end of the Paleozoic era.

The absence of late Permian and of Lower and Middle Triassic sediments in most if not all of Alaska indicates a pronounced withdrawal of the sea toward the end of Paleozoic time. A thick and widespread accumulation of lava, which lies between the Pennsylvanian or early Permian and the Upper Triassic sediments at many places south of the Alaska Range but not north of it, where the Upper Triassic and Pennsylvanian or Permian limestones are in direct contact, indicates that the withdrawal of the sea at the end of the Paleozoic era was accompanied or closely followed by widespread volcanic outbursts throughout the region south of the present Alaska Range. The volcanic deposits are sharply limited by the present axis of the

Alaska Range, a fact which indicates that the present position of the Alaska Range was determined by differential movements that began at the end of Paleozoic time.

In Upper Triassic time there was another profound marine submergence, which carried the sea into the areas of the present major mountain axes of Alaska. The restriction of Upper Triassic deposits to these mountain areas and the apparent existence, during the earlier part of the Upper Triassic epoch, of faunal facies that are characteristic of the several mountain provinces suggest that the Upper Triassic deposits were laid down in three geosynclinal basins, which occupy the sites of the present Brooks Range, Rocky Mountains, and Alaska and Coast Ranges. In later Upper Triassic (Noric) time deposition was still restricted to the vicinity of the present mountains, but it was more widespread than formerly, and in the deposits then laid down there are no indications of faunal facies. At the end of the Triassic period the sea probably withdrew from the entire Alaskan area, the uppermost Triassic (Rhaetic) and the earliest Jurassic (Lower and Middle Lias) not being represented anywhere in the Territory.

In Jurassic time there was another more or less gradual marine transgression. Lower Jurassic deposits are known only on the Pacific and Arctic seaboards. Middle Jurassic deposits have a somewhat wider extent in the Pacific coastal region. Upper Jurassic deposits are believed to have been laid down throughout the area south of the Alaska Range. There are no marine Jurassic deposits north of the Alaska Range, except for some Lower Jurassic beds on the Arctic coast. In Jurassic time there was again a persistent shore line in or near the present position of the Alaska Range.

In Lower Cretaceous time the sea again swept over the greater part of Alaska. The submergence covered not only the site of Jurassic sedimentation south of the Alaska Range but most of the Yukon Valley, the greater part of which had been land since the end of the Paleozoic era, and much of northern Alaska from which the sea had been excluded since the end of the Triassic period. The deposits of Lower Cretaceous time generally include basal conglomerate succeeded in most places by limestone and shale that are indicative of the absence of vigorous erosion in any near-by regions. Sandy beds are present throughout the Lower Cretaceous sections in some places, notably in the vicinity of the present mountains. Volcanic rocks are notably absent in the Cretaceous of Alaska, the only apparent exceptions being the conglomeratic tuff of the Matanuska Valley, which the writer believes to be reworked Jurassic volcanic material, and the supposed Cretaceous volcanic beds of the Kuskokwim and Koyukuk Valleys, which the writer believes to be partly Carboniferous volcanic beds and partly post-Cretaceous intrusive rocks. The Lower Cretaceous faunas of Alaska consist chiefly of boreal species of *Aucella.*

At the beginning of Upper Cretaceous time the sea had receded from the Alaskan area, and when Upper Cretaceous sedimentation began it was of a different type and in different areas from those of the earlier Cretaceous deposits. The major tectonic features of Alaska appear to have been well outlined by the beginning of Upper Cretaceous time, so that the distribution of the Upper Cretaceous deposits bears a very definite relation to the existing geographic features. For example, the marine Upper Cretaceous rocks do not occur along the present major mountain axes but are found for the most part on the Pacific and Arctic coasts and in the lower, broader parts of the Yukon and Kuskokwim Valleys. The Upper Cretaceous strata also include terrestrial deposits that were laid down in embayments that were the direct predecessors of the existing major valleys.

The initial Upper Cretaceous sedimentation of Alaska may be represented by some beds of sandstone in the upper Chitina Valley which Stanton regards as either basal Upper Cretaceous or Gault but which Knowlton believes to be Jurassic.

The oldest undoubted Upper Cretaceous deposits of Alaska are found on the lower Yukon and probably extend into the Koyukuk and Kuskokwim Valleys. The stratigraphic succession on the lower Yukon includes conglomeratic beds at the base, followed in sequence by fresh-water shale and sandstone, then by marine sandstone and shale, and finally by terrestrial coal-bearing rocks which may be interbedded with a few thin marine strata. Upstream on the Yukon the full sequence outlined above is present as far as Melozi. The next exposures of Upper Cretaceous rocks are in the Rampart district, where the basal conglomerate and the fresh-water shale and sandstone are absent, and marine Upper Cretaceous sandstone rests directly on the Lower Cretaceous rocks. Still farther up the Yukon, in the Seventymile district, the only Upper Cretaceous rocks are shale and sandstone which contain a flora that indicates a correlation with the upper member of the section on the lower Yukon. This correlation suggests that there was a gradual submergence of the Yukon Valley in Upper Cretaceous time which permitted the younger beds to extend progressively farther up the river. The sequence of beds on the lower river, ranging from conglomerate and coarse sandstone with very few fossils at the base, through shale and sandstone with fresh-water mollusks and abundant plants, followed by marine beds, to coal-bearing rocks at the top, also indicates the gradual submergence of a large valley. The cycle began with the rapid reworking of the large volume of coarse residual detritus which had probably accumulated during the long time, possibly since the end of the Paleozoic, during which this region had been above the sea. This was followed by the deposition of finer detritus, which now forms the fresh-water shale and sandstone. The submergence afterward went far enough to permit the incursion of marine waters throughout the lower and middle parts of the Yukon Valley. Finally the submergence slackened, and the marshes, in which the present coal beds were formed, spread over the surface of the marine sediments, while contemporaneous deposits now represented by plant-bearing shale and sandstone extended up the valley into areas where the Upper Cretaceous sea had never reached.

The events of Upper Cretaceous time in the Yukon region, as outlined above, probably occupied approximately the earlier half of the Upper Cretaceous epoch, and the area affected included not only the valley of the Yukon but extended north into the lower part of the Koyukuk Valley and south across the valley of the Kuskokwim nearly to Clark Lake. The Upper Cretaceous succession in the Kuskokwim Valley appears to be very closely parallel to that on the lower Yukon. Some of the Cretaceous rocks on the upper Koyukuk and on Kobuk River may mark the northern border of this province, and the Upper Cretaceous rocks of the Arctic coast, though doubtless laid down in a different basin, may date from the same time. The Upper Cretaceous rocks of the southern part of Alaska are of later date, and it is believed that while Upper Cretaceous sedimentation was in progress in the Yukon Valley the rest of Alaska was land.

During the later half of Upper Cretaceous time, when sedimentation had probably ceased in the Yukon region, the sea invaded parts of the southern coastal region of Alaska. In the Alaska Peninsula the deposits include marine shale, followed by coal-bearing shale, and then by conglomerate, sandstone, and shale that are probably of mixed marine and terrestrial origin. The sequence of events seems to have been a submergence that permitted the encroachment of the sea, a quiet period in which coal-forming marshes spread over the surface of the marine sediments, and a period of differential movement in which the marshes were submerged beneath marine waters and renewed erosion delivered large volumes of coarse gravel into the sea. The end of Cretaceous time on the Alaska Peninsula appears to have been marked by a renewal of mountain growth, which finds its expression in the increasing coarseness of the youngest Cretaceous deposits. The next succeeding deposits consist of Eocene tuff, which shows that the diastrophic movements that began in late Cretaceous time culminated afterward in volcanic outbursts. On the Alaska Peninsula, as probably everywhere else in Alaska, Cretaceous time was free from volcanism. The Upper Cretaceous deposits of the Alaska Peninsula are known near the west end of the peninsula at Chignik and Herendeen Bays and near the east end in the vicinity of Cape Douglas. In the intervening area Upper Cretaceous deposits are believed to have been laid down and removed by subsequent erosion.

The late Upper Cretaceous sea also extended into the sites of the present Matanuska and Chitina Valleys, where there are shale and sandstone carrying a marine fauna that probably was approximately contemporaneous with the fauna of the lower member of the Chignik formation. The absence of Upper Cretaceous coal-bearing rocks in these valleys may mean either that marine conditions persisted there until the end of Cretaceous time or that these districts were raised well above the sea while the coal-forming marshes existed on the Alaska Peninsula.

The notable absence of Upper Cretaceous rocks along most of the Pacific seaboard, especially beneath the Tertiary coal-bearing rocks on Cook Inlet, at Controller Bay, and in southeastern Alaska, may mean either that the deposition of the Upper Cretaceous sediments was restricted to a few districts, or that early Tertiary erosion removed all traces of the Upper Cretaceous rocks except in a few places where conditions were especially favorable for their preservation. There is also the possibility that the slate and graywacke of Kodiak Island, Kenai Peninsula, Prince William Sound, the Controller Bay district, Yakutat Bay and the west coast of Chichagof Island include Upper Cretaceous rocks which have been subjected, throughout their entire linear extent, to folding and metamorphism that were much more intense than those which affected either the rocks on the margin of the belt of slate and graywacke or the Upper Cretaceous rocks of neighboring districts.

Upper Cretaceous time ended with the complete withdrawal of the sea from the Alaskan area and probably was closely followed by the folding and erosion of the Cretaceous rocks. The Cretaceous rocks of Alaska are highly folded almost everywhere, and many of them are cut by intrusive rocks and by metalliferous veins. In many places it is not possible to determine the exact date of the folding, intrusion, and mineralization, especially as some of the Tertiary rocks have been similarly affected. It is believed, however, that at least part of the folding, intrusion, and mineralization dates from about the end of Cretaceous time. The earliest post-Cretaceous rocks in most of Alaska are the widespread Tertiary coal-bearing beds. Although these rocks are highly folded in some places and have been cut by dikes and veins, they are in general notably less indurated, folded, and altered than the Cretaceous rocks. In some places there is clear proof of an unconformity at the base of the Tertiary rocks, and the writer believes that the Cretaceous rocks of Alaska were uplifted and eroded, if not folded, immediately at the end of Cretaceous time in all parts of the Territory.

DESCRIPTIONS OF SPECIES

Phylum THALLOPHYTA

Class ALGAE

Subclass PHAEOPHYCEAE

Order CYCLOSPORALES

Family FUCACEAE

Genus FUCUS Linnaeus

Fucus irregularis Hollick, n. sp.

Plate 1, Figure 1

Frond irregularly dichotomously branched; branches approximately 5 millimeters in width; subdivisions relatively long, the lower ones distinctly separated, the upper ones shorter and closer together and ultimately overlapping.

This specimen is very much broken and in part dismembered, so that the size and shape of the complete frond can not be determined. There can be but little doubt, however, that it is a thallophyte, and apparently it was of considerable consistency, inasmuch as more or less carbonaceous matter is preserved in connection with it. Surface markings of any kind are lacking.

The generic name *Fucus* is adopted for the reason that similar remains from Upper Cretaceous and lower Tertiary beds in the western United States have been described and figured under the name *Fucus lignitum* Lesquereux,[40] and our specimen appears to represent merely a larger species, of coarser or more vigorous habit. It also resembles remains described under the names *Chondrites bulbosus* Lesquereux,[41] from the Vermejo formation of northeastern New Mexico, and *Chrondrites filiciformis* Lesquereux,[42] from the Jurassic of Cape Lisburne, Alaska.

[40] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 42, pl. 61, figs. 24, 24a, 1878. Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 549, pl. 31, figs. 1, 2, 1886. Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 17, pl. 3, fig. 4, 1900.

[41] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 373, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 42, pl. 1, fig. 14, 1878.

[42] Lesquereux, Leo, U. S. Nat. Mus. Proc., vol. 11, p. 32, pl. 16, fig. 1, 1888 [1889].

Locality: Yukon River, north bank, just below Pickart's mine (original No. 3AH18b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3255).

Phylum BRYOPHYTA

Class HEPATICAE

Order MARCHANTIALES

Family MARCHANTIACEAE

Genus MARCHANTIA Linnaeus

Marchantia yukonensis Hollick, n. sp.

Plate 1, Figure 2

A branching frond of unknown size; branches about 5 millimeters in width, provided with a midrib, along the sides of which are minute reticulations that apparently represent the marks of scales.

Seven other fossil representatives of the Hepaticae are recorded from America—*Preissites wardii* Knowlton,[43] from the Fort Union formation (Eocene) of Montana; "*Marchantites erectus* (Bean) Seward?," fide Ward,[44] from the Jurassic of Oregon[45]; *Marchantia pealei* Knowlton,[46] from the Lance formation (lower Tertiary?) of Montana; *Jungermannites cretaceus* Berry,[47] from the Upper Cretaceous of Alabama; *Marchantites sewardi* Berry,[48] from the Lower Cretaceous of Maryland; *Marchantites stephensoni* Berry,[48a] from the upper Wilcox (Eocene) of Arkansas; and *Jungermanniopsis cockerellii* Howe and Hollick,[49] from the Tertiary (Miocene) of Colorado.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

[43] Knowlton, F. H., Torrey Bot. Club Bull., vol. 21, p. 458, pl. 219, figs. 1–3, 1894.

[44] Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 53, pl. 6, figs. 1, 2, 1905.

[45] *Marchantites crectus* was originally described and figured by Bean (in Leckenby, John, Geol. Soc. London Quart. Jour., vol. 20, p. 81, pl. 11, figs. 3a, 3b (2a, 2b on plate), 1864) as a seaweed, under the name *Fucoides erectus;* and inasmuch as Ward (op. cit., p. 54) remarks that the Oregon fossil, in its mode of branching, "is similar to that of *Brachyphyllum,* and the plant may be really a twig of that conifer," we may properly regard its taxonomic status as problematical.

[46] Knowlton, F. H., U. S. Nat. Mus. Proc., vol. 35, p. 157, pl. 25, 1908.

[47] Berry, E. W., U. S. Geol. Survey Prof. Paper 112, p. 49, pl. 5, figs. 2, 3, 1919.

[48] Berry, E. W., Am. Jour. Sci., 4th ser., vol. 50, p. text fig. 3, 1920.

[48a] Berry, E. W., U. S. Geol. Survey Prof. Paper 131, p. 4, pl. 4, fig. 1, 1922.

[49] Howe, M. A., and Hollick, Arthur, Torrey Bot. Club Bull., vol 49, p. 208, text fig. 1, 1922.

Phylum **PTERIDOPHYTA**

Class **FILICINAE**

Order **POLYPODIALES**

Family **POLYPODIACEAE**

Genus **DRYOPTERIS** Adanson

Dryopteris oerstedi (Heer) Knowlton?

Dryopteris oerstedi (Heer) Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 92, 1898.

Aspidium oerstedi Heer, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 30, pl. 34, figs. 1–10, 1882; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 2, pl. 48, fig. 11; pl. 49, figs. 1, 2, 1883.

Numerous fragments of pinnae of a fern were provisionally identified as belonging to this species. It was not previously recorded elsewhere than from the Cretaceous (Atane and Patoot beds) of Greenland, except provisionally by Fontaine,[50] who based his identification upon the apical portion of a single pinnule from the Lower Cretaceous (Potomac group) of Virginia, which was referred by Berry [51] to *Cladophlebis albertsii* (Dunker) Brongniart, with the following brief comment: [52] "The specimen which was the basis for the presence of *Aspidium oerstedi* Heer in this flora is the merest fragment, without significance in any way."

The particular figure to which our specimens appear to bear the closest resemblance is Heer's Figure 11, Plate 48 (Flora fossilis arctica, vol. 7).

Locality: Yukon River, north bank, 24 miles below Nulato and 1 mile below Bluff Point (original No. 2AC263); collected by A. J. Collier and Sidney Paige in 1902 (lot 2982).

Genus **PHEGOPTERIS** Fée

Phegopteris alaskensis Hollick, n. sp.

Plate 2, Figures 4a, 5

Size and shape of frond not known; pinnae alternately arranged, almost at right angles to and along a stout rachis, which they apparently overlap with their broad, alate, slightly auriculate bases; lamina wrinkled or wavy, especially near the obscurely crenulate margins; nervation consisting of a well-defined midrib with pinnately arranged forked veins that occupy the wrinkles and extend to the margin. These fragmentary but well-defined specimens are somewhat suggestive of *Phegopteris jorgenseni* Heer [53] and *Phegopteris grothiana* Heer,[54] from the Patoot beds of Greenland, and the general resemblance that exists between them all appears to indicate a generic relationship, although the characters of the nervation, as far as they are discernible, are more like those of *Dryopteris* than *Phegopteris*.

There is also more or less of a general resemblance between our figures and those of *Cladophlebis columbiana* Dawson,[55] from the Cretaceous of Vancouver Island, but Dawson's figures are too poorly defined for any but surficial comparison. The bases of the pinnae in our specimens appear as if connected with one another and decurrent on the rachis; but close examination indicates that this appearance is due to pressure of the overlapping parts, and that each pinna is separate and distinct.

Locality: Chignik Lagoon, south side, near entrance (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295).

Genus **ASPLENIUM** Linnaeus

Asplenium foersteri Debey and Ettingshausen?

Plate 1, Figures 3–5

Asplenium foersteri Debey and Ettingshausen, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 17, p. 193 (13), pl. 2, figs. 4–7, 11, 1859.

Fragmentary remains of a fern, provisionally referred to this species, are represented in several of the collections; but none of the specimens are sufficiently well preserved for satisfactory identification.

Similar fragmentary remains from the Atane beds of Greenland, referred to this species, are described and figured by Heer; [56] and more complete specimens from the Raritan formation of New Jersey, are provisionally referred to the species by Newberry.[57]

Localities: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 1, fig. 3). Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963) (pl. 1, fig. 4). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 1, fig. 5).

[50] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 99, pl. 19, figs. 4, 4a, 1889.

[51] Berry, E. W., U. S. Nat. Mus. Proc., vol. 41, p. 310, 1911.

[52] Idem, p. 312.

[53] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 32, pl. 35, figs. 1–3, 1882.

[54] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 3, pl. 48, figs. 12, 13, 1883.

[55] Dawson, J. W., Roy. Soc. Canada Trans., vol. 11, sec. 4, p. 55, pl. 5, figs. 4, 5, 1893 [1894].

[56] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 93, pl. 26, figs. 1, 1b, 1c, 1874.

[57] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 41, pl. 4, figs. 1–11, 1895 [1896].

Asplenium johnstrupi (Heer) Heer?

Plate 1, Figures 10, 11

Asplenium johnstrupi (Heer) Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2. p. 32, pl. 1, figs. 6, 6b, 7, 7b; pl. 10, figs. 6c, 6d; p. 122, pl. 35, figs. 1–5, 1874.

Sphenopteris (*Asplenium?*) *johnstrupi* Heer, Flora fossilis arctica, vol. 1, p. 78, pl. 43, fig. 7, 1868.

These fragmentary and imperfectly preserved specimens are referred provisionally to Heer's species from the Kome beds of Greenland and Svalbard. The fragments figured by Heer include a wide variety of remains, some of which resemble our specimens closely—for example, his Figures 6 and 7 on Plate 1, and Figures 1 and 5 on Plate 35 of volume 3—and these appear to warrant at least a provisional reference of our specimens to the species.

Localities: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 1, fig. 10). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 1, fig. 11).

Genus PTERIS Linnaeus

Pteris nitida Hollick, n. sp.

Plate 2, Figure 11

Frond at least once pinnate; upper pinnae gradually diminishing in size, confluent, forming an irregularly lobed or pinnatifid, pyramidal summit to the frond; lower pinnae pinnatifid, ascending, the divisions or lobes upward pointing, bluntly triangular or apiculate, coalescing at the extremities of the pinnae into broad, wedge-shaped, blunt-tipped apices; nervation pinnate-reticulate, consisting of a midrib with branches extending to the termini of the lobes, with three or four forked or simple veinlets on each side and obscurely reticulate (?) veinlets close to the midrib.

This fern was apparently smooth and thick in texture with a relatively close or compact habit of growth. The nervation is rather obscurely defined, but apparently the veinlets were reticulate along and in connection with the main rachis of the frond and the midribs of the pinnae.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Genus CLADOPHLEBIS Brongniart

Cladophlebis browniana infirma Hollick, n. var.

Plate 1, Figure 8

Frond branched, pinnate; pinnae dentate-pinnatifid, linear, tapering to the extremities, attached to the rachis by the obscurely decurrent bases, ascending, the midribs subtending acute angles w iththe rachis.

This specimen is hardly to be distinguished from certain of the many diverse forms that have been at one time or another referred to different species in the genera *Pecopteris* and *Cladophlebis*, especially the American Lower Cretaceous forms segregated by Berry [58] and included under the one specific name *Cladophlebis browniana* (Dunker) Seward.

The particular species form that appears to resemble ours most closely is *Pecopteris virginiensis* Fontaine,[59] from the lower part of the Potomac group of Virginia, from which it differs far less than many of the other forms differ between themselves.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Cladophlebis septentrionalis Hollick, n. sp.

Plate 2, Figures 1–3

Size and shape of frond not known, pinnae linear-lanceolate, pinnatifid toward the extremities, pinnate toward the base; pinnules alternately arranged, contiguous, triangular-falcate, entire, decurrent throughout, venation pinnate, the veins once forked.

These fragments of pinnae apparently represent a fern identical with or closely resembling specimens from the Atane beds of Greenland figured by Heer [60] and described under the name "*Pteris? albertsii* Dunk. sp." (=*Neuropteris albertsii* Dunker [61]), but a comparison between Heer's figures and those of Dunker does not indicate specific identity, as the latter show pinnules that are much narrower, strictly opposite instead of alternate in arrangement, and distinct from instead of contiguous to one another.

Another fragmentary fern specimen, from the island of Sakhalin, that is almost identical with ours is described and figured by Kryshtofovich [62] and referred to *Pteris frigida* Heer,[63] of the Kome and Atane beds of Greenland, but the resemblance to this species appears to be too remote to require discussion.

A third specimen, from the Lower Cretaceous of the Canadian Rocky Mountain region, that also ap-

[58] Berry, E. W., U. S. Nat. Mus. Proc., vol. 41, pp. 307–322, 1911.

[59] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 82, pl. 8, figs. 1–7; pl. 9, figs. 1–6; pl. 24, fig. 2; pl. 169, fig. 3, 1889.

[60] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 29, pl. 16, figs. 5, 6; pl. 28, figs. 1–3; pl. 46, figs. 22–24, 1882.

[61] Dunker, Wilhelm, Monographie der norddeutschen Wealdenbildung, p. 8, pl. 7, figs. 6, 6a, Braunschweig, 1846.

[62] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 33, fig. 3, 1918.

[63] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 3, pl. 2, fig. 13; p. 25, pl. 6, fig. 5b; pl. 10, figs. 1–4; pl. 11, figs. 1–4, 5a, 6, 7a, 8a, 9–11; pl. 12, fig. 2; pl. 13, figs. 2, 2b; pl. 16, figs. 1, 2; pl. 18, fig. 10b, 1882.

pears to be identical with ours, is figured by Dawson [64] and referred provisionally to *Aspidium fredericksburgense* Fontaine, of the Potomac group of Virginia; but again a comparison fails to show satisfactory indications of specific identity. The Greenland, Sakhalin, Canadian, and Alaskan specimens may therefore be regarded as probably representing one and the same species—a species heretofore known under the names *Neuropteris albertsii* Dunker, *Pteris frigida* Heer, and *Aspidium fredericksburgense* Fontaine and probably referable to the genus *Cladophlebis* Brongniart.[65] In this connection it is pertinent to mention the work of Berry [66] in the revision of this genus, in which an effort is made to segregate these and some 30 other cognate species under 8 specific names; but whether or not our species is to be included in one or another of these groups is properly a matter of individual opinion.

Localities: Port Moller, 2 miles up the canyon west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 2, figs. 1–2). Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 2, fig. 3).

Genus ONYCHIOPSIS Yokoyama

Onychiopsis nervosa (Fontaine) Berry

Plate 28, Figure 5a

Onychiopsis nervosa (Fontaine) Berry, U. S. Nat. Mus. Proc., vol. 41, p. 327, 1911.

Thyrsopteris nervosa Fontaine, The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 122, pl. 25, figs. 4, 4a, 5, 16; pl. 37, figs. 2, 2a, 4, 4a; pl. 39, fig. 5; pl. 40, fig. 6, 1889.

Among the many closely related species and varieties that have been included from time to time in the genera *Onychiopsis* and *Thyrsopteris* it is difficult to select the particular one to which our specimen should be referred. It is evidently identical, however, with some one or another of the so-called species of *Thyrsopteris* from the lower part of the Potomac group (Patuxent formation) of Virginia, Maryland, and the District of Columbia described by Fontaine, and it agrees in all essential characters with the forms that Berry has grouped under the name *Onychiopsis nervosa*.

It is probable that, under some other name or names, the species has a considerably wider geographic distribution than is here recognized; but this is not the place for any such extended critical analysis of the species as would be necessary for a satisfactory investigation in this connection.

Locality: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962).

Family SCHIZAEACEAE

Genus ANEMIA Swartz

Anemia supercretacea conformis Hollick, n. var.

Plate 1, Figures 6, 7

Size and form of frond, also nervation, unknown; divisions pinnate; pinnae slender, elongated triangular, decurrent along the rachis, ascending, tapering to the tips, deeply pinnatifid below, the divisions becoming confluent above and forming crenate marginal extremities to the pinnae.

This fern is almost identical in its characters with *Anemia supercretacea* Hollick,[67] from the Upper Cretaceous of Colorado, differing for the most part merely in its more slender habit. It is possible, indeed, that the Alaska specimens may merely represent the upper parts of a branching frond of the species. More complete specimens would be necessary, however, to determine or disprove specific identity.

A fern from the Vermejo formation of southeastern Colorado is doubtfully referred to the species by Knowlton,[68] but the reference hardly appears to be justified by the figure, which differs far more from the specific type than the specimens from Alaska.

Localities: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963) (pl. 1, fig. 6). Yukon River, north bank. 1 mile above Williams' mine (original No. 38); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4641) (pl. 1, fig. 7).

Genus STACHYPTERIS Pomel

Stachypteris inenarrabilis Hollick, n. sp.

Plate 1, Figure 9

Frond delicate; size and shape not known; pinna linear-lanceolate, pinnate; pinnules triangular, the lower ones pinnatifid, the divisions subtriangular and thumb-shaped, the upper ones gradually diminishing in size and becoming confluent toward the end of the pinna.

This specimen, enlarged in the figure to twice its natural size, represents a fragment of a delicately formed frond, with divisions too small and too obscurely defined for accurate or satisfactory analysis,

[64] Dawson, J. W., Roy. Soc. Canada Trans., vol. 10, sec. 4, p. 85, fig. 5, 1892 [1893].

[65] Brongniart, Adolph, Tableau des genres de végétaux, p. 25, Paris, 1849.

[66] Berry, E. W., A revision of the fossil ferns from the Potomac group which have been referred to the genera *Cladophlebis* and *Thyrsopteris*: U. S. Nat. Mus. Proc., vol. 41, pp. 307–332, 1911.

[67] Hollick, Arthur, Torreya, vol. 2, p. 145, pl. 3, figs. 6, 7, 1902.

[68] Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 248, pl. 30, fig. 5, 1917.

and it is referred to the genus *Stachypteris* with some hesitation for the reason that, although it possesses a strong resemblance to *Stachypteris litophylla* Pomel, as depicted by Saporta,[69] it is equally suggestive of *Scleropteris tenuisecta* Saporta.[70] Both of these species are Jurassic, whereas our fern is associated with an undoubted Cretaceous flora; but there does not appear to be any described Cretaceous fern species with which it may be as satisfactorily compared as with those mentioned, with the possible exception of *Scleropteris vernonensis* Ward,[71] recorded from the "Mount Vernon series" (Patapsco formation) of the Potomac group of Virginia, which Ward compares with *Scleropteris tenuisecta* and which Berry[72] includes in a new genus, *Dicksoniopsis*. Unless more complete remains of our species are found, however, it will manifestly be impossible to describe and figure it properly, or to venture to identify it positively with any recognized species or genus.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Order SALVINIALES

Family SALVINIACEAE

Genus SAGENOPTERIS Presl

Sagenopteris suspecta Hollick, n. sp.

Plate 2, Figure 6

Pinnule apparently elliptical or elliptical-spatulate, entire; nervation consisting of a network of reticulations that begin in an obscurely defined central nerve or midrib at the base of the pinnule and extend upward and outward to the margin.

The basal portion of our specimen is not preserved, hence the basilar outline can not be defined. The upper part, however, is symmetrical, and this is probably the character of the pinnule as a whole. It is suggestive of specimens from the Shasta series of California, referred by Fontaine[73] to *Sagenopteris mantelli* (Dunker) Schenk,[74] from the Wealden of Germany, and although it appears to be probable that the Alaska and California specimens are specifically identical it is doubtful if either of them is identical with *Sagenopteris mantelli*, in which any indication of a main central nerve or midrib is entirely lacking.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31), collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Sagenopteris paucireticulata Hollick, n. sp.

Plate 2, Figure 7

Pinnule spatulate, entire, 3.5 centimeters in length by 1.5 centimeters in maximum width, rounded above, tapering to an elongated, narrow base; nervation consisting of an obscurely defined median nerve at the base of the pinnule that is soon split into fine, diverging, forked and sparingly reticulated nerves extending upward and outward to the margin.

This species closely resembles a pinnule from the Shasta series of California, doubtfully identified by Fontaine[75] as *Sagenopteris elliptica* Fontaine. The specimens from the type locality in Virginia, representing the Potomac group,[76] vary considerably in shape and size; but none is quite comparable with the California specimen, which differs in possessing a midvein that is only obscurely defined and sparsely reticulated secondary nervation, thus approaching more nearly the type of the Alaska specimen, with which it may be specifically identical. In any event neither one appears to be properly referable to *Sagenopteris elliptica* as originally described and figured.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Sagenopteris variabilis (Velenovsky) Velenovsky

Plate 2, Figure 8

Sagenopteris variabilis (Velenovsky) Velenovsky, K. böhm. Gesell. Wiss., 7th ser., vol. 3, p. 40, 1889.

Thinnfeldia variabilis Velenovsky, Die Gymnospermen der böhmischen Kreideformation, p. 6, pl. 2, figs. 1–5; pl. 3, fig. 12, Prag, 1885. (Not *T. variabilis* Fontaine, The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 110, pl. 17, figs. 3–7; pl. 18, figs. 1–6, 1889.)

This species, as depicted by Velenovsky, presents a considerable variation in the size and form of the leaves. Our specimen belongs to the spatulate type, with an obscurely defined midrib.

A fragment, referred to the species with some doubt, from the Magothy formation of Marthas Vineyard, Mass., is figured by Hollick,[77] but otherwise the species does not appear to be recorded from any other locality in America.

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[69] Saporta, Gaston de, Plantes jurassiques, vol. 1: Paléontologie française, sér. 2, text p. 387, atlas pl. 50, figs. 1–5, 1873; idem, vol. 4, pl. 289 (63), figs. 2–2b, Paris, 1891.

[70] Idem, vol. 4, text p. 425, atlas pl. 280 (54), figs. 2–4; pl. 281 (55), figs. 6–7; pl. 285 (59), figs. 4–6a; pl. 286 (60), figs. 1, 1a, 3–5a; pl. 287 (61), figs. 1–4a, 1891.

[71] Ward, L. F., The Potomac formation: U. S. Geol. Survey Fifteenth Ann. Rept., p. 349, pl. 2, figs. 1, 1a, 2, 3, 1895.

[72] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 237, 1911.

[73] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 233, pl. 65, figs. 30–35, 1905.

[74] Schenk, August, Palaeontographica, vol. 19, p. 222 (20), pl. 31 (10), fig. 5, 1871.

[75] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 236, pl. 65, fig. 40, 1905.

[76] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 149, pl. 27, figs. 9, 11, 15a, 16, 16a, 17, 1889.

[77] Hollick, Arthur, New York Bot. Gard. Bull., vol. 2, p. 403, pl. 41, fig. 12, 1902.

Locality: Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262).

Phylum SPERMATOPHYTA

Class GYMNOSPERMAE

Order CYCADALES

Family CYCADACEAE

Genus CYCADITES Buckland

Cycadites? sp.

Plate 2, Figure 12

This specimen is too fragmentary and too poorly preserved for either description or definite identification. It appears to belong in the same generic category as *Cycadites unjiga* Dawson,[78] from the Cretaceous of the Northwest Territory, and it is strikingly similar to *Cycadites morrisianus* Dunker,[79] from the Upper Jurassic of northern Germany. On the other hand, a close examination reveals what appear, obscurely, like the remains of sheaths at the bases of the leaves, suggesting the structure of *Pinus*. In the circumstances it may be regarded as a gymnosperm, and most probably a cycad specifically related to or identical with one or another of the species mentioned.

It may also be compared with *Dioönites dunkerianus* (Goeppert) Miguel, as identified by Fontaine,[80] from the Lower Cretaceous of Texas; but our specimen apparently possesses only a single nerve or midrib, which would indicate relationship with *Cycadites* rather than with *Dioönites*.

Locality: Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262).

Genus NILSSONIA Brongniart

Nilssonia yukonensis Hollick, n. sp.

Plate 3, Figures 1–7a; Plate 7, Figure 4

Leaves of various sizes, approximately 5 to 8 centimeters in length, linear oblong or spatulate, narrowed below to a cuneate base, terminating more or less abruptly above in a truncate or broadly emarginate apex; margin entire; nervation fine, simple, parallel throughout and curved gently upward.

This species belongs with the general type of leaf represented by *Nilssonia orientalis* Heer,[81] of supposed Jurassic age, from the Lena River region of Siberia, and *Nilssonia johnstrupi* Heer,[82] of early Upper Cretaceous age, from the Atane beds of Greenland. *N. orientalis* is recorded by Fontaine [83] from the Jurassic of Oregon, and *N. johnstrupi* is recorded from the Cretaceous of Washington and described and figured by Newberry,[84] first in 1863, under the name *Taeniopteris gibbsii*, and subsequently, in 1898, as *Nilssonia gibbsii.*

The conspicuous apical sinus in our specimens, however, aside from any other characters, serves to differentiate them from either of the above-named species. This conspicuous character is suggestively foreshadowed, however, in one of Heer's Siberian specimens [85] and also in certain of the Oregon specimens figured by Fontaine [86] and referred to *Nilssonia orientalis* Heer and *N. orientalis minor* Fontaine. Another species, similar to the latter but apparently much more elongated, is *Nilssonia bohemica* Velenovsky [87] from the Cretaceous of Bohemia, and it is evident that this general type of *Nilssonia* was one which had a wide geographic and considerable vertical range.

The apparently abnormal specimen represented by our Plate 3, Figure 1, might be regarded as a distinct species; but it differs from the typical form of the species no more than the various forms of *Nilssonia orientalis* differ among themselves; and it is interesting to note that the peculiar constricted summit in this specimen is also indicated in certain figures of each of the other species mentioned.

Incidentally it may also be of interest to call attention to the leaf figured under the name *Phyllites scitaminaeformis* Sternberg,[88] from the Jurassic of England, and to compare it with the retuse and emarginate types of *Nilssonia* leaves.

Localities: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected

[78] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 20, pl. 1, figs. 2, 2a, 2b, 1882 [1883].

[79] Dunker, Wilhelm, Monographie der norddeutschen Wealdenbildung, p. 16, pl. 7, fig. 1, Braunschweig, 1846.

[80] Fontaine, W. M., U. S. Nat. Mus. Proc., vol. 16, p. 265, pl. 36, fig. 12; pl. 37, fig. 1, 1893.

[81] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes; II, Jura-Pflanzen aus der arctischen Zone Sibiriens; aus dem Flussgebiete der Lena: Flora fossilis arctica, vol. 5, No. 2, p. 18, pl. 4, figs. 5–9, 1878.

[82] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 44, pl. 6, figs. 1–3, 4a, 4b, 4c, 5a, 6, 1882.

[83] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 90, pl. 16, figs. 3–9, 1905.

[84] Newberry, J. S., Boston Jour. Nat. Hist., vol. 7, p. 512, 1865; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 16, pl. 15, figs. 2, 2a, 1898.

[85] Heer, Oswald, op. cit., vol. 5, pl. 4, fig. 5.

[86] Fontaine, W. M., op. cit., pl. 16, figs. 7, 13.

[87] Velenovsky, Josef, Die Gymnospermen der böhmischen Kreideformation, p. 11, pl. 2, figs. 25–28, Prag, 1885.

[88] Sternberg, Kaspar, Versuch einer geognostisch-botanischer Darstellung der Flora der Vorwelt, vol. 1, pt. 3, pp. 37, 39, pl. 37, fig. 2, Leipzig and Prag, 1823 (= *Taeniopteris scitaminea* Presl, idem, vol. 2, pts. 7 and 8, p. 139, Prag, 1838).

by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 3, figs. 1–3; pl. 7, fig. 4). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 3, figs. 4, 6, 7a).

Nilssonia serotina Heer

Plate 4, Figures 1–7; Plate 5, Figures 1–5a; Plate 7, Figures 6a, 6b, 10a; Plate 29, Figures 3b, 5a; Plate 30, Figures 2a, 3b

Nilssonia serotina Heer, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, No. 4, p. 19, pl. 2, figs. 1a, 2–5, 1878.

The figures upon which Heer's description of the species is based represent fragmentary specimens, in none of which is the summit of a frond preserved, and apparently the species has not been described or figured elsewhere than in the original place of publication. Our specimens, however, in the aggregate show every part and feature of the fronds, thus making possible the following amended and more complete description of the species:

Fronds varying in size, broadest at or near the summit, narrowed to the base, irregularly dissected or pinnatifid; segments subtriangular, rhomboidal, or ligulate, cuneate, rounded or bluntly acuminate, mostly curved slightly upward, lowest ones more or less distinct, upper ones gradually becoming approximated and ultimately merging into a truncate or broadly emarginate summit; nervation fine, simple, uniform, parallel.

It is with some hesitation that I have included all these diverse forms under a single specific name; but the accompanying figures do not show all the intermediate forms contained in the collections, and as attempts to differentiate them resulted in constant shifting and changing of specimens from one group of forms to another, the decision was finally made to regard them all as belonging to one polymorphous species.

The species to which they are referred was originally described and figured by Heer from specimens obtained on the island of Sakhalin, in strata regarded as Tertiary; but Kryshtofovich,[89] as a result of investigations made in 1917, concludes that Heer's "so-called Miocene flora belongs in fact to several geological horizons, not only of the Tertiary period, but also of the Cretaceous"; and in the Mgach flora, included in his Gyliakian series and regarded as of Cenomanian age, he lists *Nilssonia serotina* Heer.

Another closely allied species that calls for special critical study and comparison is *Nilssonia comptula* Heer,[90] described as Jurassic, from the Lena River region of Siberia. So far as I am aware the stratigraphic position of the beds in which this species occurs has not been questioned; but in view of the serious error that was made in connection with the stratigraphic relations of the Sakhalin fossil floras it may be pertinent to suggest that careful field work in the Lena River region might result in the discovery of facts that would necessitate a change or modification of opinion in regard to the exclusive Jurassic age of the flora of that region. Certain of the species, such as *Podozamites lanceolatus*, for example, are equally suggestive of the Cretaceous age of the flora.

In all our specimens in which the nervation is well defined it may be seen to cross or to impinge upon the midrib in the manner characteristic of *Nilssonia;* otherwise, if only the general form of the fronds and segments were available as diagnostic characters they might readily be mistaken for coordinate remains of certain species of cycads, presumably of Jurassic age, such as *Anomozamites schmidtii* Heer,[91] *Anomozamites acutilobus* Heer,[92] *Pterophyllum helmersianum* Heer,[93] and *Pterophyllum lancilobum* Heer,[94] from the province of Amur, Siberia.

It is an interesting and significant fact in connection with this species that, although it is one of the most abundant elements in the Cretaceous flora of Alaska Peninsula, it has not been found in any of the collections from the Yukon River district.

A number of the specimens present a false appearance of being pinnatifid, where the frond is merely broken or split. This condition may be seen in the upper portions of Figures 1 and 5 on Plate 4, Figure 5a on Plate 5, and throughout Figure 6b on Plate 7. In the last-named figure the frond appears to be made up of narrow segments, closely approximated; but critical examination shows this feature to be due to laceration or splitting. Apparently the fronds, in their upper parts, are normally not pinnatifid or divided, and this condition may represent a character due to age or to partial disintegration during the process of fossilization. In connection with the figures above mentioned and with Figure 10a on Plate 7, comparison should be made with the fragmentary remains described and figured under the name *Nilssonia*

[89] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, 1918.

[90] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes; II, Jura-Pflanzen aus der arctischen Zone Sibiriens; aus dem Flussgebiete der Lena: Flora fossilis arctica, vol. 5, No. 2, p. 19, pl. 4, figs. 10a, 11–16, 1878.

[91] Heer, Oswald, Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes; II, Pflanzen des Amurlandes: Flora fossilis arctica, vol. 4, No. 2, p. 100, pl. 23, figs. 2, 3; pl. 24, figs. 4–7, 1876.

[92] Idem, p. 102, pl. 23, fig. 1a; pl. 24, figs. 1, 2, 3b; pl. 25, fig. 9.

[93] Idem, p. 104, pl. 25, figs. 2–6; pl. 29, fig. 1d.

[94] Idem, p. 104, pl. 25, figs. 7, 8.

stantoni Ward,[95] from the Shasta series of California, which may represent lower parts of the same species as that to which our specimens belong. Close specific relationship is also indicated with the Jurassic species *Nilssoni nipponensis* Yokoyama and *Nilssonia compta* (Phillips) Goeppert, as identified by Fontaine [96] from specimens collected in Oregon.

A large frond, representative of the species in all its normal and extranormal features, could be reconstructed from the three fragments shown in Figures 1 and 3 on Plate 5.

Localities: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 4, fig. 1). Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297) (pl. 4, figs. 2, 3; pl. 5, fig. 5a; pl. 7, fig. 10a; pl. 29, fig. 3b; pl. 30, figs. 2a, 3b). Chignik Lagoon, south side, near entrance, Alaska Peninsula (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295) (pl. 4, figs. 4, 5; pl. 5, fig. 4). Chignik Bay, east side of Doris Cove, Alaska Peninsula (original No. 963); collected by T. W. Stanton in 1904 (lot 3525) (pl. 4, fig. 6). Coal Creek, Mine Harbor, Herendeen Bay, Alaska Peninsula; collected by Sidney Paige in 1905 (lot 3708) (pl. 4, fig. 7). Port Moller, canyon west of Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 5, figs. 1–3; pl. 29, fig. 5a). Coal mines in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185) (pl 7, figs. 6a, 6b).

Nilssonia comptula approximata Hollick, n. var.

Plate 6, Figure 1

Frond linear, narrowed and tapering at the base, about 2 centimeters in maximum width, irregularly pinnatifid below, irregularly split or dissected above, entire at and for a short distance below the rounded or emarginate apex.

This specimen is more or less difficult to separate from *Nilssonia comptula* Heer,[97] a supposed Jurassic species from the Lena River region of Siberia, and it has seemed impossible to escape the conviction that it is merely varietally different from that species, representing a modified survival of an Asiatic Jurassic type of vegetation in the Cretaceous of Alaska.

Our specimen appears to be less dissected than the specimens of the species figured by Heer, and the basilar outline is apparently more acutely cuneate, the lower segments being more cuneate or triangular. A tendency to splitting is indicated in the marginal irregularities in several of the segments of our specimen and in Heer's Figure 10a, and it may be inferred that more or less of the apparent pinnatification shown in Heer's figures is in reality due to similar splitting or laceration of the frond.

Ward [98] described and figured certain specimens from the Jurassic of Oregon that he referred to *Nilssonia orientalis* Heer,[99] in connection with which he mentioned [1] the feature of "laceration that imitates original segmentation." Ward's figures are far more suggestive of our Alaska specimen than they are of Heer's figures of *Nilssonia orientalis.*

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 6, fig. 1). Yukon River, north bank, shore from 2 to 10 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259).

Nilssonia pseudopterophylloides Hollick, n. sp.

Plate 6, Figure 2

Size of frond not known, deeply pinnatifid almost to the rachis; segments closely approximated, linear, about 3 millimeters in width, each slightly expanded at the base; nervation simple, uniform, apparently four nerves to each segment.

This specimen is given distinct specific rank not because of any feeling of certainty that it should be so regarded but because it was difficult to determine which of several described species it resembles most closely. Its resemblance to *Nilssonia pterophylloides* Nathorst,[2] from the Triassic of Sweden, is striking, and that species has been identified by Ward [3] in the Jurassic of Oregon. It is not probable, however, that the species would persist from the Triassic through the whole of Jurassic time into the Cretaceous; hence, no matter how striking the resemblance might be, our specimen should, on general principles, be regarded as

[95] Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 251, pl. 67, figs. 5, 6, 1905.

[96] Fontaine, W. M., in Ward, L. F., op. cit., p. 94 (*N. nipponensis*, pl. 17, figs. 8–10; *N. compta*, pl. 17, figs. 11–14).

[97] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes; II, Jura-Pflanzen aus der arctischen Zone Sibiriens; aus dem Flussgebiete der Lena: Flora fossilis arctica, vol. 5, No. 2, p. 19, pl. 4, figs. 10a, 11–15, (16?), 1878.

[98] Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 90, pl. 16, figs. 3–9, 1905.

[99] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes; II, Jura-Pflanzen aus der arctischen Zone Sibiriens; aus dem Flussgebiete der Lena: Flora fossilis arctica, vol. 5, No. 2, p. 18, pl. 4, figs. 5–9, 1878.

[1] Ward, L. F., op. cit., p. 91.

[2] Nathorst, A. G., Floran vid Bjuf, pt. 1: Sveriges geol. Undersökning Afh., ser. C, No. 27, p. 11, 1878; Floran vid Bjuf, pt. 2: Idem, No. 33, p. 72, pl. 16, fig. 1; pl. 17, figs. 2, 3, 1879. (Not *N. pterophylloides* Yokoyama, Coll. Sci. Imp. Univ. Tokyo Jour., vol. 7, pt. 3, pp. 207, 228, pl. 22, figs. 8–10; pl. 25, fig. 7, 1894.)

[3] Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 96, pl. 18, figs. 1–6, 1905.

specifically distinct, or it might be given varietal rank in the species.

Locality: Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22A); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4636).

Nilssonia alaskana Hollick, n. sp.

Plate 6, Figures 3–6a, 7, 8a, 9, 10; Plate 7, Figures 1, 2a, 3a, 5, 7–9a

Fronds varying in size, linear oblong or linear obovate, deeply pinnatifid; segments blunt tipped and slightly expanded at the bases, lower ones mostly subtriangular and short, upper ones mostly linear oblong or ligulate, the terminal ones broadest, forming a truncate or broadly emarginate apex; nervation simple, uniform, parallel.

A considerable diversity of forms are included in this species, and possibly more than one species may be represented; but the probabilities appear to be that the specimens merely represent fragments of different parts of the fronds, or fronds from different parts of the plants, or of different stages of growth and age. Typical basal parts are shown in Figures 4 and 10 on Plate 6, and typical apical parts in Figures 3a and 9a on Plate 7.

Certain of the specimens, such as the one represented by Figure 3 on Plate 6, bear a striking resemblance to *Nilssonia californica* (Fontaine) Fontaine,[4] from the Shasta series of California; and possibly as large a collection of material from that horizon as we have from Alaska might prove them all to belong to one and the same species. Under existing circumstances, however, it seems advisable merely to note the resemblance.

More or less of a superficial resemblance may also be noted to *Pterophyllum concinnum* Heer[5] and *Pterophyllum lepidum* Heer,[6] from the Kome beds of Greenland; but the nervation of our specimens, whereever it can be discerned, is clearly that of *Nilssonia*, and the foliar segments subtend more acute angles with the rachis than those of either of the species of *Pterophyllum* mentioned.

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 6, fig. 3). Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635) (pl. 6, fig. 4; pl. 7, fig. 2a). Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22A); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4636) (pl. 7, fig. 9a). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 6, figs. 5, 6a, 7; pl. 7, fig. 5). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 6, figs. 8a, 9; pl. 7, fig. 3). Yukon River, north bank, a short distance above Kaltag (original No. 3AH27); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3266) (pl. 6, fig. 10; pl. 7, fig. 1). Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185) (pl. 7, figs. 7, 8).

Genus PTEROPHYLLUM Brongniart

Pterophyllum alaskense Fontaine

Pterophyllum alaskense Fontaine, in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 152, pl. 38, figs. 19, 20, 1905.

This species is included in the Cretaceous flora of Alaska with reservation. It was based upon a single fragment, shown in the illustrations above cited, collected in 1900 by Ernest S. Locke in the "coal measures" of Herendeen Bay, Alaska Peninsula, and was assumed to be of Jurassic or "Jurasso-Cretaceous" age, although the associated molluscan fauna was identified by T. W. Stanton as Lower Cretaceous.

The specimen has not been seen by me; but the figures are so strikingly like those of *Pterophyllum lepidum* Heer,[7] from the Kome beds of Greenland, that it is almost impossible to escape the idea that they may represent one and the same species.

Pterophyllum validum Hollick, n. sp.

Plate 8, Figure 1

Frond large, dimensions not known, pinnate; pinnae linear, approximately 3 to 4 millimeters in width, apparently abruptly expanded and contiguous at the bases, subtending obtuse, almost right angles with the stout rachis; nervation simple, parallel, about six nerves to each pinna.

This specimen is evidently a fragment of a large cycadaceous frond with a very thick central rachis. Apparently it is the under surface that is represented; but the remains are so poorly preserved that critical details are not determinable. The arrangement of the pinnae is so obscurely defined that it is impossible to

[4] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 252, pl. 67, fig. 7, 1905 (=*Pterophyllum californicum* Fontaine, in Diller, J. S., and Stanton, T. W., Geol. Soc. America Bull., vol. 5, p. 450, 1894).

[5] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 68, pl. 14, figs. 15–20; pl. 15, figs. 11, 5b, 1874.

[6] Idem, pl. 16, figs. 1, 2, 3b.

[7] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 68, pl. 16, figs. 1–3b, 1874.

determine satisfactorily whether they are attached to the sides or to the upper surface of the rachis. The general aspect and gross characters of the specimen, however, are indicative of the genus *Pterophyllum* and apparently of a heretofore undescribed species.

Locality: Yukon River, north bank, about 15 miles below mine No. 1 (original No. 3AH32); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3271).

Genus PODOZAMITES C. F. W. Braun

Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun

Plate 6, Figures 6b, 8b; Plate 7, Figures 2b, 3b, 9b; Plate 8, Figures 2, 4–8; Plate 9, Figures 1–4; Plate 10, Figures 1, 2a, 3a, 4, 5; Plate 11, Figure 7b; Plate 16, Figures 1b, 3b; Plate 20, Figure 1b; Plate 27, Figures 5, 6a; Plate 30, Figures 1a, 4a

Podozamites lanceolatus (Lindley and Hutton) C. F. W. Braun, in Münster, Beiträge zur Petrefacten-Kunde, vol. 2, No. 6, p. 33, Bayreuth, 1843.

Zamia lanceolata Lindley and Hutton, The fossil flora of Great Britain, vol. 3, p. 121, pl. 194, London, 1836.

Under this species I have included a number of leaf forms to which distinct varietal and specific names have been applied from time to time by different authors, for the reason that in the collections from Alaska these leaf forms occur in every gradation of size and shape, often in the same piece of matrix, and I have found it impossible to separate or to distinguish them satisfactorily one from another.

The type of the species, *Zamia lanceolata* Lindley and Hutton, is a narrow-leaved form, similar to *P. lanceolatus genuinus* Heer [8] and *P. lanceolatus minor* (Schenk) Heer,[9] from the Jurassic of Siberia, and to *P. lanceolatus* as identified by Dawson [10] from the Kootenai formation of British Columbia, by Fontaine [11] from the Jurassic of California, and by Velenovsky [12] from the Cenomanian of Bohemia. Our Figure 1, Plate 10, represents this form.

Our Figure 2, Plate 9, is typical of *P. lanceolatus eichwaldi* (Schimper) Heer,[13] especially if compared with Heer's Figure 1, Plate 27. This form was differentiated and named *P. eichwaldi* by Schimper,[14] on the basis of a specimen figured by Eichwald [15]; and as originally used by Schimper this name was designed to define the form represented by oblong leaves with blunt apices; but subsequent authors included a wide variety of forms under the name, as may be seen by reference to Heer's figures and to the specimens previously figured by the same author from the Jurassic of Svalbard [16] and by Velenovsky [17] from the Cenomanian of Bohemia. If we accept any such comprehensive conception of the variety as those references would imply, the specimens represented by our Figures 1–4, Plate 9, and Figures 3a, 4, and 5, Plate 10, would be included under it or under *P. lanceolatus latifolius* (Schenk) Heer.[18] Other forms, such as those represented by our Figures 2, 5–7, Plate 8, would probably be recognized under the names *P. lanceolatus intermedius* Heer [19] and *P. lanceolatus distans* (Presl) Heer.[20]

The large leaf represented by our Figure 8, Plate 8, may be compared with *Podozamites tenuinervis* Heer,[21] which is probably merely a large form of *P. lanceolatus;* and the small leaf represented by our Figure 4, Plate 8, is probably identical with *Podozamites pusillus* Velenovsky,[22] which is practically indistinguishable from small forms of *P. lanceolatus.* Size variations in leaves of *P. lanceolatus* are figured by Velenovsky on the same plate,[23] from which may be seen the great diversity in this respect that exists in the species as recognized by that author. A similar diversity is recorded by Yokoyama [24] in connection with the species from Jurassic and Cretaceous strata in China, and he takes occasion to remark [25] that "the subdivision of this species into many varieties according to the form of the leaflets, as has been done by Heer, is, I believe, not tenable, as already pointed out by Seward." I have also found a similar condition in specimens collected on Long Island, N. Y.,[26] where leaves of *Podozamites* have been found that show every gradation in size and a wide diversity of form, all matted together in the same matrix so that it is impossible to resist the idea that they must all belong to a single species, referable to *P. lanceolatus.* A

[8] Heer, Oswald, Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes; II, Pflanzen des Amurlandes: Flora fossilis arctica, vol. 4, No. 2, p. 108, pl. 26, fig. 10, 1876.

[9] Idem. p. 110, pl. 27, figs. 5a, 5b, 6–8.

[10] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 6, pl. 1, fig. 3, 1885 [1886].

[11] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, first paper; The older Mesozoic: U. S. Geol. Survey Twentieth Ann. Rept., pt. 2, p. 360, pl. 64, fig. 1, 1900.

[12] Velenovsky, Josef, Neue Beiträge zur Kenntniss der Pflanzen des böhmischen Cenomans: K. böhm. Gesell. Wiss. Sitzungsber., 1886, p. 642 (10), pl. [not numbered], fig. 18, 1887.

[13] Heer, Oswald, Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes; II, Pflanzen des Amurlandes: Flora fossilis arctica, vol. 4, No. 2, p. 109, pl. 23, figs. 1c, 4a, b, c, d; pl. 26, figs. 2, 3, (4a, b?), 9; pl. 27, figs. 1, (5c, 11a?), 1876.

[14] Schimper, W. P., Traité de paléontologie végétale, vol. 2, p. 160, Paris, 1870.

[15] Eichwald, Édouard, Lethaea rossica, vol. 2 (Période moyenne, sec. 1), p. 40; Atlas (Période moyenne), pl. 3, fig. 1, Stuttgart, 1865.

[16] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, No. 1, p. 36, pl. 6, fig. 22c; pl. 7, fig. 7e; pl. 8, figs. 1b, c, d, e, 2a, b, c, 3, 3b, 4a, b, c, d, 1876.

[17] Velenovsky, Josef, Die Gymnospermen der böhmischen Kreideformation, p. 11, pl. 2, figs. 9, 10, 23, Prag, 1885.

[18] Heer, Oswald, Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes; II, Pflanzen des Amurlandes: Flora fossilis arctica, vol. 4, No. 2, p. 109, pl. 26, figs. 5, 6, 8b, c, 1876.

[19] Idem, p. 108, pl. 26, fig. 8a.

[20] Idem, p. 109, pl. 26, fig. 7; pl. 27, figs. 3a, 4a.

[21] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 44, pl. 16, fig. 9, 1882.

[22] Velenovsky, Josef, Die Gymnospermen der böhmischen Kreideformation, p. 11, pl. 2, figs. 20–22, 24a, Prag, 1885.

[23] Idem, pl. 2, figs. 11–19.

[24] Yokoyama, Matajiro, Mesozoic plants from China: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 21, art. 9, p. 18, pl. 2, figs. 5, 6; p. 21, pl. 4, fig. 3; p. 22, pl. 4, figs. 1, 2, 5, 6; p. 26, pl. 6, figs. 1b, 2; p. 33, pl. 11, fig. 3; p. 37, pl. 12, fig. 3, 1906.

[25] Idem, p. 19.

[26] Hollick, Arthur, New York Bot. Gard. Bull., vol. 8, No. 28, p. 155, pl. 162 in part; pl. 163, figs. 2, 3, 1912.

somewhat similar example may be seen in our Figure 6, Plate 8, in which a large leaf (a) is shown in close proximity to a small leaf (b), in a single fragment of matrix.

The wealth of material collected in Alaska, instead of being of assistance in determining specific or varietal forms in the genus *Podozamites*, has only added to the uncertainty of attempting to differentiate them satisfactorily, and it would be quite possible to arrange an intergrading series of forms, with our Figure 8, Plate 8, at one extreme and our Figure 4, Plate 8, at the other, in which any dividing line or lines to differentiate specific, varietal, or form groups would be purely arbitrary and would merely represent personal ideas or opinions. The feature of principal interest and significance, however, is that we can recognize, beyond question, in these specimens from the Cretaceous of Alaska, a type of vegetation that is specifically identical with vegetation from equivalent geologic horizons elsewhere in America and in the Old World, and also with vegetation that is recognized as Jurassic from localities that include the northwestern United States and practically the whole of the Eurasian Continent.

In America the vertical range and areal distribution of *Podozamites lanceolatus* in its various forms includes the Jurassic of California,[27] Oregon,[28] and Alaska;[29] the Lower Cretaceous (Kootenai formation) of British Columbia[30] and Montana;[31] the lower part of the Potomac group of Virginia;[32] the Raritan formation of New Jersey[33] and Maryland;[34] the Dakota sandstone of Kansas;[35] and the Magothy formation of New York.[36] So far as the known distribution in Alaska is concerned the species, in any of its forms, is confined to the Jurassic of Cape Lisburne and the Cretaceous of the Yukon River Valley. In the Yukon region it is one of the most abundant elements in the Cretaceous flora, being included in at least 10 of the collections; but not a specimen has yet been found in any of the collections from the Alaska Peninsula.

Localities: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 6, fig. 6b; pl. 8, fig. 8; pl. 10, fig. 4; pl. 16, figs. 1b, 3b; pl. 30, fig. 1a). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 6, fig. 8b; pl. 7, fig. 3b; pl. 8, figs. 2, 7; pl. 10, fig. 1; pl. 11, fig. 7b). Yukon River, north bank, about 5 miles above Louden station (Nahochatilton) (original Nos. 22 and 22A); collected by W. W. Atwood and H. M. Eakin in 1907 (lots 4635 and 4636) (pl. 7, figs. 2b, 9b; pl. 10, fig. 3a). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 8, figs. 5, 6a, 6b). Yukon River, south side, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243) (pl. 8, fig. 4). Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 9, fig. 1). Yukon River, north bank, at Blatchford's mine (original No. 3AH22); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3261) (pl. 9, figs. 2, 3, 4; pl. 10, fig. 5; pl. 30, fig. 4a). Yukon River, north bank, just above Kaltag (original No. 3AH27); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3266) (pl. 10, fig. 2a). Yukon River, north bank, just below Pickart's mine (original No. 3AH18b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3255) (pl. 20, fig. 1b). Yukon River, south bank, about 1½ miles below Seventymile Creek (original No. 80); collected by G. C. Martin in 1914 (lot 6815) (pl. 27, figs. 5, 6a). Yukon River, north bank, shore from 2 to 10 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259).

Order GINKGOALES

Family GINKGOACEAE

Genus GINKGO Linnaeus

Ginkgo concinna Heer

Plate 11, figure 1

Ginkgo concinna Heer, Beiträge zur Jura-Flora Ostsibiriens und des Amurlandes; I, Pflanzen aus dem Gouvernement Irkutsk: Flora fossilis arctica, vol. 4, No. 2, p. 63, pl. 7, fig. 8; pl. 13, figs. 6b, 6c, 7, 8, 8b, 1876.

Although this species was originally described by Heer from the Jurassic of Siberia and has not been heretofore recorded from any other region or any other geologic horizon, there is no discernible specific

[27] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, first paper, The older Mesozoic: U. S. Geol. Survey Twentieth Ann. Rept., pt. 2, pp. 360, 361, pl. 63, fig. 4; pl. 64, figs. 1, 2; pl. 66, fig. 4 in part; pl. 67, figs. 3, 4, 1900.

[28] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, pp. 110–112, pl. 24, figs. 17–20; pl. 25, figs. 1–7; p. 150, pl. 38, figs. 11, 12, 1905.

[29] Knowlton, F. H., The Jurassic flora of Cape Lisburne, Alaska: U. S. Geol. Survey Prof. Paper 85, pp. 52, 53, pl. 5, fig. 6; pl. 6, fig. 5 in part, 1914.

[30] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 6, pl. 1, fig. 3, 1885 [1886].

[31] Knowlton, F. H., Smithsonian Misc. Coll., vol. 50, p. 120, pl. 14, fig. 4, 1907.

[32] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 341, pl. 53, figs. 5, 6, 1911.

[33] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 44, pl. 13, fig. 2, under the name "*Podozamites angustifolius* (Eichw.) Schimp."; excluding figs. 1, 3, 4, 1895 [1896].

[34] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 272, 1916.

[35] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 28, pl. 1, figs. 5, 6, 1892.

[36] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 35, pl. 2, fig. 1, 1906; New York Bot. Gard. Bull., vol. 8, p. 155, pl. 162 in part; pl. 163, figs. 2, 3, 1912.

difference between it and our specimens from Alaska, where it is an element of a flora that is undoubtedly Cretaceous. The only difference that can be noted is that our specimens are somewhat larger.

This represents one of the many similar surprises that we have encountered in comparing the Cretaceous flora of Alaska with the Jurassic flora of other regions. It apparently represents one of the many Jurassic specific types that have persisted well into the Cretaceous period; and incidentally, in this connection, it is interesting to note that Kryshtofovich [37] has apparently found similar types in the Cretaceous flora of the island of Sakhalin, where he mentions the occurrence of "Ginkgoales * * * like *Baiera* and *Ginkgodium*."

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 11, fig. 1). Yukon River, north bank, shore from 2 to 10 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259).

Ginkgo digitata (Brongniart) Heer

Plate 11, Figures 2–7a, 8

Ginkgo digitata (Brongniart) Heer, Regel's Gartenflora, Jahrg. 23, p. 261, pl. 807, figs. 1–3, 1874.

Cyclopteris digitata Brongniart, Histoire des végétaux fossiles, vol. 1, p. 219, pl. 61 bis, figs. 2, 3, Paris, 1830.

Ginkgo huttoni (Sternberg) Heer, Regel's Gartenflora, Jahrg. 23, p. 261, pl. 807, fig. 4, 1874.

Cyclopteris huttoni Sternberg, Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, vol. 2, pts. 5, 6, p. 66, Prag, 1833.

Ginkgo digitata huttoni (Sternberg) Seward, Catalogue of the Mesozoic plants in the department of geology, British Museum, The Jurassic flora, pt. 1, p. 259, pl. 9, fig. 2, London, 1900.

Ginkgo huttoni magnifolia, Fontaine, in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 124, pl. 31, figs. 4–8; pl. 32, figs. 1, 2; p. 170, pl. 44, figs. 7, 8, 1905.

Under this specific name I have included a number of lobed-leaved Ginkgos that vary more or less in size and in the extent and character of their lobation. Some would probably be referred without question to *G. digitata* (Brongniart) Heer, as that species is generally recognized, and others to *G. huttoni* (Sternberg) Heer. Some authorities have maintained a specific distinction between the two species; others have regarded them as varieties or leaf forms of a single species; and under one or the other name the stratigraphic distribution has been made to include the entire time period from Upper Triassic to Lower Cretaceous, and the geographic distribution to include England, Scandinavia, Russia, Siberia, Japan, China, Afghanistan, Australia, Iceland, the northwestern United States, and Alaska.

The multiplicity of forms and varieties that have been described and figured under the two specific names may be regarded as excessive; but, on the other hand, to attempt to differentiate them any further only results in greater confusion. In his discussion of the specimens from the Jurassic of Oregon, Fontaine [38] remarks: "I am not sure that they are not all modifications of the rather polymorphous species *Ginkgo digitata* (Brong.) Heer"; and Knowlton,[39] in discussing the same species, says:

> This genus [*Ginkgo*] has been very much overburdened, for in dealing with such an abundance of specimens and multiplicity of forms one must needs make either many "species" to accommodate this diversity or only one or two, and in view of the known variation exhibited by the single living species, the latter plan seems preferable. As a consequence, all the Alaska [Cape Lisburne] specimens are here considered as referable to the extremely variable *Ginkgo digitata*.

Following the same course of reasoning I have, therefore, included the series of diverse digitate and subdigitate forms from the Yukon River localities under the one specific name which, however, is to be regarded merely as an arbitrary arrangement with no more taxonomic significance than would be expressed by a differentiation into two or more so-called species and varieties.

Comparison may also be made with *Ginkgo multinervis* Heer,[40] from the Atane beds of Greenland, which is strikingly similar to certain of the leaf forms included under *Ginkgo digitata* and may belong to the same species. In this connection reference may also be pertinent to a specimen from the Jurassic of Cape Lisburne, Alaska, referred to *Ginkgo multinervis* by Lesquereux.[41]

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 11, figs. 2, 3). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 11, figs. 4–6). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 11, figs. 7a, 8).

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[37] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 40, 1918.

[38] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic flores of the United States, second paper: U. S. Geol. Survey Mon. 48, pp. 120–121, 1905.

[39] Knowlton, F. H., The Jurassic flora of Cape Lisburne, Alaska: U. S. Geol. Survey Prof. Paper 85, p. 55, 1914.

[40] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 46, pl. 5, fig. 1d; pl. 8, figs. 2b, 3, 4; pl. 9, fig. 3b, 1882.

[41] Lesquereux, Leo, U. S. Nat. Mus. Proc., vol. 11, p. 31, pl. 16, fig. 6. 1888 [1889].

Ginkgo laramiensis Ward?

Plate 12, Figures 3, 4

Ginkgo laramiensis Ward, Science, vol. 5, p. 496, fig. 7, 1885.

These leaves agree, essentially, with the leaf forms of the genus *Ginkgo* from the so-called "Laramie" formation of Wyoming, to which this specific name was given by Ward; but they agree about equally well with *Ginkgo dawsoni* Knowlton,[42] from the Upper Cretaceous of Vancouver Island, and with certain of the forms referred to the Tertiary species *Ginkgo adiantoides* (Unger) Heer,[43] from the island of Sakhalin, where the supposed Tertiary flora has been shown by Kryshtofovich[44] to be, at least in part, Cretaceous. Leaves referred to *Ginkgo laramiensis* Ward are also described and figured by Knowlton[45] from the Montana group of Wyoming. In fact, it seems probable that all the specific forms mentioned may eventually be included in a single species.

Locality: Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262).

Ginkgo sp.?

Plate 11, Figure 9

This specimen is too fragmentary for either description or satisfactory comparison. The upper margin is crenulate, but beyond that there are no diagnostic characters by means of which it may be either described or identified.

It was found at the same locality as the specimens referred to *Ginkgo laramiensis* Ward? (see pl. 12, figs. 3, 4), and may possibly represent a form of that species.

Locality: Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262).

Ginkgo reniformis Hollick, n. sp.

Plate 12, Figures 5–7

Leaves suborbicular or reniform, about 7 centimeters in length by 8 centimeters in maximum width, abruptly and narrowly wedge-shaped at the base; margin entire; nervation flabellate, divergent, fine, dichotomously forked.

It is with some hesitation that I give these leaves a distinct specific name, especially as the specimens are imperfect, and all their characters can not be determined. They may represent merely a large, rotund form of *Ginkgo laramiensis* Ward (see pl. 12, figs. 3, 4), but their large size as well as distinctive shape appear to differentiate the species more or less satisfactorily.

Localities: Yukon River, north bank, about 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642) (pl. 12, fig. 5). Yukon River, north bank, about 15 miles below mine No. 1 (original No. 3AH32); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3271) (pl. 12, fig. 6). Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262) (pl. 12, fig. 7).

Ginkgo crenulata Hollick, n. sp.

Plate 12, Figures 1, 2

Leaves flabelliform, subtriangular, curved above, truncate below and abruptly constricted to a narrow, elongated, wedge-shaped base, long petiolate; margin crenulate or coarsely crenate-dentate above, entire in the basilar part; nervation fine, flabellate, dichotomously forked.

This well-marked species is apparently distinct from any heretofore described. Immediately above the narrow, wedge-shaped basilar extension the margin curves abruptly and extends almost horizontally to the extremities of the broadest part of the leaf, where it turns abruptly and continues on each side in the form of a gentle convex curve to the summit.

Localities: Yukon River, north bank, just above Williams mine (original No. 3AH30); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3269) (pl. 12, fig. 1). Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258) (pl. 12, fig. 2).

Ginkgo pseudoadiantoides Hollick, n. sp.

Plate 3, Figure 7b; Plate 13, Figures 8–12; Plate 28, Figure 4a

Leaves flabelliform, wedge-shaped, flattened or rounded above, tapering below and gently curved to an elongated, narrow base; margin entire; nervation flabellate, forked.

More or less variation in form may be noted in the leaves included under this specific name, some of which, such as the one represented by Figure 10 on Plate 13, are so closely similar to certain forms

[42] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 302, 1919 (=*Ginkgo pusilla* (Dawson) Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 111, 1898, not *G. pusilla* Heer, 1876; = *Salisburia pusilla* Dawson, Roy. Soc. Canada Trans., vol. 11, sec. 4, p. 56, pl. 6, figs. 11–13, 1893 [1894]).

[43] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, No. 3, p. 21, pl. 2, figs. 7, 8, 1878.

[44] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, pp. 1–26, 1918.

[45] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 31, pl. 4, figs. 7–10; pl. 5, fig. 5, 1900.

referred to the Tertiary species *Ginkgo adiantoides* (Unger) Heer[46] as to appear almost identical. Comparison between Heer's Figures 8 and 10 and our Figures 10–12 on Plate 13 shows this similarity in a striking manner; and it may be pertinent to infer the possibility that Heer's specimens, at least in part, may have been erroneously identified, inasmuch as their geologic age may be either Cretaceous or Tertiary, according to Kryshtofovich.[47] Similar leaves, however, are described and figured by Heer[48] from the Tertiary of Greenland, but these all differ more or less from the original *Salisburia adiantoides* Unger[49] of Europe, as depicted by Massalongo[50] and other authors; and to regard all the forms that have been included in the species by various authors as specifically identical is about as unsatisfactory as to attempt to differentiate them into distinct species.

It should be recognized, also, that practically no difference can be discerned between certain forms of *Ginkgo adiantoides* (Unger) Heer, *G. laramiensis* Ward (see p. 49, pl. 12, figs. 3, 4), *G. dawsoni* Knowlton[51] from the Cretaceous of Vancouver Island, and certain of our specimens from Alaska, so that all these specific designations may possess little or no taxonomic significance and be of value merely as convenient names to indicate stratigraphic position.

Localities: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 3, fig. 7b). Yukon River, north bank, about 10 miles below Melozi (original No. 18); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4633) (pl. 13, figs. 8–12). Yukon River, north bank, about 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642) (pl. 28, fig. 4a).

Ginkgo pseudoadiantoides major Hollick, n. var.

Plate 13, Figure 13

Leaf large, wedge shaped, size not known, apparently about 8 centimeters in length by 9 or 10 centimeters in maximum width; nervation flabelliform, forked.

This leaf differs from the species last described merely in its larger size; but this character is so pronounced that it seems to warrant a varietal designation.

Locality: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Ginkgo minor Hollick, n. sp.

Plate 2, Figure 4b; Plate 13, Figures 1–7; Plate 19, Figures 6b, 7b; Plate 29, Figures 2c, 4c, 6a

Leaves small, flabelliform, varying in size and shape, mostly bilobate or with an emarginate apex and a broad cuneate base and short petiole; nervation flabellate, dichotomously forked.

These leaves are abundant at several localities on the Alaska Peninsula but have not been found in any of the collections from the Yukon River region. They are smaller than the leaves of any species heretofore referred to the genus, but they are somewhat suggestive of the leaves described and figured under the names *Adiantum formosum* Heer[52] and *A. formosum incisum* Heer,[53] from the Kome beds of Greenland; our leaves, however, appear undoubtedly to belong to a species of *Ginkgo* and not to any species of fern.

Certain of our larger specimens, such as the one represented by Figure 6 on Plate 13, resemble small forms of *Ginkgo integriuscula* Heer,[54] from the Jurassic of Svalbard; but the resemblance is too remote to warrant more than incidental mention.

Localities: Chignik Lagoon, south side, near entrance, Alaska Peninsula (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295) (pl. 2, fig. 4b). Port Moller, 2 miles up the canyon, west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 13, figs. 1–5; pl. 19, figs. 6b, 7b). Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 13, figs. 6, 7; pl. 29, fig. 6a). Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297) (pl. 29, figs. 2c, 4c). Coal mines in Coal Bluff, Herendeen Bay, (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

[46] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, No. 3, p. 21, pl. 2, figs. 7–10, 1878.

[47] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, pp. 1–26, 1918.

[48] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 57, pl. 87, figs. 9–12, 1883.

[49] Unger, Franz, Chloris protogaea, pt. 6, p. lxxvii, Leipzig, 1845; Synopsis plantarum fossilium, p. 211, Leipzig, 1845.

[50] Massalongo, A. B., Studii sulla flora fossile e geologia stratigraphica del Senigalliese, pt. 2, Flora fossile, pl. 6, fig. 18; pl. 7, fig. 2; pl. 39, fig. 12, Imola, 1859.

[51] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 302, 1919 (=*Salisburia pusilla* Dawson, Roy. Soc. Canada Trans., vol. 11, sec. 4, p. 56, pl. 6, figs. 11–13, 1893 [1894]).

[52] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 35, pl. 3, figs. 1a, 1b, 2a; pl. 13, fig. 2b, 1874.

[53] Idem, p. 36, pl. 13, figs. 11, 12.

[54] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, No. 1, p. 44, pl. 10, figs. 7–9, 1876.

Order CONIFERALES

Family TAXACEAE

Genus NAGEIOPSIS Fontaine

Nageiopsis zamioides Fontaine?

Plate 8, Figure 3

Nageiopsis zamioides Fontaine, The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 196, pl. 79, figs. 1, 3; pl. 80, figs. 1–2a, 4; pl. 81, figs. 1–6, 1889.

This single leaf is referred to the above-named species with hesitation, although it apparently represents the genus *Nageiopsis*. In outline it might readily be mistaken for a small form of *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun, as may be seen by comparison with certain of the figures of that species shown on the same plate; but the coarser nervation serves to distinguish it.

Locality: Chignik Lagoon, south side, near entrance, Alaska Peninsula (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295).

Nageiopsis angustifolia Fontaine

Plate 28, Figure 2

Nageiopsis angustifolia Fontaine, The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 202, pl. 86, figs. 8, 9; pl. 87, figs. 2–6a; pl. 88, figs. 1, 3, 4, 6–8; pl. 89, fig. 2, 1889.

The species to which this specimen is referred is variable in the size of its leaves, but certain of the smaller ones figured by Fontaine [55] compare very satisfactorily with ours.

The distribution of the species outside of Alaska includes the Lower Cretaceous of Wyoming and South Dakota, the Shasta series of California, and the lower part of the Potomac group of Maryland, Virginia, and the District of Columbia.[56]

Locality: Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259).

Genus PROTOPHYLLOCLADUS Berry

Protophyllocladus obesus Hollick, n. sp.

Plate 14, figure 6

Leaf 6.5 centimeters in length by 5 centimeters in width, oblong, with a cuneate base, a deeply emarginate apex, and a corrugated lamina; margin entire or wavy; midrib curved, conspicuously thick up to about the middle of the leaf, thence thinning out rather abruptly to the apex; nervation simple, spreading below, gradually becoming less and less divergent from the midrib above.

This leaf apparently differs from any other described species of the genus in its greater width relative to length. It may possibly be a variety or form of *Protophyllocladus polymorphus* (Lesquereux) Berry, the species next described, but unless intermediate forms are discovered a specific differentiation appears to be justified.

Locality: Yukon River, north bank, immediately above Williams mine (original No. 3AH30); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3269).

Protophyllocladus polymorphus (Lesquereux) Berry

Plate 14, figure 7

Protophyllocladus polymorphus (Lesquereux) Berry, Torrey Bot. Club Bull., vol. 30, p. 442, 1903.

Salisburia polymorpha Lesquereux, Am. Jour. Sci., 2d ser., vol. 27, p. 362, 1859; U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 404, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 84, pl. 6, figs. 40, 41, 1878.

This leaf is referred with some hesitation to this species for the reason that the specimens upon which the species was originally based by Lesquereux are very small as compared with ours, although in other characters they agree closely. Knowlton,[57] however, refers specimens as large as ours, from the so-called "Laramie" formation (Eagle sandstone) of Montana, to the species, and in connection with these leaves specific identity with ours can hardly be questioned.

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Protophyllocladus subintegrifolius (Lesquereux) Berry

Plate 14, Figures 1–3

Protophyllocladus subintegrifolius (Lesquereux) Berry, Torrey Bot. Club Bull., vol. 30, p. 440, 1903.

Phyllocladus subintegrifolius Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 92, 1868; The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 54, pl. 1, fig. 12, 1874; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 34, pl. 2, figs. 1–3, 1892.

Although our specimens are somewhat fragmentary, there can be but little doubt that they are referable to this more or less variable species.

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[55] Fontaine, W. M., op. cit., pl. 87, fig. 3; pl. 88, figs. 1, 3, 4.

[56] Fontaine, W. M., in Ward, L. F., U. S. Geol. Survey Nineteenth Ann. Rept., pt. 2, p. 684, pl. 168, fig. 7, 1899; Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, pp. 219, 491, 516, 528, 560, pl. 117, figs. 4, 5, 1905.

[57] Knowlton, F. H., in Weed, W. H., The Laramie and the overlying Livingston formation in Montana: U. S. Geol. Survey Bull. 105, p. 47, pl. 1, figs. 1–4, 1893.

Under the name *Thinnfeldia lesquereuxiana* Heer [58] it is represented in the Atane beds of Greenland and the Raritan formation of New Jersey; [59] and under the name *Protophyllocladus subintegrifolius* it is reported by Berry [60] from the Upper Cretaceous of Maryland, the Tuscaloosa formation of Alabama, and the Magothy formation of New Jersey [61] and by Hollick from what is probably an equivalent horizon on Staten Island, N. Y., Block Island, R. I., and Marthas Vineyard, Mass.[62]

The specimens from Kansas figured by Lesquereux in his "Flora of the Dakota group" are noticeably larger than any of the other American specimens referred to the species and are more or less suggestive of *Protophyllocladus polymorphus* (Lesquereux) Berry, the species last described; and Kryshtofovich [63] has figured a similar specimen from the Cretaceous of the island of Sakhalin, under the name *P. subintegrifolius*, that might about equally well be referred to *P. polymorphus*. If correctly represented in the figure, however, the nervation is hardly that of *Protophyllocladus*.

Localities: Yukon River, north bank, about 8 miles below Kaltag (original No. 3AH29); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3268) (pl. 14, fig. 1). Yukon River, north bank, about 8 miles below Kaltag (original No. 2AC266); collected by A. J. Collier and Sidney Paige in 1902 (lot 2984) (pl. 14, figs. 2, 3).

Protophyllocladus simplex Hollick, n. sp.

Plate 14, Figures 4, 5

Leaves small, from 2.75 to about 4.75 centimeters in length and from 1 to 1.75 centimeters in width, elliptical-lanceolate, curved to the apex and tapering sharply to the base; margin entire; nervation fine, subtending almost uniform acute angles of divergence with the midrib throughout.

These leaves appear to represent a distinct specific type of *Protophyllocladus*, different from any heretofore described.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 2AC266); collected by A. J. Collier and Sidney Paige in 1902 (lot 2984).

Genus PHYLLOCLADITES Visiani

Phyllocladites dubiosus Hollick, n. sp.

Plate 2, Figure 9

Foliaceous organ, resembling a bract, phyllode, or stipule, obliquely orbiculate-cordate, entire, traversed by numerous fine, dichotomously branching veins that radiate from the base.

This well-defined specimen is referred to the genus *Phyllocladites* because of its apparent generic relationship to *Phyllocladites rotundifolius* Heer,[64] from the Cretaceous of Svalbard, which he regards as representing the leaf-like organs or phyllodes of a coniferous tree related to *Phyllocladus;* but whether or not this reflects the correct morphologic nature and systematic position of our specimen may be considered an open question. The nervation is so delicate that it is difficult to define accurately. There is an obscure indication of a midrib, and this, as well as each of the other veins, occasionally forks by successively finer and shorter branches that ultimately terminate in the margin. So far as can be discerned there is nowhere any indication of reticulation, otherwise it might be compared with *Proteaephyllum orbiculare* Fontaine,[65] to which it bears a very close surficial resemblance.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Genus CEPHALOTAXOPSIS Fontaine

Cephalotaxopsis heterophylla Hollick, n. sp.

Plate 10, Figure 2b; Plate 15, Figures 1–11; Plate 16, Figure 6b; Plate 17, Figure 4; Plate 19, Figures 8, 11; Plate 28, Figure 1

Leafy twigs; leaves varying in shape from linear-lanceolate to linear-elliptical; apex acuminate; base abruptly rounded-cuneate, terminating in a short but distinct footstalk or petiole.

This species is represented by numerous specimens in several of the collections from the Yukon region. There is more or less variation in the size and form of the leaves, according to the position that they occupy in relation to the twig or branch to which they are attached. They are rather rigid and are closely approximated on the ultimate twigs but are more distant below. The general appearance suggests a relatively open and sparse foliage, although this appearance may be more or less due to partial defoliation of the older parts of the twigs and branches. Some of our smaller specimens, represented by Figures 2, 5–9,

[58] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 37, pl. 44, figs. 9, 10; pl. 46; figs. 1–11, 12a, b, 1882.

[59] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 59, pl. 11, figs. 1–17, 1895 [1896].

[60] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 796, 1916.

[61] Berry, E. W., Torrey Bot. Club Bull., vol. 31, p. 69, pl. 1, fig. 5, 1904.

[62] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 36, pl. 5, figs. 1–6, 1906.

[63] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 41, text fig. 6 on p. 42, 1918.

[64] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 124, pl. 35, figs. 17–21b, 1874.

[65] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 283, pl. 139, fig. 4, 1889.

Plate 15, are suggestive of *Torreya venusta* Yokoyama,[66] a Lower Cretaceous species from Japan, which Yokoyama compares with *Torreya virginica* Fontaine,[67] from the lower part of the Potomac group of Virginia; and they may also be compared with *Cephalotaxopsis microphylla* Fontaine,[68] but none of our specimens appear to have the rigidity of those depicted in Fontaine's figures.

Localities: Yukon River, north bank, a short distance above Kaltag (original No. 3AH27); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3266) (pl. 10, fig. 2b). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 15, figs. 1, 2; pl. 17, fig. 4; pl. 19, fig. 11). Yukon River, north bank, between Pickart's mine and Nulato (original No. 3AH18d); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3256) (pl. 15, figs. 3, 11). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 15, fig. 4; pl. 19, fig. 8). Yukon River, north bank, about 8 miles below Kaltag (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4640) (pl. 15, figs. 5–7). Yukon River, north bank, about 1 mile above Williams mine (original No. 38); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4641) (pl. 15, figs. 8, 9). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 15, fig. 10). Yukon River, north bank, at Williams mine (original No. 2AC284); collected by A. J. Collier and Sidney Paige in 1902 (lot 2985) (pl. 16, fig. 6b). Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638) (pl. 28, fig. 1).

Cephalotaxopsis magnifolia successiva Hollick, n. var.

Plate 7, Figure 9c; Plate 16, Figures 1a, 2, 3a, 4–6a; Plate 20, Figure 4b

Leaves averaging about 4.5 centimeters in length by about 2.5 millimeters in maximum width, linear-lanceolate, straight or falcate, tapering gradually above to a narrow acute tip and somewhat more abruptly below to a curved cuneate base; texture evidently coriaceous, as indicated by numerous transverse cracks or wrinkles, simulating fine nervation.

These leaves, which are all detached, are strikingly similar to those in the figure of the specimen referred by Berry[69] to *Cephalotaxopsis magnifolia* Fontaine,[70] from the Potomac group of Virginia, and it is difficult to escape the idea that the species to which Berry's specimen belongs is identical with ours from Alaska. The reference to *Cephalotaxopsis magnifolia*, however, may be questioned. The leaves of this species are shorter, more rigid, and closer together than they are depicted in Berry's figure, in which the leaves are long, slender, and occasionally falcate as in ours.

Similar remains, from the Shasta series of California, that compare very closely with the slender apical parts of our leaves, are referred by Fontaine to *Cephalotaxopsis ramosa* Fontaine,[71] and others to *Cephalotaxopsis? rhytidodes* Ward.[72] These remains show the characteristic transverse cracks or wrinkles at right angles to the midrib, as in our specimens. Fontaine[73] refers to the same character in connection with *Cephalotaxopsis magnifolia*, and it may also be noted in connection with *Torreya dicksonioides* Dawson,[74] from the Cretaceous of British Columbia.

Although our specimens are represented only by detached leaves, and their arrangement when attached can therefore not be defined with certainty, an indication of the character of their arrangement may be seen in Figure 6a on Plate 16, in which they appear to be rather widely separated and to subtend acute angles with the central rachis. The specimen illustrated in this figure may be regarded as the type of the variety.

Incidentally, in connection with this phase of the subject, suggestive comparisons may be made with the figures of *Taxites zamioides* (Leckenby) Seward and *Pinus nordenskiöldii* Heer, from the Jurassic of Oregon, as described and depicted by Fontaine.[75] The detached leaves of each of these species are strikingly like ours in shape and dimensions but lack the characteristic transverse wrinkling, which, however, being apparently due to secondary conditions and not to conditions of growth, is merely an accidental and not a normal feature. Perfect specimens, with leaves attached, might modify or change our ideas in connection with the generic relationships of both the Oregon and the Alaska specimens.

[66] Yokoyama, Matajiro, Coll. Sci. Imp. Univ. Tokyo Jour., vol. 7, p. 230, pl. 22, figs. 11, 12, 12a, 1895.

[67] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 234, pl. 109, fig. 8, 1889.

[68] Idem, p. 238, pl. 108, fig. 5; pl. 109, fig. 9.

[69] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 377, pl. 60, fig. 1, 1911.

[70] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 236, pl. 104, figs. 4, 5; pl. 105, figs. 1, 1a, 1b, 2, 4; pl. 106, figs. 1, 1a, 3; pl. 107, figs. 1, 2, 4, 4a; pl. 108, figs. 1, 3, 4, 1889.

[71] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 258, pl. 68, figs. 5–7, 1905.

[72] Idem, p. 258, pl. 68, fig. 8.

[73] Idem, p. 237.

[74] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 21, pl. 2, figs. 4, 4a, 1882 [1883] (=*Tumion dicksonioides* (Dawson) Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 234, 1898).

[75] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 129, pl. 34, figs. 15–17; pl. 35, figs. 1–3; p. 131, pl. 35, figs. 10–17, 1905.

Localities: Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22A); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4636) (pl. 7, fig. 9c). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) pl. 16, figs. 1a, 2, 3a). Yukon River, north bank, about 10 miles below Melozi telegraph station (original No. 18); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4633) (pl. 16, fig. 4). Yukon River, north bank, at Bluff Point, about 16 miles above Kaltag (original No. 3AH25); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3264) (pl. 16, fig. 5; pl. 20, fig. 4b). Yukon River, north bank, at Williams mine (original No. 2AC284); collected by A. J. Collier and Sidney Paige in 1902 (lot 2985) (pl. 16, fig. 6a).

Cephalotaxopsis intermedia Hollick, n. sp.

Plate 17, Figures 1–3

Leafy twigs; leaves intermediate in shape and dimensions between *Cephalotaxopsis magnifolia successiva*, the variety last described, and *Cephalotaxopsis microphylla laxa*, the variety next described, being prevailingly smaller than the former and larger and more rigid in habit than the latter.

The specimens included under this specific name represent one of the group forms of foliage referred to the genus *Cephalotaxopsis* that is very difficult to differentiate satisfactorily from other similar group forms contained in the collections from Alaska.

It is inevitable that there should be considerable difference in the size of the leaves and in their disposition and arrangement in connection with the rachis to which they are attached, according to the part that happens to be preserved in any particular specimen, and hence dismembered specimens and detached leaves are often very difficult to relegate to or to identify satisfactorily with any one of the groups to which a specific or varietal name has been given. The ultimate twig shown in Figure 1, for example, has short, closely approximated leaves and, if found isolated, would hardly be regarded as the same species as the larger twig or branch, with long, relatively widely spaced leaves, included in the same figure, or the median fragments shown in Figures 2 and 3.

Localities: Anchorage Bay, opposite Northwestern Fishery Co.'s cannery, Chignik Bay, Alaska Peninsula (original No. 48), collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5294) (pl. 17, fig. 1). Chignik Bay, 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 17, fig. 3). Yukon River, north bank, about 10 miles below Melozi telegraph station (original No. 18); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4633).

Cephalotaxopsis microphylla laxa Hollick, n. var.

Plate 5, Figure 5b; Plate 7, Figure 10b; Plate 17, Figure 5; Plate 19, Figures 1–3, 9, 10, 12; Plate 29, Figure 6c

Leafy twigs or branches; leaves linear-lanceolate or linear-elliptical, about 1 centimeter in maximum length by about 1 millimeter in maximum width, tapering to an acuminate apex, abruptly rounded to a curved cuneate base with a short footstalk or petiole.

These specimens have the general aspect of *Cephalotaxopsis microphylla* Fontaine,[76] but the leaves appear to be less rigid and to be prevailingly rather more lanceolate than elliptical. The general habit of the foliation appears to be more open and lax than is typical of the species; but our collections contain a considerable variety of similar leaf forms which are very difficult either to differentiate from one another or to segregate into form groups, and portions of certain of the leafy twigs, if taken by themselves, might be regarded as identical with the specific type or with certain of the specimens figured under *Cephalotaxopsis heterophylla*.

The entire series of specific and varietal forms from Alaska included under the genus *Cephalotaxopsis* is to be regarded as more or less arbitrarily differentiated, and the specific and varietal names may be regarded as convenient designations for form groups rather than as terms indicating definite botanic entities.

Localities: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297) (pl. 5, fig. 5b; pl. 7, fig. 10b). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 17, fig. 5; pl. 19, figs. 9, 10). Yukon River, south bank, 1½ miles below Seventymile Creek (original No. 80); collected by G. C. Martin in 1914 (lot 6815) (pl. 19, fig. 1). Yukon River, south bank, about 25 miles below Mission Creek; collected by J. E. Spurr in 1896 (lot 1555) (pl. 19, fig. 2). Yukon River, north bank, 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635) (pl. 19, fig. 3). Port Moller, 2 miles up the canyon, west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 19, fig. 12). Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No.

[76] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 238, pl. 108, fig. 5; pl. 109, fig. 9, 1889.

958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 29, fig. 6c).

Cephalotaxopsis electilis Hollick, n. sp.

Plate 24, Figure 1

Leafy twigs; leaves linear-lanceolate, obscurely petiolate, about 6 millimeters in length, acute, closely approximated, rigid, subtending angles of 60° to 70° with the slender, rigid supporting twig.

This single specimen appears to be distinct from any of the coniferous remains of similar surficial characters. It resembles long-leaved twigs of *Glyptostrobus*, such as are figured on the same plate, but the leaves are apparently rounded at the base, short petiolate, and rigid, thus indicating generic relationship with *Cephalotaxopsis*.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634).

Genus TUMION Rafinesque

Tumion gracillimum Hollick, n. sp.

Plate 10, Figure 3b; Plate 17, Figure 6; Plate 18, Figures 1–11; Plate 28, Figure 3

Remains consisting of leafy twigs and branchlets; leaves narrowly linear-lanceolate, averaging about 2 centimeters in length by about 1 millimeter in maximum width, tapering to an aciculate apex and abruptly rounded to a curved cuneate base with a short petiole of footstalk, alternately arranged, normally rigid and subtending acute angles with the supporting rachis.

It is with some hesitation that this species is referred to the genus *Tumion* in preference to *Cephalotaxopsis*, and it is difficult to differentiate certain of the specimens, such as the one represented by Figure 6 on Plate 17, from *Cephalotaxopsis intermedia* as shown in Figure 3 on the same plate. The leaves of the latter, however, are somewhat wider, are less rigid, and normally subtend more obtuse angles with the rachis.

The general aspect of our specimens, also, is so strikingly like that of *Torreya virginica* Fontaine,[77] from the Potomac group of Virginia, that their mutual generic identity appears to be obvious, although in our leaves only a single line, apparently representing the midrib, can be discerned, instead of the two lines that represent the characteristic stomatal bands in Fontaine's figure.

Superficially our specimens might easily be mistaken for *Taxodium angustifolium* Heer,[78] from the Tertiary of Iceland, but the leaves of this species have obtuse apices, whereas those of ours are conspicuously aciculate.

Localities: Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635) (pl. 10, fig. 3b; pl. 18, fig. 11). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 17, fig. 6). Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262) (pl. 18, figs. 1–5). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 18, fig. 6). Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 18, fig. 7). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 18, fig. 8). Yukon River, north bank, about 10 miles above Nulato (original No. 2AC249); collected by A. J. Collier and Sidney Paige in 1902 (lot 2964) (pl. 18, fig. 9). Yukon River, north bank, about 10 miles below Melozi telegraph station (original No. 18); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4633) (pl. 18, fig. 10).

Tumion? suspectum Hollick, n. sp.

Plate 19, Figures 4–6a; Plate 29, Figure 1b

Leafy twigs subtending almost right angles of divergence with the supporting branches; leaves apparently short petioled, linear or obscurely linear-lanceolate, subtending obtuse angles with the supporting twigs.

These specimens are designated as representing a new specific type in the genus *Tumion* (*Torreya*), although it appears to be probable that they may represent a form of some one or another of certain previously described species. They are rather poorly preserved, and details of form and method of attachment of the leaves are obscurely defined, so that even the generic appellation may be erroneous. The general shape of the leaves is somewhat suggestive of *Taxodium?* sp. Knowlton,[79] from the Vermejo formation of northeastern New Mexico, but the angles of divergence of these leaves with the supporting twig are acute, whereas in the Alaskan specimens the angles of divergence are conspicuously obtuse. In this respect our specimens more nearly resemble *Torreya*

[77] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 234, pl. 109, figs. 8, 8a, 1889 (=*Tumion virginicum* (Fontaine) Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 234, 1898).

[78] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 156, pl. 30, fig. 1, 1868.

[79] Lee, W. T., and Knowlton, F. H., Geology and paleontology of Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 252, pl. 32, figs. 1, 2, 1917.

parvifolia Heer,[80] from the Kome beds of Greenland, and *Torreya dicksonioides* Dawson,[81] from the "Middle Cretaceous" of Alberta, and this resemblance was the determining factor in the provisional reference of our specimens to the genus *Tumion.*

A strikingly similar specimen, from the Kootenai formation of British Columbia, is referred by Dawson[82] to *Sequoia smittiana* Heer,[83] a species that occurs in the same beds with *Torreya parvifolia* Heer in Greenland; and between certain of Heer's figures of the two species there is a very close resemblance. Also, Dawson's Figures 7 and 7a that he refers to *Sequoia smittiana* resemble that species as depicted by Heer rather less than they do *Torreya parvifolia.* Neither species appears to be very well known, however, and their joint distribution, so far as recorded, is limited to the horizons and localities mentioned, and to the Kootenai formation of Great Falls, Mont., incidentally mentioned by Newberry.[84]

Localities: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 19, figs. 4, 5; pl. 29, fig. 1b). Port Moller, 2 miles up the canyon west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 19, fig. 6a).

Family PINACEAE

Genus PINUS Linnaeus

Pinus? sp.

Plate 20, Figure 10

These narrow, linear leaves are about 1 millimeter in width and apparently about 7 centimeters in length. They occur in a crisscrossed, matted layer and evidently possessed considerable thickness of texture. They are provisionally referred to the genus *Pinus*, as they appear to resemble pine needles more closely than any other kind of foliar organs.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

[80] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 71, pl. 17, figs. 1, 2, 1874; Die fossile Flora Grönlands, erster Theil: Idem, vol. 6, pt. 2, p. 15, pl. 2, fig. 11, 1882.

[81] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 21, pl. 2, figs. 4, 4a, 1882 [1883].

[82] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 9, pl. 2, figs. 7, 7a, 1885 [1886].

[83] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 82, pl. 12, fig. 10b; pl. 17, figs. 3, 4; pl. 18, fig. 1b; pl. 20, figs. 5b, 7c; pl. 23, figs. 1–6, 1874.

[84] Newberry, J. S., Am. Jour. Sci., 3d ser., vol. 41, p. 192, 1891.

Genus SEQUOIA Endlicher

Sequoia ambigua Heer

Plate 20, Figures 1a, 2–4a, 5–7

Sequoia ambigua Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 78, pl. 21, figs. 1, 2a, 3–9, 10a, b, c; pl. 25, fig. 5, 1874.

There can be no question in regard to the identity of our specimens with Heer's species from the Kome beds of Greenland; and the same may be said in regard to specimens from the Magothy formation of Marthas Vineyard, Mass., collected by White.[85] The identity of most, if not all, of the diverse forms from the Cretaceous of the eastern United States that have been referred to the species, however, is exceedingly doubtful, as may be appreciated by an examination and comparison of the figures by Fontaine[86] of specimens from the lower part of the Potomac group of Maryland, in regard to which he says: "There are a few points of difference in the Kome and Potomac forms. * * * The leaves of the Potomac plant are apparently not quite so thick as those from Kome and not so constantly incurved, and they are usually more closely placed."

Subsequently Berry[87] still further enlarged the scope of the species by including in it the three species *Sphenolepidium recurvifolium* Fontaine, *Sphenolepidium dentifolium* Fontaine, and *Athrotaxopsis expansa* Fontaine, all of which may be specifically identical with the Potomac so-called *Sequoia ambigua* but hardly with the species as defined and figured by Heer.

Fontaine[88] has also reported it from the Shasta series of California upon the basis of a twig of very doubtful identity. In fact, so far as satisfactory identification of the species is concerned, its distribution in America, outside of Alaska, appears to be restricted to the Lower Cretaceous of Greenland and the basal Upper Cretaceous of the eastern United States; although it is also recorded from the Kootenai formation (Lower Cretaceous) of Montana by Knowlton[89] and the Neocomian of Mexico by Nathorst[90]; but I

[85] White, David, Am. Jour. Sci., 3d ser., vol. 39, p. 97, pl. 2, figs. 2, 3, 1890.

[86] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, pp. 245, 246, pl. 118, figs. 2, 2a; pl. 120, figs. 1–2a, 3–6a; pl. 127, figs. 5, 5a; pl. 132, figs. 3, 3a, 1889.

[87] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 449, pl. 78, figs. 1–7, 1911; Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol, Survey Prof. Paper 112, p. 66, pl. 6, figs. 3, 4, 1919.

[88] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 264, pl. 69, fig. 6, 1905.

[89] Knowlton, F. H., Smithsonian Misc. Coll., vol. 50, p. 126, 1907.

[90] Nathorst, A. G., Versteinerungen aus dem mexicanischen Staat Oaxaca, in Felix, J., and Lenk, H., Beiträge zur Geologie und Paläontologie der Republik Mexico, pt. 2, no. 1, p. 51, figs. 1–3, Leipzig, 1893.

have not seen the specimens upon which either of these records was based.

Localities: Yukon River, north bank, immediately above Pickart's mine (original No. 3AH15b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3255) (pl. 20, figs. 1a, 2, 3, 6, 7). Yukon River, north bank, about 16 miles above Kaltag (original No. 3AH25); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3264) (pl. 20, figs. 4a, 5).

Sequoia fastigiata (Sternberg) Heer

Plate 21, Figures 1–4

Sequoia fastigiata (Sternberg) Heer, Beiträge zur Kreide-Flora; I, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, p. 11, pl. 1, figs. 10, 10b, 11, 11b, 12, 12c, 13, 1869.

Caulerpites fastigiatus Sternberg (?), Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, vol. 2, p. 23, Prag, 1838.

Whatever may be thought of Heer's reference of this species to Sternberg's *Caulerpites fastigiatus* there can be but little doubt that our specimens are specifically identical with the specimen shown in Heer's Figure 10 under the name *Sequoia fastigiata*, from the Cenomanian of Moravia; and if all the diverse forms that have been identified from time to time with the species actually belong there its distribution in the New World would include the Atane and Patoot beds of Greenland, the Dakota sandstone of Kansas, the Magothy (?) formation of Marthas Vineyard, Mass., and the Tuscaloosa formation of Alabama. The foliage varies considerably in size, according to the position of the twig or branch on which it is borne. On the ultimate twigs, as may be seen in the specimen depicted in Figure 4, Plate 21, the leaves are very fine and delicate, but on the lower twigs and supporting branches, as shown in Figures 1–3 on the same plate, they are larger and are hardly to be distinguished from similar remains of *Sequoia concinna* Heer, the species next described, with which they occur in several of the collections.

Localities: Yukon River, north side, about 10 miles above Nulato (original No. 2AC249); collected by A. J. Collier and Sidney Paige in 1902 (lot No. 2964) (pl. 21, fig. 1). Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249) (pl. 21, figs. 2–4).

Sequoia concinna Heer

Plate 22, Figures 6–8; Plate 27, Figures 1–3

Sequoia concinna Heer, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 13, pl. 49, figs. 8b, 8c; pl. 50, fig. 1b; pl. 51, figs. 2, 3, 3b, 4–10; pl. 52, figs. 1–3; pl. 53, fig. 1b, 1883.

Numerous remains that are apparently referable to this species are abundant in several of the collections from the Yukon River region. The specific identity of some of these can hardly be questioned, but others are difficult to differentiate from certain closely allied species such as *S. fastigiata* and *S. reichenbachi*, both of which are represented in the same and other collections from the region.

Sequoia concinna was originally described by Heer from the Patoot beds of Greenland and has been identified by Berry[91] from the Upper Cretaceous (Bingen sand) of Arkansas and the Magothy formation of New Jersey.[92] A cone from the Magothy (?) formation of Marthas Vineyard, Mass., was also provisionally referred to the species by Hollick.[93]

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 22, fig. 6). Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 22, figs. 7, 8; pl. 27, fig. 3). Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249) (pl. 27, fig. 1). Yukon River, north bank, at Pickart's mine (original No. 26), collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638) (pl. 27, fig. 2).

Sequoia reichenbachi (Geinitz) Heer

Plate 22, Figures 3–5; Plate 27, Figure 4

Sequoia reichenbachi (Geinitz) Heer, Flora fossilis arctica, vol. 1, p. 83, pl. 43, figs. 1d, 2b, 5a, 5d, 5dd, 8, 8b, 1868.

Araucarites reichenbachi Geinitz, Characteristik der Schichten und Petrefacten des sächsisch-böhmischen Kreidegebirges, pt. 3, p. 98, pl. 24, fig. 4, Dresden and Leipzig, 1842.

The variety of forms that have been included under this specific name, ranging in age from Jurassic to Tertiary, renders impossible any critical comparison and discussion of our fragmentary specimens. Their reference to the species is to be regarded merely as the most convenient disposition that could be determined for them. They may be identified more or less satisfactorily with a number of Cretaceous forms of the species. A specimen collected at Bishop Rock, Yukon River (pl. 22, fig. 5), identified by Knowlton[94] as *Sequoia subulata* Heer (misprinted "*subalata*") proves to be more satisfactorily identifiable as *Sequoia reichenbachi*.

Localities: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903

[91] Berry, E. W., Torrey Bot. Club Bull., vol. 44, p. 172, pl. 7, figs. 1, 2, 1917.

[92] Idem, figs. 3–5.

[93] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 43, pl. 2, fig. 41, 1906.

[94] Knowlton, F. H., in Eakin, H. M., The Yukon-Koyukuk region, Alaska: U. S. Geol. Survey Bull. 631, p. 48, 1916.

(lot 3248) (pl. 22, figs. 3, 4; pl. 27, fig. 4). Yukon River, north bank, at Bishop Rock (original No. 24); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4637) (pl. 22, fig. 5).

Sequoia rigida Heer?

Plate 19, Figure 7a; Plate 25, Figure 7

Sequoia rigida Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, pp. 80, 91, 102, 128, pl. 22, figs. 5g, 11a; pl. 25, fig. 6; pl. 27, figs. 8a, 9a, 9b, 10, 11, 12a, 13, 14, 1874.

These fragmentary specimens are referred provisionally to this species. They agree in general characters with Heer's figures of specimens from the Kome and Atane beds of Greenland quite as satisfactorily as certain specimens from the Potomac group of Virginia and Maryland, referred to the species by Fontaine [95] and Berry.[96] It appears to be probable that in any critical revision of the genus a considerable rearrangement of this and other species of similar leaf characters (*S. smittiana* Heer, *S. subulata* Heer, etc.) would result.

Localities: Port Moller, 2 miles up the canyon, west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 19, fig. 7a). Yukon River, north bank, about 16 miles below Melozi telegraph station (original Nos. 3AH14, 3AH14a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3251) (pl. 25, fig. 7).

Sequoia rigida spinifolia Hollick, n. var.

Plate 22, Figures 1, 2

Branches and twigs with relatively sparse, rigid, narrow acicular leaves on the ultimate twigs, and shorter, thicker leaves at the bases of the twigs and on the supporting branches.

These specimens represent a form in which the leaves are intermediate in character between *Sequoia rigida* Heer [97] and *Sequoia spinosa* Newberry.[98] The former is a species well represented in the Kome and Atane beds of Greenland, and the latter is based upon a single fragmentary specimen, presumably of Tertiary age, from Cook Inlet, Alaska. Our specimens closely resemble Newberry's figure of the leafy twigs, but inasmuch as the species is known to me only by Newberry's description and figure, and as it has not been recorded from elsewhere than the type locality, its specific status and identity appear to be more or less uncertain. Except that the leaves in our specimens are more sparse or more widely spaced than in *Sequoia rigida*, they might be regarded as specifically identical, as may be appreciated by comparison with Heer's Figures 9a and 10 on Plate 27, and varietal relationship, at least, may be properly indicated in the name adopted. The possible status of our specimens in relation to Newberry's species must, for the present, remain a matter of individual opinion.

Locality: Yukon River, north bank, 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642).

Sequoia subulata Heer?

Plate 25, Figures 8, 9

Sequoia subulata Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 102, pl. 27, figs. 3b, 7a, 7b, 8b, 15a; pl. 28, figs. 3, 4, 4b, 4c, 5, 6a, 6b; pl. 29, figs. 2c, 7b, 1874; Die fossile Flora Grönlands, erster Theil: Idem, vol. 6, pt. 2, p. 54, pl. 5, fig. c; pl. 8, fig. 8; pl. 12, fig. 3; pl. 17, figs. 1, 2, 2b, 9b, 1882.

These specimens are too poorly preserved for positive identification, but they agree in general characters with most of Heer's figures of the species, in which he includes a considerable variety of forms.

Fragmentary specimens from the Potomac group of Virginia are referred to the species by Fontaine,[99] but the identity of these is no more conclusive than that of the Alaskan specimens.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Sequoia obovata Knowlton

Plate 25, Figures 10–12; Plate 29, Figure 2b

Sequoia obovata Knowlton, Flora of the Fruitland and Kirtland formations: U. S. Geol. Survey Prof. Paper 98, p. 333, 1916; Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 250, pl. 30, fig. 7, 1917.

These specimens are almost certainly referable to the Upper Cretaceous species to which Knowlton gave the above name in order to differentiate it, stratigraphically, from *Sequoia brevifolia* Heer,[1] from the Tertiary of Greenland, a species to which certain specimens from the western United States were referred by

[95] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 246, pl. 118, figs. 3, 3a; pl. 121, figs. 2, 2a; pl. 126, figs. 2, 2a; pl. 130, figs. 3, 3a, 1889.

[96] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 447, pl. 78, fig. 8, 1911.

[97] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, pp. 80, 91, 102, 128, pl. 22, figs. 5g, 11a; pl. 25, fig. 6; pl. 27, figs. 8a, 9a, 9b, 10–12, 12a, 13, 14; pl. 38, figs. 9a, 10, 11, 1874.

[98] Newberry, J. S., U. S. Nat. Mus. Proc., vol. 5, p. 504, 1882 [1883]; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 21, pl. 53, figs. 4 (5?), 1898.

[99] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 245, pl. 117, figs. 7, 7a; pl. 118, figs. 5, 5a, 6, 6a, 1889.

[1] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 93, pl. 2, fig. 23, 1868.

Lesquereux.[2] The two species resemble each other very closely, and it is questionable whether or not they are specifically different: and the broader leaves of *Sequoia obovata* are also very difficult to distinguish from *Sequoia cuneata* (Newberry) Newberry,[3] from the Upper Cretaceous of Vancouver Island.

Whatever the ultimate taxonomic determination of these three so-called species may be, there can be no question of the specific identity of our specimens with those figured by Knowlton from the Vermejo formation of southeastern Colorado under *S. obovata* and from the Montana group of Wyoming under *S. brevifolia*.[4]

Localities: Coal Creek, right branch, 200 feet above forks, Herendeen Bay, Alaska Peninsula; collected by Sidney Paige in 1905 (lot 3709) (pl. 25, fig. 10). Pavlof Bay, east side, about 50 miles west of Portage Bay, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189) (pl. 25, fig. 11). Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297) pl. 25, fig. 12; pl. 29, fig. 2b).

Cones of Sequoia sp.

Plate 20, Figures 8–9; Plate 23, Figures 1–10

Immature, mature, and more or less disintegrated cones are present in most of the collections from the Yukon River region that contain the leafy twigs and branches of one or another of the species of *Sequoia* described in the preceding pages; but it is very difficult to identify any of them satisfactorily with any particular species.

Figure 8 on Plate 20 apparently represents a branch with immature cones and without any leaves by which it might be identified, and it may belong to some coniferous genus other than *Sequoia*.

Figure 9 on the same plate represents a branch with old, partly disintegrated cones, relatively small in size, and a few obscurely defined leaves, both of which are suggestive of *S. fastigiata* (Sternberg) Heer.

Figures 1 and 8 on Plate 23 are included in the same collection with the leafy twigs represented by Figures 7 and 8 on Plate 22, which are referred to *S. concinna* Heer; and in connection with Figure 1 may be seen some fragmentary remains of leafy twigs that might be provisionally referred to that species.

Figures 2 and 3 on Plate 23 possess no distinctive features by means of which they may be satisfactorily differentiated from the specimens last mentioned.

Figures 4–7 on Plate 23 are included in the collection that contains the leafy twigs represented by Figures 3 and 4 on Plate 22 and Figure 4 on Plate 27, referred to *S. reichenbachi* (Geinitz) Heer; and in connection with the cones in Figures 4 and 6 may be seen fragmentary leafy twigs that are somewhat suggestive of that species.

Figure 9 on Plate 20 is included in the same collection with the leafy twigs represented by Figures 2–4 on Plate 21, referred to *S. fastigiata;* but the leaves attached to the branch that supports the cone are more like those of *S. concinna.*

Figure 10 on Plate 23 is from the same collection that contains the leafy twigs represented in Figure 6 on Plate 22, referred to *S. concinna.*

The difficulty of any attempt to identify these cones definitely with those of described species of *Sequoia*, unless they are found actually attached to leafy twigs, may be appreciated by comparing them with certain of the published figures of *S. fastigiata*,[5] *S. concinna*,[6] and *S. reichenbachi*,[7] many of which appear to be specifically interchangeable.

If specimens should be found in which cones are definitely associated with identifiable foliage a differentiation of our figured specimens into recognized species might be feasible; but under existing conditions any such attempt would be purely arbitrary.

Localities: Yukon River, north bank, about 3 miles above Kaltag (original No. 3AH28); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3267) (pl. 20, fig. 8). Yukon River, north bank, just above Pickart's mine (original No. 3AH18a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3254) (pl. 20, fig. 9). Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 23, figs. 1, 8). Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262) (pl. 23, figs. 2–3). Yukon River, north bank, about 12 miles below Melozi

[2] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Bull., vol. 1, p. 365, 1875 [1876]; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 78, pl. 61, figs. 25–27, 1878.

[3] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 18, pl. 14, figs. 3–4a, 1898 (=*Taxodium cuneatum* Newberry, Boston Jour. Nat. Hist., vol. 7, p. 517, 1863).

[4] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 27, pl. 4, figs. 1–4, 1900.

[5] Heer, Oswald, Beiträge zur Kreide-Flora; I, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, pl. 1, figs. 12, 13, 1869; Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, pl. 3, figs. 8, 9; pl. 41, fig. 5, 1882; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, pl. 51, fig. 11, 1883. Lesquereux, Leo, U. S. Geol. Survey Terr. Ann. Rept. for 1874, p. 335, pl. 3, fig. 2, 1876. Velenovsky, Josef, Die Gymnospermen der böhmischen Kreideformation, pl. 8, fig. 13; pl. 9, fig. 3; pl. 11, fig. 1, Prag, 1885.

[6] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, pl. 51, figs. 2, 3 in part, 3b, 4–8, 10, 1883.

[7] Heer, Oswald, Beiträge zur Kreide-Flora; I, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, pl. 1, figs. 1–5, 1869.

telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 23, figs. 4–7). Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249) (pl. 23, fig. 9). Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 23, fig. 10).

Genus SPHENOLEPIS Schenk

Sphenolepis sternbergiana (Dunker) Schenk

Plate 25, Figures 1–6

Sphenolepis sternbergiana (Dunker) Schenk, Palaeontographica, vol. 19, p. 243, pl. 37, figs. 3, 4; pl. 38, figs. 3–13, 1871.

Muscites sternbergianus Dunker, Monographie der norddeutschen Wealdenbildungen, p. 20, pl. 7, fig. 10, Braunschweig, 1846.

Whatever may be thought of the identity of our specimens with the species as originally described by Dunker from the Wealden of northern Germany, there can be no doubt that they are specifically identical with many specimens subsequently referred to the species, from time to time, by other authorities.

Under the name *Sphenolepidium sternbergianum* var. *densifolium* a number of specimens are figured by Fontaine [8] from the Potomac group of Virginia, certain of which (pl. 118, fig. 7; pl. 121, fig. 9; pl. 131, fig. 3) are undoubtedly identical with our specimens from Alaska; and more recently, under the name *Sphenolepis sternbergiana* (Dunker) Schenk, the species was described and figured by Berry [9] from the same group and State and also listed from Maryland and the District of Columbia. Berry includes Fontaine's variety and several species of other genera under the one specific designation and discusses the status of the species rather fully. The specimens he figures appear, unquestionably, to be specifically identical with the Alaskan specimens.

A somewhat doubtful specimen from the Shasta series of California is referred to the species by Fontaine; [10] but it appears to be probable that the species is actually represented under the name *Sphenolepidium oregonense* Fontaine,[11] from the Jurassic of Oregon.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 2AC266); collected by A. J. Collier and Sidney Paige in 1902 (lot 2984) (pl. 25, figs. 1–4). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 25, figs. 5–6).

Genus TAXODIUM L. C. Richard

Taxodium sp. Knowlton

Taxodium sp. Knowlton, in Harrington, The Anvik-Andreafski region, Alaska: U. S. Geol. Survey Bull. 683, p. 33, 1918.

Certain coniferous remains, listed by Knowlton as representing a species of *Taxodium*, associated with leaves of *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun, may possibly be referable to *Taxodium* (*Glyptostrobus*) *virginicum* Fontaine,[12] from the Lower Cretaceous (Potomac group) of Virginia; but this species is difficult to distinguish from certain of the leaf forms of *Glyptostrobus grönlandicus* Heer (see below), which is represented in several of the collections from the lower Yukon Valley, and there is a possibility that the specimens identified as *Taxodium* may be referable to that species. The genus *Taxodium* is more commonly associated with Tertiary than with Cretaceous floras.

Locality: Andreafski River, east bank, 9.2 miles northeast of Andreafski (original No. 136); collected by G. L. Harrington in 1916 (lot 7259; erroneously given as 7250 in Bull. 683).

Genus GLYPTOSTROBUS Endlicher

Glyptostrobus grönlandicus Heer

Plate 10, Figure 3c; Plate 24, Figure 2; Plate 26, Figures 1–4

Glyptostrobus grönlandicus Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 76, pl. 17, fig. 9; pl. 20, figs. 9, 10a; pl. 22, fig. 12, 1874.

The heterophyllous character of this species is well exemplified in Heer's Figure 9 on Plate 20, and by our Figure 2 on Plate 26, which also includes an immature fruiting twig. The leaves of our specimens appear to be somewhat narrower throughout than in Heer's figures; but the differences between them are too insignificant to warrant anything more than a possible varietal distinction, in any event.

The species is also recorded by Dawson [13] from the Kootenai formation of the Canadian Rocky Mountain region, which is about the equivalent of the Kome beds of Greenland from which Heer's specimens were obtained.

Localities: Yukon River, north bank, 5 miles above Louden station (Nahochatilton) (original No. 22);

[8] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 261, pl. 118, fig. 7; pl. 121, figs. 5–5b, 7, 7a, 9, 9a; pl. 125, figs. 2, 2a; pl. 129, figs. 3, 3a; pl. 130, figs. 1, 1a; pl. 131, figs. 1–1c, 3, 3a; pl. 132, fig. 4, 1889.

[9] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 435, pl. 75, figs. 1, 2, 1911.

[10] Fontaine, W. M., in Ward, L. F., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 264, pl. 69, fig. 7, 1905.

[11] Idem, p. 133, pl. 36, figs. 3–8.

[12] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 252, pl. 121, fig. 6, 1889.

[13] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 9, pl. 3, fig. 8, 1885 [1886].

collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635) (pl. 10, fig. 3c). Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638) (pl. 24, fig. 2). Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262) (pl. 26, figs. 1–4).

Glyptostrobus specialis Hollick, n. sp.

Plate 24, Figures 3–6

Slender, leafy, heterophyllous twigs; leaves linear, linear lanceolate, and aciculate, acute at both ends.

Certain of these specimens, such as the one represented by our Figure 3, closely resemble the long-leaved forms of *Glyptostrobus ungeri* Heer;[14] but in none of our specimens is there any indication of the scalelike leaves that are a characteristic feature of this and other allied species.

Localities: Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 24, fig. 3). Yukon River, north bank, about 10 miles below Blatchford's mine (original No. 3AH23); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3262) (pl. 24, figs. 4–6).

Glyptostrobus? sp.

Plate 24, Figure 7

Leafy and defoliated twigs and detached leaves; leaves mostly lanceolate, aciculate, sessile.

These remains occur massed in layers, mostly in the form of broken twigs and detached leaves. Essential characters necessary for satisfactory generic identification are lacking; but a general resemblance to *Glyptostrobus* may be noted, especially to the short-leaved forms of *Glyptostrobus ungeri* Heer from the Tertiary of Colorado as figured by Lesquereux.[15] In none of our remains, however, is there any indication of the scalelike leaves that are commonly present in connection with the twigs and branchlets of *G. ungeri*.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Class ANGIOSPERMAE

Subclass MONOCOTYLEDONAE

Order LILIALES

Family SMILACACEAE

Genus SMILAX Linnaeus

Smilax herendeenensis Hollick, n. sp.

Plate 27, Figure 7

Leaf short petiolate, ovate-acuminate, entire, about 6 centimeters in length by 4 centimeters in maximum width, tapering to the apex, rounded to a broad, truncate-cuneate base; nervation acrodrome from the base, consisting of a straight midrib and two pairs of curved lateral primaries, the inner pair simple, the outer pair simple below, somewhat looped above; secondary nervation parallel and at right angles to the primary nerves throughout.

This is a parallel-veined leaf apparently referable to some monocotyledonous genus such as *Smilax*. The primary nervation is all of approximately equal rank, and the secondary nervation is uniform throughout. I have been unable to find any described species with which it may be satisfactorily compared.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Order ZINGIBERALES

Family ZINGIBERACEAE

Genus ZINGIBERITES Heer

Zingiberites alaskensis Hollick, n. sp.

Plate 27, Figure 8

Leaf of unknown size and shape; nervation pinnate, parallel; midrib strong; secondary nerves fine, simple, all of same rank, approximately 1 millimeter apart.

This species has been found only in fragments, but these possess well-defined characters that show them to be leaves of a monocotyledonous plant resembling the Tertiary species *Cannophyllites antiquus* Unger,[16] from Croatia, except that the nervation in this species is more ascending than in ours. The secondary nerves in our species apparently start at right angles from the midrib, then, at a short distance away, curve sharply and straighten out to a more or less horizontal position, similar to this character of the nervation in *Musophyllum complicatum* Lesquereux,[17] from the Eocene of Wyoming. Fragmentary remains of this species from the Miocene of the Yellowstone National Park, that show the same character, are also described and figured by Knowlton.[18] In other respects, however, the nervation differs from ours. In Lesquereux's specimens the nerves are often forked near the midrib, and in Knowlton's they are indicated as of two ranks, while in our specimens they are apparently simple and uniform throughout. In two places only are there obscure indications of forking or coalescing of the nerves—in each place at a considerable distance from the midrib and presenting the appearance of an incidental rather than a characteristic feature.

So far as I am aware the only plant remains of similar character heretofore reported from any Creta-

[14] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 52, pl. 18, figs. 5, 6, Winterthur, 1855.

[15] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, pl. 22, fig. 2, 1883.

[16] Unger, Franz, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 29, p. 15 (139), pl. 1, fig. 2, 1868.

[17] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1873, p. 418, 1874; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 96, pl. 15, figs. 1–6, 1878.

[18] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 686, pl. 83, fig. 1, 1899.

ceous deposits are *Cannophyllites septentrionalis* Nilsson,[19] from Sweden, and *Canna? magnifolia* Knowlton,[20] from the Vermejo formation of southeastern Colorado. The species that apparently resembles ours more closely than any of the others, however, is *Zingiberites undulatus* Heer,[21] from the Miocene of the Baltic provinces, with which at least generic relationship can hardly be questioned.

Locality: Yukon River, north bank, at Williams mine (original No. 2AC284); collected by A. J. Collier and Sidney Paige in 1902 (lot 2985).

Subclass DICOTYLEDONAE

Division CHORIPETALAE

Order PIPERALES

Family PIPERACEAE

Genus PIPER Linnaeus

Piper arcuatile Hollick, n. sp.

Plate 31, Figures 1, 2

Leaves ovate-elliptical, inequilateral, 6 centimeters in length by 3.75 centimeters in maximum width across the middle, constricted above to an acuminate apex, rounded below and terminating in a short, acute, slightly decurrent base; margin entire; petiole 1 centimeter in length, curved; midrib curved in continuation of the petiole; nervation palmate; secondary nerves two on each side, starting from the base of the leaf at acute angles of divergence from the midrib, the inner pair acrodrome, stronger than the outer pair, branched on the outer sides, the branches curving upward and becoming camptodrome with the outer secondaries.

It was more or less of a surprise to find what is apparently a well-defined species of *Piper* in two of the collections from Alaska. Only two species of the genus have been heretofore reported from America—namely, *Piper heerii* Lesquereux,[22] from the Eocene of Colorado, and *Piper* sp. Knowlton,[23] from the Eocene of Washington. Unfortunately neither species is figured, but it may be of interest to compare Lesquereux's description of his species with the description of ours. He says:

> Leaves subcoriaceous, round or oval, very entire, palmately nerved from the base; lateral nerves very curved, the outer following the borders up to the middle of the leaf, the inner acrodrome. * * * The nerves are distinct; the outer primary follows the borders at a small distance, its branches, nearly at right angles, forming, by anastomosing curves, a series of areoles along the borders from the middle downward, and the areas are traversed by nervilles at right angles.

Two species have been reported from the Old World—*Piper antiqua* Heer, from the Tertiary (Eocene?) of Sumatra, and *P. feistmantelli* Ettingshausen, from the Eocene of Australia; but neither of these has a specific resemblance to ours.

Under the allied genus *Piperites* have been described three species from the Eocene of Java and one, *Piperites tuscaloosensis* Berry,[24] from the Upper Cretaceous of Alabama; the latter might almost equally well be referred to the genus *Piper*.

Our Figure 1, it may be noted, includes fragments of three leaves, one of which represents a long, narrow, acute apex, considerably more attenuated than is the apex of the specimen depicted in Figure 2, suggesting the possibility that these fragments may represent another species.

Localities: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258) (pl. 31, fig. 1). Yukon River, north bank, about 6 miles below Blatchford's mine (original No. 3AH22); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3261) (pl. 31, fig. 2).

Order SALICALES

Family SALICACEAE

Genus POPULUS Linnaeus

Populus hyperborea Heer?

Plate 29, Figure 5b

Populus hyperborea Heer, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 106, pl. 27, fig. 8d; pl. 29, figs. 6, 7a, 8a, 9; pl. 30, fig. 2b, 1874; Die fossile Flora Grönlands, erster Theil: Idem, vol. 6, pt. 2, p. 64, pl. 17, figs. 6, 7; pl. 21, fig. 1a, 1882.

This specimen is probably referable to a small form of this polymorphous species or, possibly, to a similar form of the equally variable *Populus berggreni* Heer.[25]

Specimens from the Dakota sandstone of Kansas, referred to *Populus hyperborea* Heer by Lesquereux,[26] compare satisfactorily with ours except in their larger size, and there appears to be but little doubt of their

[19] Nilsson, S., K. svenska Vet. Akad. Handl., 1831, p. 346, pl. 1, fig. 9, 1832.

[20] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 254, pl. 36, fig. 3, 1917.

[21] Heer, Oswald, Miocene baltische Flora: Beitr. Naturk. Preuss., p. 64, pl. 17, figs. 1–3, Königsberg, 1869.

[22] Lesquereux, Leo, Harvard Coll. Mus. Comp. Zoology Bull., vol. 16, No. 3 (Geol. series, vol. 2), p. 44, 1888.

[23] Knowlton, F. H., Washington Geol. Survey Ann. Rept., vol. 1, p. 33, 1902.

[24] Berry, E. W., Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 72, pl. 12, fig. 3, 1919.

[25] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 106, pl. 29, figs. 1, 2a, 3–5, 1874; Die fossile Flora Grönlands, erster Theil: Idem, vol. 6, pt. 2, p. 63, pl. 17, fig. 8a; pl. 18, figs. 1–4, 4a, b, 9a, 10a; pl. 19, fig. 1a; pl. 40, fig. 7a; pl. 41, fig. 1; pl. 45, fig. 12, 1882.

[26] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 43, pl. 3, figs. 9–11 [excluding pl. 8, fig. 1, and pl. 47, fig. 5], 1892.

mutual specific identity, whatever may be thought of their reference to Heer's species.

It is also recorded by Berry [27] from the Tuscaloosa formation of Alabama, in connection with which he says: "The species is represented by considerable material * * * that is obviously identical with that from Kansas, with which comparisons can be made much more conclusively than with the figures of the Greenland specimens." Unfortunately, however, none of the material is figured.

Locality: Port Moller, 2 miles up the canyon west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187).

Populus pseudostygia Hollick, n. sp.

Plate 31, Figure 7

Leaf ovate, slightly irregular in outline, entire or minutely denticulate, 2.75 centimeters in length by 2.5 centimeters in maximum width, tapering above to a blunt apex, rounded below to a broad, cuneate base; midrib curved, slender; nervation fine, craspedodrome(?), tripalmate with an exterior pair of basilar nervilles; lateral primaries ascending, irregularly branched on the outer or under sides; secondary nervation obscurely defined, merging into the tertiary nervation and forming a network of irregular areolae with fine nervilles terminating in the margin.

This leaf is somewhat peculiar in the manner in which the primary, secondary, and tertiary nerves merge into one another, in this respect resembling certain of the smaller leaves of *Populus stygia* Heer,[28] from the Cretaceous Atane beds of Greenland. In fact, if it were not that that species is described and figured as cordate at the base our specimen might be regarded as identical with it, especially when compared with Heer's Figure 6, in which the nervation is distinctly tripalmate, as in ours, thus differing from all the other specimens included in the species by Heer; and a similar form is also figured by Lesquereux [29] from the Dakota sandstone of Kansas. Our specimen, however, appears to be minutely denticulate, with the ultimate nervation craspedodrome, but these characters are very obscure, and they may be more apparent than real and due to the granular character of the matrix. In any event, our species may at least be regarded as closely allied to the small forms of *Populus stygia.*

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

[27] Berry, E. W., Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 77, 1919.

[28] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 64, pl. 18, figs. 6–8, 1882.

[29] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, pl. 3, fig. 12, 1892.

Populus elliptica Newberry

Plate 31, Figure 5

Populus elliptica Newberry, Lyceum Nat. Hist. New York Annals, vol. 9, p. 16, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 43, pl. 3, figs. 1, 2, 1898.

This specimen is apparently merely a small form of the species from the Dakota sandstone of Nebraska described by Newberry, although it may also be compared with the orbicular forms of *Populus cyclomorpha* Knowlton and Cockerell,[30] from the Eocene of the western United States, in regard to which Newberry [31] remarks:

> They present, however, a marked resemblance to those [poplars] described and figured in this report under the names of *P. elliptica* and *P. flabellum*, one from the Dakota group of Kansas, the other from the Upper Cretaceous of Orcas Island on the northwest coast, and *P. cuneata* from the Tongue River Tertiary.

Populus elliptica has not been heretofore recorded from elsewhere than the type locality in Nebraska.

Locality: Coal mines in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Populus pseudoelliptica Hollick, n. sp.

Plate 31, Figure 6

Leaf petiolate, ovate-elliptical, broadest in lateral dimension, 4.5 centimeters in length, exclusive of the petiole, by 6 centimeters in width across the middle, slightly curved to the apex, rounded to the truncate base; margin crenulate-dentate above, entire below; nervation tripalmate, campto-craspedodrome; lateral primaries basilar, ascending, flexed or angled, with forking branches extending outward from the angles, the branches forked and connected by cross nervation, forming irregular loops near the margin with short, ultimate nervilles that extend from the loops and terminate in the crenulations; secondary nerves weak, four on each side, irregularly spaced and arranged, subtending obtuse angles with the midrib, merging into the tertiary nervation and forming a network of polygonal areolae with fine, short nervilles on the outer borders that extend to and terminate in the adjacent marginal crenulations.

This species belongs, biologically, in the same group as *Populus glandulifera* Heer,[32] in part, and *Populus hookeri* Heer,[33] both of which, however, are Tertiary

[30] Knowlton, F. H., and Cockerell, T. D. A., in Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 487, 1919 (=*Populus rotundifolia* Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 506, 1882 [1883]; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 51, pl. 29, figs. 1–4, 1898. Not *Populus rotundifolia* Griffith, 1847).

[31] Newberry, J. S., op. cit. (Mon. 35), p. 52.

[32] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 17, pl. 58, figs. 5–11; pl. 63, fig. 7, Winterthur, 1856.

[33] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 137, pl. 21, figs. 16, 16b, 1868.

species. Four diverse forms, from the Fort Union formation of Montana, referred to *P. glandulifera*, are depicted by Ward,[34] one of which (fig. 1) has tripalmate nervation like ours but a different outline, while another (fig. 2) is almost identical in outline with ours but has quinquepalmate nervation.

The Cretaceous species to which our specimen appears to be most closely related is *Populus elliptica* Newberry,[35] from the Dakota sandstone of Nebraska; but our species is broader and has a truncate instead of a more or less cuneate base.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Populus praelatior Hollick, n. sp.

Plate 31, Figures 8, 9

Leaves broadly deltoid, denticulate, 4 centimeters in length by 4 centimeters in width across the expanded lower part, rather abruptly narrowed above to an apiculate apex, rounded below to a truncate or broad-cuneate base; nervation tripalmate from the base, campto-craspedodrome; lateral primaries spreading, curved upward, branched from the under sides, the branches subhorizontal, camptodrome a short distance from the margin, with fine nervilles extending to the denticulations; secondary nerves alternate, subtending obtuse angles with the midrib and curving upward.

This species belongs to the general type of leaf represented by *Populus latior* Alex. Braun and its varieties, as depicted by Heer[36] from the Tertiary of Switzerland. From these our species differs mostly in the minor characters of smaller size and finer denticulations, and it is impossible to escape the conviction that they are very closely related, specifically as well as generically.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

Genus POPULITES Viviani, 1833; Goeppert, 1852; Lesquereux emend., 1874[37]

The genus *Populites* was founded by Viviani[38] in 1833, upon a palmately 5-nerved leaf. The name *Populites* was also utilized by Goeppert[39] in 1852 as a new generic term, founded upon a pinnately nerved leaf. Apparently Goeppert was not aware of the previous use of the name by Viviani, and a comparison of the two generic types, with their accompanying descriptions, appears to preclude the possibility that Goeppert could have intended to include them in the same genus. The name, therefore, should be credited to Viviani by reason of priority of publication and, if strictly applied, should include only leaves with basilar, quinquepalmate nervation and be referred to the section of the genus *Populus* with palmately nerved leaves.

Massalongo[40] in 1858, also apparently unaware of Viviani's prior description of the genus *Populites*, credited it to Goeppert and under it described a new species, *P. gasparinii*, with pinnate nervation.

Lesquereux, in 1874, amended the generic description and enlarged it so as to include both palmate and subpinnate nerved leaves, but made no mention of either Viviani or Goeppert and erroneously credited the genus to Massalongo, although Massalongo himself had credited the genus to Goeppert.

In view of these facts, and under a strict interpretation and application of the rules of nomenclature, it may be contended that the generic name *Populites* should be credited to Viviani and relegated to synonymy under the genus *Populus*, and that a new name should be adopted for the genus defined by Goeppert and amended by Lesquereux; but the name has become so familiar in American paleobotanic literature, in connection with a number of well-known species of leaves, some of which have been from time to time referred to other genera, that considerable confusion would result if a new name were to be added to those already in use. Under the circumstances, therefore, the name *Populites* is here retained for the genus as separately defined by Viviani and Goeppert and amended by Lesquereux.

Populites pseudoelegans Hollick, n. sp.

Plate 35, Figure 2

Leaf about 10 centimeters in length by 14 centimeters in width, orbicular-reniform, with a rounded, curved, truncate base and broadly triangular-dentate margin; nervation pinnate-tripalmate, craspedodrome; midrib straight, thickened below; secondary nerves opposite, leaving the midrib at acute angles of divergence on one side and at obtuse angles on the other, the lowest pair suprabasilar, simulating lateral primaries, with branches on the under sides.

[34] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 550, pl. 33, figs. 1–4, 1886.

[35] Newberry, J. S., Lyceum Nat. Hist. New York Annals, vol. 9, p. 16, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 43, pl. 3, figs. 1, 2, 1898.

[36] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 11, pl. 53, figs. 1, 7; pl. 54, figs. 2, 6; pl. 55, figs. 1–4; pl. 56, figs. 1–8; pl. 57, figs. 2, 3, 6, 7, Winterthur, 1856.

[37] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 58, pl. 3, fig. 1, 1874. (Type, *Populites lancastriensis* (Lesquereux) Lesquereux, op. cit.=*Populus lancastriensis* Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 93, 1868.)

[38] Viviani, Vincente, Lettre de M. le Professeur Viviani à M. Pareto, sur les restes des plantes fossiles trouvés dans les gypses tertiaires de la Straddella, près Pavie: Soc. géol. France Mém., vol. 1, No. 7, p. 133 (5), pl. 10 (B), fig. 2 (type *P. phaetonis*), 1833.

[39] Goeppert, H. R., Beiträge zur Tertiarflora Schlesiens: Palaeontographica, vol. 2, art. 6, p. 276 (20), pl. 35 (3), fig. 5 (type *P. platyphyllus*), 1852.

[40] Massalongo, Abramo, in Massalongo and Scarabelli, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 250, Imola, 1858 [1859].

This species is very close, specifically, to certain of the forms of *Populites elegans* Lesquereux,[41] from the Dakota sandstone of the western United States, and differs far less from the broad, dentate form represented by Lesquereux's Figure 3, Plate 48, than many of the other diverse forms included by Lesquereux in the species. In fact, it appears impossible that all these forms can be specifically identical.

The exaggerated curvature of the secondary nerves on the right side of our specimen is apparently due to distortion and hence is not recognized as a normal character of the species.

Locality: Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638).

Populites pseudolancastriensis Hollick, n. sp.

Plate 35, Figure 3

Leaf ovate or oblong, slightly asymmetrical, with a broad, shallow, cordate base; margin triangular-dentate above, entire below; nervation pinnate-tripalmate, craspedodrome; secondary nerves widely spaced, subopposite, leaving the midrib at angles of about 40° and 45°; lateral primaries opposite, suprabasilar at a distance of 2 millimeters from the base, unequal in length, leaving the midrib at obtuse angles of divergence, slightly flexed or bent at a distance of about 1.3 centimeters from the midrib, thence ascending more obliquely, irregularly branched on the under sides; basilar veinlets one on each side, extending close to and following the curve of the margin.

This species resembles *Populites lancastriensis* (Lesquereux) Lesquereux [42] very closely, especially the specimen depicted by Lesquereux [43] from the Dakota sandstone of Minnesota. The asymmetry of our leaf, however, is more pronounced than in Lesquereux's figure, and the margin is more distinctly dentate.

As in the other Alaskan species of the genus, the secondaries on one side of the midrib (the right side in our specimen) and the corresponding lateral primary are longer and diverge from the midrib at more acute angles than those on the opposite side, indicating that the apex was more or less oblique.

Locality: Yukon River, north bank, about 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642).

[41] Lesquereux, Leo, Am. Jour. Sci., 2d ser., vol. 46, p. 94, 1868; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 47, pl. 48, fig. 3, 1892; Minnesota Geol. and Nat. Hist. Survey Final Rept., vol. 3, pt. 1, p. 10, pl. A, fig. 2, 1893.

[42] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 58, pl. 3, fig. 1, 1874 (=*Populus lancastriensis* Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 93, 1868).

[43] Lesquereux, Leo, Minnesota Geol. and Nat. Hist. Survey Final Rept., vol. 3, pt. 1, p. 12, pl. A, fig. 4, 1893.

Populites vitiformis Hollick, n. sp.

Plate 34, Figures 2–4

Leaves petiolate, triangular ovate, somewhat asymmetric, with a broad, slightly curved, truncate base and an obtuse, oblique apex; margin dentate; nervation pinnate-tripalmate, craspedodrome; midrib straight; secondary nerves four on each side, subopposite, leaving the midrib at acute angles of divergence, slightly upward curved at the extremities; lateral primaries opposite, suprabasilar, branched on the under sides, one somewhat longer, straighter, and more ascending than the other.

This species has an outline similar to that of *Populites lancastriensis* (Lesquereux) Lesquereux,[44] from the western United States, especially to Lesquereux's Figure 4, Plate A; but ours is more expanded at the base and has a dentate margin. The asymmetry of our species is also a distinguishing feature. The apex is oblique. The secondaries subtend more acute angles with the midrib on one side than on the other, and the basal portion of the leaf on that side is more extended laterally than on the other. These characters give to the leaf an appearance that is suggestive of the genus *Vitis*.

Localities: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 34, fig. 2). Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249) (pl. 34, fig. 3). Yukon River, north bank, about 12 miles below Melozi station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634) (pl. 34, fig. 4).

Populites platanoides Hollick, n. sp.

Plate 34, Figure 5; Plate 36, Figure 3

Leaf about 18 centimeters in maximum width across the middle, with a broad, rounded, truncate base and an irregularly triangular-serrate-dentate margin; nervation tripalmate, craspedodrome; midrib apparently straight, thickened where it merges into the petiole; secondary nerves subopposite or opposite; lateral primaries obscurely subopposite, slightly suprabasilar, branched on the under sides, the upper branches branched, the lower ones simple and simulating the basilar veinlets below.

[44] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 58, pl. 3, fig. 1, 1874; Minnesota Geol. and Nat. Hist. Survey Final Rept., vol. 3, pt. 1, p. 12, pl. A, fig. 4, 1893 (=*Populus lancastriensis* Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 93, 1868).

These fragmentary specimens are strikingly similar to *Platanus? wardii* Knowlton,[45] from the Upper Cretaceous of Montana, especially the basal portion of the leaf represented by our Figure 5, Plate 34, which is almost identical with Knowlton's Figure 4. They each have the same broad, rounded, truncate base with dentate margin and the same abnormally thickened upper part of the petiole. So far as size is concerned a comparison of the figures is misleading, for the reason that Knowlton's figures represent only the smaller leaves, as indicated by the description, in which it is stated that they range from 4 to 11 centimeters in width. The question in connection with the generic reference can not be satisfactorily answered unless more perfect specimens are available for critical examination; but in so far as the visible characters are concerned the specimens depicted might belong to either *Populites* or *Platanus*.

Localities: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier in 1902 (lot 2963) (pl. 34, fig. 5). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634) (pl. 36, fig. 3).

Populites spatiosus Hollick, n. sp.

Plate 32, Figures 1, 2

Leaf reniform-orbicular, about 11 centimeters in length by 19 centimeters in width across the middle, with a broad, curved, truncate base and a blunt apex; margin undulate or triangular-dentate except at the base; nervation tripalmate; secondary nerves four on each side, subopposite below, alternate above, subparallel, leaving the midrib at angles of about 40° and extending almost straight to the margin, the upper ones simple, the lower ones branched toward the extremities, the branches leaving the secondaries at acute angles, the secondaries and their branches craspedodrome; lateral primaries slightly suprabasilar, leaving the midrib at angles of about 45°, curving upward, with one or more branches on the upper sides toward the extremities and six or more on the under sides that subtend acute angles of divergence and are branched toward their extremities in a similar manner, the branches and branchlets craspedodrome; tertiary nervation well defined, bent upward and outward throughout, forming flexed quadrangular and polygonal areolae.

This species, except that the margin is dentate, somewhat resembles the larger forms of *Populites litigiosus* (Heer) Lesquereux,[46] especially his Figure 5 on Plate 8, and it may be identical with the variety *denticulata*,[47] which he names but does not figure, and in connection with which he remarks: "I have seen * * * a number of leaves with dentate borders. * * * They appear to constitute a variety of the species."

Localities: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249) (pl. 32, fig. 1). Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963) (pl. 32, fig. 2).

Populites? captiosus Hollick, n. sp.

Plate 36, Figure 2

Leaf apparently ovate, about 12 centimeters in length by 11 centimeters in width, with a broad, slightly curved, entire, truncate base; margin remotely and bluntly undulate-dentate; nervation tripalmate, craspedodrome; midrib straight, conspicuously thickened below; secondary nerves subparallel, four or more on each side, opposite or approximately so, extending upward at acute angles of divergence from the midrib; lateral primaries subopposite, suprabasilar at a distance of 6 millimeters from the base of the leaf, with branches on the under sides that extend almost horizontally to the margin, the upper ones occasionally forked toward the extremities, the lower one on each side branched on the under side; basilar veinlets simple, two on each side, leaving the midrib at right angles and ultimately bending downward.

This leaf is apparently inequilateral, as indicated by the more oblique angles of divergence of the secondaries on one side of the midrib than on the opposite side. It apparently belongs in the same generic category with the other palmately nerved leaves here referred to *Populites*, and it also has a superficial resemblance to *Platanus* and *Cissus*. An imperfect specimen, however, may present a deceptive appearance, and hence the generic designation is questioned.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634).

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[45] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 14, pl. 2, figs. 1–4, 1900.

[46] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 46, pl. 7, fig. 7; pl. 8, fig. 5; pl. 46, fig. 6; pl. 47, fig. 1, 1892 (=*Populus litigiosa* Heer, in Capellini, J., and Heer, O., Les phyllites crétacées du Nebraska: Soc. helv. sci. nat. Nouv. mém., vol. 22, No. 1, p. 13, pl. 1, fig. 2, 1866).

[47] *Populites litigiosus denticulata* (Lesquereux) Knowlton, A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 482, 1919 (=*Populus litigiosus denticulata* Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 47, 1892).

Populites mirabilis Hollick, n. sp.

Plate 33

Leaf large, of unknown shape and dimensions, coarsely triangular dentate, the teeth broad and blunt, with shallow sinuses between; nervation pinnate(?), craspedodrome; midrib strong; secondary nerves stout, flexuous, widely spaced, arranged in subopposite pairs, those on one side leaving the midrib somewhat more obliquely than those on the opposite side; tertiary nervation relatively fine, consisting of branches from the under sides of the lower secondaries toward the extremities, and curved or angled nervilles that form a network of polygonal areolae throughout the lamina.

This fragment is referred to the genus *Populites* because of the character of the dentition in combination with the apparent asymmetry of the leaf. So far as can be seen the secondary nervation is pinnately arranged throughout, but the basal part of the leaf is missing, and it is possible that the lowest pair of secondaries may have a subpalmate arrangement. The midrib is slightly curved to the left in our specimen, and on that side the secondary nerves subtend more obtuse angles with the midrib than those opposed to them. The latter are more extended, so that the extremity of the third one from the apex occupies about the same relative position as that of the second one on the opposite side, and so on. The indications are that one side of the leaf (the right side in our specimen) was more broadly rounded in outline than the other.

Our specimen is ruptured in three places through the middle, and the adjacent parts are laterally displaced. It is evident that if the midrib were restored to its original condition the curvature would be more pronounced and the asymmetry of the leaf more obvious.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Order MYRICALES

Family MYRICACEAE

Genus MYRICA Linnaeus

Myrica? trifoliata Newberry?

Plate 31, Figure 10

Myrica? trifoliata Newberry, The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 37, pl. 14, fig. 2, 1898.

This species, described and figured by Newberry from the Dakota sandstone of New Mexico, is represented by a trifoliolate leaf, and the generic designation is questioned by the author. In outline and in the marginal characters the leaflets agree very closely with our specimen, which, to judge by the character of its nervation, may properly be regarded as a species of *Myrica*. Unfortunately, however, the nervation is not shown in Newberry's figure, and in the description he merely says "nervation delicate"; hence a comparison of these characters is not feasible. The secondary nervation of the Alaska leaf may be described as simply pinnate, fine, almost straight, subparallel, reticulated toward the extremities, forming elongated polygonal areolae with delicate nervilles extending to the dentitions.

So far as I am aware ours is the only recorded specimen that has been even provisionally referred to or compared with Newberry's species.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

Order JUGLANDALES

Family JUGLANDACEAE

Genus JUGLANS Linnaeus

Juglans arctica Heer

Plate 35, Figures 5, 6

Juglans arctica Heer, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 71, pl. 40, fig. 2; pl. 41, fig. 4c; pl. 42, figs. 1a, 1b, 2a, 2b, 3; pl. 43, fig. 3, 1882.

A considerable variety of leaf forms have been included in this species by Heer and subsequent writers; in fact, Heer's Figure 2, Plate 40, which under the generally accepted rules of nomenclature may be taken as the specific type, differs so widely from the figures that follow that these might be considered specifically distinct.

In one or another of its forms the species has been recognized in the Dakota sandstone of Kansas by Lesquereux;[48] in the Raritan formation of New Jersey by Newberry;[49] in the Magothy formation of Staten Island and Long Island, N. Y., Block Island, R. I., and Marthas Vineyard, Mass., by Hollick;[50] and in the Tuscaloosa and allied formations of Alabama, Georgia, South Carolina, and North Carolina by Berry.[51]

[48] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 68, pl. 19, fig. 3; pl. 39, fig. 5, 1892.

[49] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 62, pl. 20, fig. 2, 1895 [1896].

[50] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 54, pl. 9, figs. 6–8, 1906; New York Bot. Gard. Bull., vol. 8, p. 157, pl. 164, figs. 3–4, 1912.

[51] Berry, E. W., The Upper Cretaceous and Eocene floras of South Carolina and Georgia: U. S. Geol. Survey Prof. Paper 84, p. 30, pl. 8, figs. 1, 2, 1914; Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 73, 1919.

Localities: Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638) (pl. 35, fig. 5). Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635) (pl. 35, fig. 6).

Genus HICORIA Rafinesque

Hicoria duriuscula Hollick, n. sp.

Plate 34, Figure 1

Leaflet inequilateral, lanceolate-ovate, narrowed at the base, coriaceous or rugose; midrib slightly curved at the base; secondary nerves numerous, the lower ones opposite, the upper ones subopposite, leaving the midrib at acute angles of divergence, curving upward along the borders, where they merge into and connect with the tertiary nerves that extend to the denticulations in the upper part of the margin.

This leaf agrees almost exactly with the description and figure of *Juglans coloradensis* Lesquereux MS., Knowlton,[52] from the Vermejo formation of southeastern Colorado. Our specimen is apparently somewhat broader, but as both specimens are imperfect an exact comparison is not possible. The margin in each is denticulate, at least in the upper part, although in Knowlton's figure the denticulations are indicated as somewhat larger than in ours. In the discussion of this species Knowlton suggests comparison with certain figures of the leaves of *Juglans rugosa* Lesquereux,[53] but the comparison does not appear to be well chosen, as most of the leaves of this species are quite different in shape, and all have entire margins.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Order FAGALES

Family BETULACEAE

Genus BETULA Linnaeus

Betula beatricina conformis Hollick, n. var.

Plate 35, Figure 4

Leaf 4.5 centimeters in length by 3.4 centimeters in width across the middle, rhomboid-elliptical, tapering to base and apex, sharply dentate from the middle upward, entire below; nervation simply pinnate, craspedodrome; midrib straight; secondary nerves six on each side, arranged in opposite or subopposite pairs, leaving the midrib at acute angles of divergence, the lower ones with one or more branches from the under sides toward the extremities.

This leaf differs so little from *Betula beatricina* Lesquereux,[54] from the Dakota sandstone of Nebraska, that it might be regarded as specifically identical. It appears, however, to be broader, relative to its length, with dentition that is sharper and more serrate than in the specific type. It resembles Lesquereux's Figure 4 on Plate 30 more nearly than it does his Figure 5 on Plate 5 and more nearly than his two figures resemble each other.

Comparison is also suggested with *Betula atavina* Heer,[55] from the Patoot beds of Greenland, and with one of the forms of *Betulites snowii* Lesquereux,[56] from the Dakota sandstone of Kansas.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4640).

Genus BETULITES Goeppert

Betulites rugosus apiculatus Hollick, n. var.

Plate 36, Figure 1

Leaf orbiculate-ovoid, 6.5 centimeters in length by about the same in width across the middle, denticulate, apiculate at the apex, rounded to a short, truncate base; petiole 1 centimeter or more in length; nervation pinnate, craspedodrome; secondary nerves seven on each side of the midrib, subopposite, parallel, leaving the midrib at angles of about 40°, the upper ones simple, the lower ones branched toward their extremities on the under sides, the basal pair with seven or more branches on the under side.

This well-defined leaf is difficult to differentiate satisfactorily from one or another of the many species and varieties that have been described and figured under the genus *Betulites*, especially *B. westii reniformis* Lesquereux[57] and *B. rugosus* Lesquereux,[58] from the Dakota sandstone of Kansas. It hardly appears to be worthy of specific rank, and yet its pronounced apiculate apex serves to distinguish it from the other leaf forms with which it is evidently closely allied. In the circumstances I have thought it best to regard it as a variety of the species which it approaches more nearly in other characters.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4640).

[52] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 255, pl. 36, fig. 1, 1917.

[53] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 286, pl. 54, figs. 5, 14?; pl. 50, figs. 1–9; pl. 51, figs. 1, 2, 4, 1878.

[54] Lesquereux, Leo, Am. Jour. Sci., 2d ser., vol. 46, p. 95, 1868; The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 61, pl. 5, fig. 5; pl. 30, fig. 4, 1874.

[55] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 22, pl. 55, figs. 8, 21b, 1883.

[56] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 64, pl. 5, fig. 2, 1892.

[57] Idem, p. 62, pl. 5, fig. 5.

[58] Idem, p. 65, pl. 6, figs. 3–5.

Genus ALNUS Gaertner

Alnus pyramidalis Hollick, n. sp.

Plate 85, Figure 4a

Leaf pyramidal, 3 centimeters in length by 2 centimeters in width at a distance of about 6 millimeters above the base, tapering above to a wedge-shaped apex and rounded below to a broad, truncate base; margin triangular-serrate-dentate; nervation pinnate, craspedodrome; upper secondary nerves straight, parallel, opposite; lower two pairs subopposite; basal pair curved upward, with upward-curved branches on the under sides.

This well-defined little leaf appears to be different from any heretofore described fossil species. It somewhat resembles the living *Alnus rubra* Bongard, of the Pacific coast, but the dentition is apparently simple. The base, while described as truncate, appears to be obscurely cordate.

Locality: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Family FAGACEAE

Genus QUERCUS Linnaeus

Quercus pseudomarioni Hollick, n. sp.

Plate 29, Figure 2a; Plate 36, Figure 4

Leaves elliptical, cuneate at the base, 7.5 centimeters in length by 3.75 centimeters in width across the middle; margin undulate or crenate-dentate; nervation simply pinnate, craspedodrome; secondary nerves subparallel, the upper ones leaving the midrib at angles of about 45°, the lower ones leaving the midrib successively at more obtuse angles and curving downward, all extending to and terminating in the marginal crenulations.

In these leaves the base is cuneate and the two sides of the leaf are unequal. The secondaries on one side are straighter and with a more acute angle of divergence from the midrib than those on the opposite side, the lower of which become almost horizontal.

Our specimens appear to represent merely a large form of some one or another of the species described under the names *Quercus marioni* Heer,[59] *Q. johnstrupi* Heer,[60] and *Q. langeana* Heer,[61] from the Patoot beds of Greenland, all of which might well be included under a single specific name.

Another figure, representing the upper part of what is apparently an oak leaf larger than ours, from the Raritan formation ("Amboy clays") of New Jersey, was tentatively referred by Newberry[62] to *Quercus johnstrupi*, but the identity of this figure with that species or with either of the other two allied species is very obscure as compared with the similarity of ours.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Quercus chignikensis Hollick, n. sp.

Plate 37, Figure 3

Leaf elliptical-ovate, 3.8 centimeters in length by 1.2 centimeters in maximum width, tapering to the apex, broadly cuneate or truncate at the base, coarsely and sharply crenate-serrate-dentate; nervation simply pinnate; lower secondary nerves leaving the midrib at obtuse angles of divergence, upper ones at acute angles, each nerve craspedodrome to one of the dentitions.

This oak is similar to the type represented by the Tertiary species *Quercus subrobur* Goeppert[63] and the living *Quercus tomentella* Engelmann of the California coastal islands. It presents a different aspect to that of any Cretaceous species of *Quercus* heretofore described, and its occurrence in Alaska appears to be limited to the Chignik Bay region.

Locality: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Quercus paleoilicoides Hollick, n. sp.

Plate 37, Figures 4, 5

Leaves 10 centimeters in length by 5.7 centimeters in width at about 2.5 centimeters above the base, lanceolate, with a broad, almost horizontal, truncate base; margin coarsely and acutely triangular dentate; nervation simply pinnate, craspedodrome; secondary nerves numerous, subparallel, mostly opposite or subopposite, the lower ones diverging from the midrib at right angles, the upper ones successively at angles more acute, each one terminating in one of the teeth; tertiary nervation at approximately right angles to the secondaries throughout, forming a series of rectangular areolae.

This species clearly belongs in the genus *Quercus* and to the same group as *Q. aquisextana* Saporta,[64] from the Tertiary of France, from which it differs, principally, in the truncate base and in the more obtuse angles of divergence of the secondary nerves. If the

[59] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 23, pl. 56, figs. 1–6, 1883.

[60] Idem, p. 24, pl. 56, figs. 7–9, 9b, 10, 11, 11b, 12a.

[61] Idem, p. 24, pl. 56, figs. 13a, 14, 15.

[62] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 69, pl. 19, fig. 7, 1895 [1896].

[63] Goeppert, H. R., Deutsche geol. Gesell. Zeitschr., vol. 4, p. 491, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 16, pl. 7, figs. 7–10, Görlitz, 1855.

[64] Saporta, Gaston de, Annales sci. nat., sér. 7, Botanique, vol. 10, p. 14, pl. 3, figs. 5–7, 1889.

nervation were not well defined the features of the outline and dentition of the leaves might readily cause them to be referred to either *Myrica* or *Ilex* or *Banksites*, as may be realized by comparison with *Myrica aculeata* (Saporta) Saporta,[65] a species that the author previously referred, in succession, to *Quercus* and *Banksites*. An interesting comparison may also be made with *Ilex knightiaefolia* Lesquereux,[66] in which the surficial appearance is strikingly suggestive of the same general type of leaf.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Quercus turbulenta Hollick, n. sp.

Plate 38, Figure 3

Leaf narrowly ovate-lanceolate, about 12 centimeters in length by 4.5 centimeters in maximum width, rounded at the base, triangular-denticulate except in the extreme lower part; nervation pinnate, craspedodrome; secondary nerves irregularly disposed, diverging from the midrib at acute angles, the upper ones occasionally branched above or merged into connecting tertiary nerves with fine nervilles terminating in the denticulations.

This leaf is difficult to assign generically, but its general features are suggestive of *Quercus juglandina* Heer,[67] from the Tertiary beds of the Atane region, Greenland, which differs from our specimen, however, in having a somewhat more tapering base and generally coarser dentition; but they apparently belong together, in the same generic category.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Quercus eamesi Trelease?

Plate 35, Figure 1

Quercus eamesi Trelease, Brooklyn Bot. Gard. Mem., vol. 1, p. 499, 1918 (= *Q. salicifolia* Newberry, Lyceum Nat. Hist. New York Annals, vol. 9, pt. 24, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 77, pl. 1, fig. 1, 1898. Not *Q. salicifolia* Née, 1801).

This leaf agrees in general characters with the description and figure of Newberry's species from the Dakota sandstone of Nebraska; but the type of leaf represented by the species is so common that only perfect specimens, with all critical characters preserved, are satisfactory for positive identification, and it is probable that several similar Upper Cretaceous leaf forms, referred to species in the genera *Salix*, *Myrica*, etc., may be referable to one and the same species, as, for example, *Salix pacifica* Dawson,[68] from Vancouver Island; *Salix foliosa* Newberry,[69] from New Mexico; and certain of those included under *Myrica longa* (Heer) Heer,[70] from the Atane beds of Greenland.

It is almost certain that our specimen is identical with some one or another of these species, and inasmuch as it appears to resemble the genus *Quercus* and to compare closely with Newberry's species under that genus, at least a provisional reference to *Quercus* seems to be justified.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

Genus DRYOPHYLLUM Debey

Dryophyllum bruneri Ward

Plate 38, Figure 2

Dryophyllum bruneri Ward, Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 551, pl. 37, figs. 6–8, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 27, pl. 10, figs. 5–8, 1887.

There can be but little doubt of the identity of our specimen with Ward's species from the Upper Cretaceous (Mesaverde formation) of Wyoming, the only difference being that the Alaska specimen is somewhat larger.

The same species is also described and figured by Knowlton[71] from the Vermejo formation of southeastern Colorado.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Order URTICALES

Family ULMACEAE

Genus ULMUS Linnaeus

Ulmus oblongifolia Hollick, n. sp.

Plate 37, Figure 1

Leaf oblong-elliptical, 3.25 centimeters in length by 1.75 centimeters in width across the middle, rounded

[65] Saporta, Gaston de, Annales sci. nat., sér. 5, Botanique, vol. 18, p. 126 [28], pl. 6, fig. 2, 1873.

[66] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 188, pl. 40, figs. 4, 5, 1883.

[67] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 89, pl. 71, fig. 19; pl. 74, figs. 4–7; pl. 76, fig. 12; pl. 102, fig. 9a, 1883.

[68] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 26, pl. 7, fig. 24, 1882 [1883].

[69] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 57, pl. 13, figs. 5, 6, 1898.

[70] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 65, pl. 18, fig. 9b; pl. 29, figs. 15–17; pl. 33, fig. 10; pl. 41, figs. 4b, 4d, 1882 (=*Proteoides longus* Heer, Die Kreide-Flora der arctischen Zone: Idem, vol. 3, No. 2, p. 110, pl. 29, fig. 8b; pl. 31, figs. 4, 5, 1874).

[71] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 259, pl. 53, fig. 5, 1917.

above and terminating in an apiculate apex, rounded to the base on one side, cuneate on the other; margin finely serrate-dentate; nervation pinnate; craspedodrome; secondary nerves alternate, subparallel, leaving the midrib at more acute angles of divergence on one side than on the other, mostly forked at the extremities, the two lower ones curved or flexed, with subhorizontal branches from the under sides.

This leaf is somewhat suggestive of the Tertiary species *Ulmus sorbifolia* Goeppert [72] in its outline, but the nervation is more irregular, ascending, and flexuous.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Ulmus alnoides Hollick, n. sp.

Plate 38, Figure 4

Leaf oblong-obovate, 12 centimeters or more in length by 5.5 centimeters in maximum width, broadest above the middle, narrowed below to a rounded, truncate, obscurely inequilateral base; margin irregularly serrate-dentate; midrib slightly curved; nervation pinnate, craspedodrome; secondary nerves numerous, leaving the midrib at acute angles, the lower ones on one side of the leaf slightly spreading and branched toward their extremities, all craspedodrome to the larger teeth, the branches terminating in the smaller intermediate teeth.

This strongly defined leaf is apparently an *Ulmus*, but it possesses features suggestive of the Betulaceae, like the Tertiary species *Ulmus carpinoides* Goeppert.[73] In fact, the resemblance of our specimen to *Carpinus* is perhaps more striking than it is to *Alnus*, but the prior publication of Goeppert's name, indicative of this resemblance, precludes its application to our species. There is, apparently, no known Cretaceous species with which it may be even remotely compared.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Family MORACEAE

Genus FICUS Linnaeus

Ficus lesquereuxii lata Hollick, n. var.

Plate 40, Figure 1

Leaf lanceolate, about 14 centimeters in length by 4 centimeters in width just below the middle, tapering to both ends; midrib slender above, slightly thickened in the lower part; nervation pinnant, camptodrome; secondary nerves irregularly disposed, the lower ones leaving the midrib at acute angles, the upper at more obtuse angles of divergence, all curving upward, thinning out and merging into connecting tertiary nervilles close to the margin.

This leaf differs from the leaf from the Dakota sandstone of Kansas described and figured by Lesquereux [74] under the name *Ficus berthoudi* (not *F. berthoudi* Lesquereux, 1888) merely in its slightly greater width. It is suggestive of *Ficus krausiana* Heer,[75] but the midrib is more slender throughout, and the secondary nerves are more ascending than in that species. It is, however, very similar in its secondary nervation to the specimen referred to *F. krausiana* by Hollick,[76] from the Magothy formation of Marthas Vineyard, Mass., which, however, has the characteristic thick midrib that serves to differentiate it from the present form.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Ficus daphnogenoides (Herr) Berry

Plate 39, Figures 3-5

Ficus daphnogenoides (Heer) Berry, Torrey Bot. Club Bull., vol. 32, p. 329, pl. 21, figs. 1-6, 9, 13, 14, 1905.

Proteoides daphnogenoides Heer, in Capellini, J., and Heer, O., Les phyllites crétacées du Nebraska: Soc. helv. sci. nat. Nouv. mém., vol. 22, No. 1, p. 17, pl. 4, figs. 9, 10, 1866.

It is possible that two species are included in these specimens—the smaller ones representing *Proteoides daphnogenoides* as originally described by Heer, and the larger one representing *Ficus proteoides* Lesquereux; [77] but Berry has relegated all such leaf forms to a single species of *Ficus*, under the original specific name, and this rearrangement of the species is accepted, without discussion, on account of its convenience. On this conception of the species its geographic distribution would include the Upper Cretaceous of the Atlantic Coastal Plain region from southern New England to North Carolina, Alabama, Texas, and Alaska.

Localities: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903

[72] Goeppert, H. R., Deutsche geol. Gesell. Zeitschr., vol. 4, p. 492, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 30, pl. 14, fig. 10, Görlitz, 1855.

[73] Goeppert, H. R., Die tertiäre Flora von Schossnitz in Schlesien, p. 28, pl. 13, figs. 4-9; pl. 14, fig. 1, Görlitz, 1855.

[74] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 78, pl. 12, fig. 3, 1892 (=*Ficus lesquereuxii* Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 102, 1898).

[75] Heer, Oswald, Beiträge zur Kreide-Flora; 1, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, p. 15, pl. 5, figs. 3-6, 1869.

[76] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 58, pl. 10, fig. 1, 1906.

[77] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 77, pl. 12, fig. 2, 1892.

(lot 3249) (pl. 39, figs. 3–4). Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250) (pl. 39, fig. 5).

Ficus laurophylla Lesquereux

Plate 40, Figure 2

Ficus laurophyllum Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 342, pl. 5, fig. 7, 1876.

Ficus laurophylla Lesquereux, The Cretaceous and Tertiary floras; U. S. Geol. Survey Terr. Rept., vol. 8, p. 49, pl. 1, figs. 12–13, 1883.

Laurophyllum reticulatum Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 425, 1873; The Cretaceous flora; U. S. Geol. Survey Terr. Rept., vol. 6, p. 76, pl. 15, figs. 4, 5, 1874.

Ficus reticulata (Lesquereux) Hollick, in Newberry, The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 88, pl. 12, figs. 2, 3, 1898. Not *Ficus reticulata* Thunberg, 1786.

There can hardly be any question as to the identity of this leaf with Lesquereux's species from the Dakota sandstone of Minnesota and Kansas, although the secondary nervation is obscurely defined, and the characteristic reticulate tertiary nervation is not visible.

Locality: Pavlof Bay, east side, about 50 miles west of Portage Bay, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189).

Ficus melanophylla Lesquereux?

Plate 52, Figure 2b

Ficus melanophylla Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 83, pl. 50, fig. 2, 1892.

This imperfect leaf is provisionally referred to Lesquereux's species from the Dakota sandstone of Kansas on account of the fine reticulate, dictyodrome nervation that is common to both specimens. This form of nervation, however, occurs in a number of other species of the genus, both living and fossil, and as examples in this connection it may be of interest to refer to *Ficus myricoides* Hollick,[78] from the Raritan and Magothy formations of New Jersey, Long Island, N. Y., and Marthas Vineyard, Mass.; and *Ficus atavina* Heer,[79] from the Atane beds of Greenland. The imperfect condition of our specimen, however, makes any satisfactory comparison of the leaf form impossible.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

[78] Hollick, Arthur, in Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 71, pl. 32, fig. 18; pl. 41, figs. 8, 9, 1895 [1896]. Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 57, pl. 11, figs. 8, 9, 1906.

[79] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 69, pl. 11, figs. 5b, 7b, 8b, etc., 1882.

Ficus dictyodroma Hollick, n. sp.

Plate 38, Figure 5

Leaf of unknown shape and size, entire; base wedge shaped, abruptly cuneate; midrib straight; nervation pinnate-dictyodrome; secondary nerves camptodrome at a considerable distance from the margin, giving off fine nervillose branchlets that connect with the tertiary nervation and form a dictyodrome network of polygonal areolae that successively diminish in size and ultimately merge into the margin.

This leaf, although represented by only a fragmentary specimen, is so remarkable for its finely developed dictyodrome system of nervation that this alone will serve to identify it in the event of more perfect specimens being collected. This character of the nervation does not appear to be exactly duplicated in any described fossil leaves, nor have I been able to compare it satisfactorily with that of any living genus. The species may possibly, however, be identical with *Ficus austiniana* Lesquereux,[80] from the Dakota sandstone of Minnesota. The nervation is closely similar; but Lesquereux's figure represents a specimen even more fragmentary than ours, and satisfactory comparison is impossible.

Locality: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962).

Ficus? juglandifolia Hollick, n. sp.

Plate 38, Figure 1

Leaf obovate-oblong, asymmetrical, entire, 8 centimeters in length by 5.9 centimeters in maximum width; apex blunt; base broadly wedge shaped; nervation pinnate, consisting of a midrib with five alternate secondary nerves on each side that leave the midrib at angles of about 45° and curve upward along the margin.

This specimen represents a leaf that is difficult to assign generically. It might be regarded as belonging to *Ficus*, or *Juglans*, or *Magnolia*, or to some other genus with leaves that have simple, curved, pinnate secondary nervation and entire margins; hence the reference to the genus *Ficus* is indicated as questionable. It is of the same general type as *Ficus asiminaefolia* Lesquereux,[81] from the Tertiary of California, in connection with which Lesquereux remarks: "This leaf has somewhat the appearance of a *Juglans* and

[80] Lesquereux, Leo, Minnesota Geol. and Nat. Hist. Survey Thirteenth Ann. Rept., p. 76, 1884 [1885]; Final Rept., vol. 3, pt. 1, p. 14, pl. A, fig. 5, 1893.

[81] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 250, pl. 56, figs. 1–3, 1883.

also of a *Magnolia*"; and it may be compared with *Ficus mudgei* Lesquereux,[82] from the Dakota sandstone of Kansas.

Leaves of similar general appearance, from the Magothy formation of Maryland, are referred by Berry [83] to *Magnolia obtusata* Heer,[84] although these leaves, to judge from the figures, almost certainly represent a species distinct from *M. obtusata.*

Locality: Pavlof Bay, east side, about 50 miles west of Portage Bay, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189).

Family URTICACEAE

Genus URTICA Linnaeus

Urtica alaskana Hollick, n. sp.

Plate 39, Figure 1

Leaf ovate-lanceolate, narrowed to the apex, rounded to the base; about 7 centimeters in length by 4 centimeters in maximum width; margin coarsely and irregularly dentate, with broad, subtriangular, acute, ascending and spreading teeth; nervation palmate; lateral primaries sharply ascending, with flexuous branches on the outer sides that extend into the adjacent teeth; secondary nerves short, anastomosing and forming a series of angular loops, from the angles of which fine nervilles extend into the teeth.

This specimen possesses all the characters of an urticaceous leaf closely similar to the living *Urtica dioica* Linnaeus. The only fossil leaf heretofore definitely referred to the genus appears to be *Urtica miocenica* Ettingshausen,[85] from the Miocene of Styria; but this leaf resembles a *Populus* rather than an *Urtica*, both in nervation and in dentition, and its reference to the former genus would hardly be questioned to-day. It may be urged that the nervation of *Urtica* is very similar to that of certain leaf forms referred to *Populus arctica* Heer,[86] *Populus zaddachi* Heer,[87] *Populus daphnogenoides* Ward,[88] etc., and that in view of such similarity it would be more consistent to adopt the genus representing trees with leaves of firm texture rather than a herbaceous genus whose leaves would be less likely to be preserved in a fossil state. The nervation in none of the leaf forms of *Populus*, however, appears to be identical in every detail with that of the specimen under discussion, nor with that of the species next described under the same genus, and the characters of the marginal dentitions in both are clearly those of *Urtica* and are different from those of any recognized leaf form or species of *Populus.*

It is also of interest to note, incidentally, that seeds and fruit of *Urtica dioica* Linnaeus and *Urtica urens* Linnaeus, the two living species that most nearly resemble our two fossil species from Alaska, are among the plant remains identified by Sernander,[89] Weber,[90] and the Reids [91] in the Pleistocene and Pliocene deposits of Europe.

Locality: Chignik Lagoon, south side, near entrance, Alaska Peninsula (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295).

Urtica exemplaris Hollick, n. sp.

Plate 29, Figure 4b; Plate 39, Figure 2

Leaf about 3 centimeters in length by about 2.4 centimeters in maximum width, ovate-lanceolate, with a broad wedge-shaped base and apparently an acuminate apex; margin triangular-dentate, with relatively large, narrow, acute, ascending and spreading teeth; nervation palmate from the base, consisting of two sharply ascending, inward-curved lateral primaries with anastomosing branches on the outer sides, from which fine nervilles extend into the teeth, and short secondary nerves that anastomose with the lateral primaries and with one another in a series of angular loops, from the angles of which fine nervilles extend into the teeth.

This leaf possesses every character of the genus *Urtica* and can hardly be distinguished specifically from certain leaf forms of the living *Urtica urens* Linnaeus. This generic relationship is discussed in connection with *Urtica alaskana*, the species last described, and need not be further considered.

Localities: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297) (pl. 29, fig. 4b). Port Moller, 2 miles up the canyon west from Mud Bay, Alaska Peninsula (original No.

[82] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 83, pl. 12, fig. 4, 1892.

[83] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 824, pl. 68, figs. 2–4, 1916.

[84] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 90, pl. 15, fig. 12; pl. 21, fig. 3, 1882.

[85] Ettingshausen, C. F. von, Beiträge zur Kenntniss der Tertiärflora Steiermarks: K. Akad. Wiss. [Wien], Natur.-wiss. Cl., Sitzungsber., vol. 60, pt. 1, p. 55 [39], pl. 2, fig. 21, 1869.

[86] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 100, pl. 5, figs. 2a, 5, 9, 12, etc., 1868.

[87] Idem, p. 98, pl. 6, fig. 3; Contributions to the fossil flora of north Greenland: Idem, vol. 2, No. 4, p. 468, pl. 44, fig. 6, etc., 1871.

[88] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 550, pl. 35, figs. 7, 8, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 20, pl. 7, figs. 4–5, 1887.

[89] Sernander, Rutger, Studier öfver den Gotländska vegetationens utvecklingshistoria, Upsala, 1894.

[90] Weber, C. A., Versuch eines Ueberblicks über die Vegetation der Diluvialzeit in den mittleren Regionen Europas: Naturw. Ver. Bremen Abh., vol. 23, 1914.

[91] Reid, Clement and E. M., Fossil flora of Tegelen-sur-Meuse, near Venloo, in the province of Limburg: K. Akad. Vetensch. Amsterdam Verk., sec. 2, vol. 13, No. 6, 1907; The Pliocene floras of the Dutch-Prussian border: Med. Rijksopsp. Delfstoffen, No. 6, 1915.

35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 39, fig. 2).

Order PROTEALES

Family PROTEACEAE

Genus MACCLINTOCKIA Heer

Macclintockia alaskana Hollick, n. sp.

Plate 31, Figure 3

Leaf ovate-lanceolate, entire, 6 centimeters in length by 2.2 centimeters in maximum width, tapering above to a narrow apiculate apex, rounded below to a curved, wedge-shaped base; nervation quinquepalmate from the base, the inner pair of lateral primaries acrodrome, the outer pair gradually thinning out and merging, at about the middle of the leaf, into fine ascending secondary nerves that arise from the outer sides of the inner laterals.

The species with which ours appears to be most nearly allied is *Macclintockia cretacea* Heer,[92] from the Atane and Patoot beds of Greenland, to which a fragmentary specimen from the Dakota sandstone of Kansas is referred by Lesquereux;[93] but the identity of this specimen with that species is very doubtful, and it resembles ours more closely than it does the one to which it is referred.

Dawson[94] also refers a specimen from the Upper Cretaceous (Mill Creek series) of Canada to the same species; but his figure shows a leaf in which the inner pair of lateral primaries are suprabasilar, and it can hardly be referable even to the same genus.

Locality: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Macclintockia electilis Hollick, n. sp.

Plate 31, Figure 4

Leaf small, 3 centimeters in length by 2.25 centimeters in width, ovate-elliptical, tapering to base and apex, sharply denticulate from just below the middle upward, entire below; nervation consisting of a slender midrib and six ascending lateral primaries, three on each side, the inner pair acrodrome, all starting from a point close to the base of the leaf, with fine secondary branches terminating in the marginal dentitions.

This delicate little leaf is clearly a *Macclintockia* as defined by Heer[95] and is closely similar to *M. sachalinensis* Kryshtofovich,[96] from the Cenomanian of the island of Sakhalin, which differs from our species, so far as comparison of the figures is concerned, merely in its somewhat more rounded outline and crenate rather than sharply dentate margin.

Locality: Yukon River, north bank, about 16 miles below Melozi telegraph station (original No. 3AH14); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3251).

Order ARISTOLOCHIALES

Family ARISTOLOCHIACEAE

Genus ARISTOLOCHIA Linnaeus

Aristolochia paigei Hollick, n. sp.

Plate 40, Figure 3

Leaf cordate(?), 9 centimeters in length from the base of the midrib to the apex by 8.9 centimeters in width across the base of the leaf; margin entire; nervation tripalmate from the base, camptodrome throughout; lateral primaries ascending at acute angles of divergence from the midrib, with branches on the outer sides that are connected by the tertiary nerves, forming a series of loops inclosing polygonal areas that diminish in size upward, with similar smaller areas or areolae extending outward to the margin; secondary nerves fine, leaving the midrib at obtuse angles of divergence, curving upward, connecting below with the extremities of the lateral primaries and above with each other, by irregular tertiary cross nervation.

Although the base of this leaf is missing the indications are that it was cordate, and that the foliar outline was as characteristic of *Aristolochia* as the nervation. The specific name is given in honor of Mr. Sidney Paige, with whose assistance the collection was made.

Locality: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250).

Order RANALES

Family NYMPHAEACEAE

Genus NYMPHAEITES Sternberg

The genus *Nymphaeites* was founded by Sternberg[97] upon *Nymphaea arethusae* Brongniart,[98] consisting entirely of the remains of rhizomes, and the generic name appears to have been restricted to such remains by subsequent authors until Heer[99] described and

[92] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 70, pl. 36, figs. 1, 2a; pl. 37, figs. 2–4, 1882; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 27, pl. 55, fig. 14, 1883.

[93] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 197, pl. 59, fig. 4, 1892.

[94] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 13, pl. 4. fig. 3, 1885 [1886].

[95] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 114, 1868.

[96] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 61, fig. 15. 1918.

[97] Sternberg, Kaspar, Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, vol. 1 (Tentamen), p. xxxix, Leipzig and Prag, 1825.

[98] Brongniart, Adolphe, Mus. hist. nat. [Paris] Mém., vol. 8, p. 332, pl. 17 (6), fig. 9, 1822.

[99] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, No. 3, p. 65, pl. 14, figs. 8, 9b, 9c, 10, 1870.

figured certain fragmentary leaf remains from the Tertiary of Svalbard, found in connection or closely associated with the rhizomes, and included them all under *Nymphaeites thulensis*.

The leaves, as indicated by the remains, were of small size, with radiating primary nerves of approximately equal rank and secondary nerves ascending at acute angles of divergence from the primaries. The original generic description should therefore be amended by including these features of the foliar organs. Heer's specimens, however, are so fragmentary that they can hardly be regarded as adequate for a comprehensive generic description.

Nymphaeites exemplaris Hollick, n. sp.

Plate 40, Figure 4

Leaf symmetrical, narrowly flabelliform, 4.5 centimeters in length by 4.2 centimeters in maximum width, just above the middle, upper part rounded, lower part cuneate, tapering to a wedge-shaped base; margin obscurely crenate above the middle, entire below; nervation flabellate, consisting of a midrib and three lateral primaries on each side, the outer pair relatively weak; secondaries ascending at acute angles of divergence, simulating forking of the primaries, the upper ones branched or forked in a similar manner and extending to the marginal crenations.

The reference of this specimen to the genus *Nymphaeites* may be regarded as open to question; but that it belongs in the Nymphaeaceae is too strongly indicated to be ignored, and all the foliar features characteristic of the genus, as described and figured by Heer, are represented in it. In our specimen the midrib is straight and without secondaries for approximately the lower two-thirds of its length; and a suggestion of a midrib may be seen in the erect, perpendicular primary depicted by Heer.[1] If our generic reference is correct our species is apparently older than any representative of the genus heretofore recorded.

Locality: Yukon River, south bank, about 3 miles below Seventymile Creek[4] (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243).

Genus PALEONUPHAR Hollick, n. gen.

Leaf ovate-lanceolate, cordate with a deep sinus; apex obtuse, emarginate; nervation consisting of a strong, straight midrib, with subopposite secondaries, all of approximately equal rank, which fork, coalesce, and form irregular polygonal loops, with a network of successively smaller and smaller areolae toward the margin, such as are characteristic of the broad, floating leaves of the Nymphaeaceae.

[1] Heer, Oswald, Flora fossilis arctica, vol. 2, No. 3, pl. 14, fig. 10.

Paleonuphar inopina Hollick, n. sp.

Plate 40, Figure 5

Leaf about 8 centimeters in length by about 6 centimeters in width across the base of the midrib, ovate-lanceolate, cordate at the base, narrowed above to an obtuse, emarginate apex; margin entire (or undulate and finely wrinkled or crenulate?); midrib straight, prominent; secondaries uniformly fine, about twelve pairs, subopposite, the basal ones curved backward and downward, the upper ones ascending, leaving the midrib at obtuse and approximately equal angles of divergence, all more or less uniformly forked, the branches connecting and forming irregular polygonal loops, with finer branches from the angles, that connect and form a series of polygonal areolae from which others are derived in similar manner, forming a network of areolae that successively diminish in size toward the margin.

The specimen upon which this genus and species is based is too imperfect to enable accurate definition of all its characters. The base of the leaf blade is evidently partly broken away. The lobes must have been originally more rounded, and the sinus much narrower and more acute at the upper part than now appears, and the undulate and in places somewhat wrinkled or crenulate margin may be due to conditions of fossilization and not a natural character of the leaf.

This may be referred, without hesitation, to the Nymphaeaceae, and may be satisfactorily compared with the living *Nymphaea kalmiana* (Michaux) Sims (= *Nuphar kalmiana* Sims), our common small yellow pond lily. It clearly does not belong in the *Nymphaea-Castalia* group, in which some thirty fossil species are included—only two of them of Cretaceous age—and apparently the *Nymphaea-Nuphar* group has not heretofore been recognized as represented by any fossil species. It is also interesting to note that our specimen is apparently not only the first representative of its group to be found in the fossil form, but that it also antedates any recorded species of the *Nymphaea-Castalia* group. It is suggestive, however, of the leaves described and figured under the name *Pterospermites cordifolius* Heer,[2] from the Atane beds of Greenland, in which occur several of the same species that are found associated in Alaska with *Paleonuphar*. Unfortunately the figures of *Pterospermites cordifolius* are too imperfect for satisfactory comparison with *Paleonuphar*, although it may be said that the general resemblance between them appears to be more marked than are the slight differences, and it is doubtful, in any event, if Heer's species is properly referable to the genus *Pterospermites* as commonly understood and recognized.

[2] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 94, pl. 27, figs. 2, 3, 1882.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Genus CASTALIITES Hollick, n. gen.

Leaves flabelliform, curving from the expanded middle part of the apex and rounded below to a curved or truncate or broadly cuneate base; midrib and lateral primaries all radiating from the base, branched or forked, the secondaries branched or forked in a similar manner, the ultimate branches apparently terminating in the margin. Generic type, *Castaliites ordinarius* (pp. 76–77, pl. 41, fig. 7).

This genus is broadly defined, in order that it may include a number of diverse leaf forms that appear to be referable to an extinct generic group of nymphaeaceous plants. The lateral primaries are very uniformly bent inward at their point of origin at the base of the leaf, and at a short distance upward they spread and curve downward to a greater or less extent toward the margin.

A leaf of the same general type, from the Upper Cretaceous of Montana, is described and figured by Knowlton [3] and referred to *Populus* cf. *P. arctica* Heer; but he expresses doubt as to identity with that species, and it may be pertinent to suggest that not only the specific but also the generic identity may well be questioned—the lateral primaries in *Populus* being bent outward at the base and ultimately curving inward, a character which is the opposite of that of the laterals in the leaf mentioned.

Another leaf, from the Upper Cretaceous of Wyoming, described and figured by Knowlton [4] under the name *Castalia? duttoniana*, is also worthy of attention as possibly related to *Castaliites*. The query mark following the generic name may be taken as an indication that the author intended the reference to be provisional or suggestive only. The midrib is poorly defined and difficult to differentiate from the lateral primaries, a character which alone would serve to separate it from *Castalia*, and the primaries all radiate from the base as in *Castaliites*.

Castaliites flabelliformis Hollick, n. sp.

Plate 41, Figure 5

Leaf broadly flabelliform, about 5 centimeters in length by 7 centimeters in maximum width, abruptly rounded from below the middle upward and broadly truncate-cuneate below, terminating in a short wedge-shaped base; margin finely crenate-dentate above, entire below; nervation consisting of a midrib (?) and six lateral primaries, all of equal rank, radiating from the base, forked in their upper parts, the branches forking in a similar manner, the ultimate branches extending to the margin and apparently terminating in the dentitions.

In this specimen the distinction between midrib and lateral primaries is obscure; the nerves are all very prominent, apparently indicating that the under surface of the leaf is represented, and the general appearance is suggestive of an infolded peltate leaf and, incidentally, of a partly opened fan.

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Castaliites cordatus Hollick, n. sp.

Plate 41, Figure 6

Leaf about 5.25 centimeters in length by about 7 centimeters in width, apparently reniform-cordate in outline, rounded below the middle to a broad curved or cordate base and broadly cuneate above to an apiculate apex; margin triangular-dentate or somewhat serrate-dentate, at least above; nervation consisting of a midrib and eight lateral primaries, all radiating from the base of the leaf; midrib with two subopposite, widely separated pairs of secondary nerves springing at acute angles of divergence from its upper part, each secondary terminating in a marginal dentition; inner lateral primaries of equal rank with the midrib, outer ones somewhat weaker, all forked, the branches forked in a similar manner, the ultimate branches terminating in the marginal dentitions.

The description of this species is based, in part, upon a theoretical reconstruction of the leaf as indicated by the characters shown in the imperfect specimen; hence the figure should be analyzed in connection with the description.

The dentition is similar to that of the leaves of several living species of *Castalia* and is especially comparable with that of the Australian species *C. gigantea* Britten. The nervation is very fine and may be assumed to indicate that the upper surface of the leaf is represented in the specimen.

Locality: Yukon River, north bank, about 13 miles above Kaltag (original No. 3AH26); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3265).

Castaliites ordinarius Hollick, n. sp.

Plate 41, Figure 7

Leaf reniform, about 6 centimeters in length by 9.5 centimeters in maximum width, rounded from the middle in both directions, lower part curving to a short, abruptly wedge-shaped base; nervation flabelli-

[3] Knowlton, F. H., in Weed, W. H., and Knowlton, F. H., The Laramie and the overlying Livingston formation in Montana: U. S. Geol. Survey Bull. 105, p. 50, pl. 6, fig. 7, 1893.

[4] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 55, pl. 13, fig. 7, 1900.

form, consisting of a midrib and six lateral primaries, all of approximately equal rank and all radiating from a common base, the laterals forked or branched from the under sides, the branches forked in a similar manner and terminating in the margin.

This specimen is evidently imperfect, as far as the margin is concerned, in all except the basal portion, and it is impossible to determine whether it was entire or dentate in its upper part. The thickness of the midrib where it is broken away indicates that the apex of the leaf was probably somewhat extended beyond this point and that the outline of the perfect leaf was similar to that of *Castaliites cordatus*, the species last described.

Heer [5] describes and figures, under the name *Nymphaea arctica*, some fragmentary leaf remains from the Tertiary of Svalbard which are suggestive of our specimen and may possibly belong in the same genus; but the base, unfortunately, is missing, and without that part any satisfactory comparison is impossible.

Locality: Yukon River, north bank, at Williams coal mine (original No. 2AC284); collected by A. J. Collier and Sidney Paige in 1902 (lot 2985).

Castaliites inordinatus Hollick, n. sp.

Plate 41, Figure 2

Leaf apparently ovate, about 8.5 centimeters in length by about 5.5 centimeters in maximum width; margin broadly triangular-dentate with shallow sinuses between; nervation consisting of a midrib and six(?) lateral primaries, all starting from the base of the leaf, the inner pair sharply ascending, the others radiating outward; midrib forked in its upper part; lateral primaries throwing off branches from their under sides which are connected by cross nervation, forming a network of polygonal areolae with fine nervilles extending to the margin and terminating above in the dentitions.

This specimen apparently represents a misshapen leaf that has been wrinkled, laterally compressed, and otherwise contorted, so that it presents an exaggerated appearance of length as compared with width. If such is the case then the above description would require modification in order to apply to a perfect or normal leaf.

Inasmuch as the specimen is from the same collection as *Castaliites ordinarius*, the species last described, which it resembles more or less closely, a suggestion of possible specific identity between the two may be regarded as pertinent.

Locality: Yukon River, north bank, at Williams coal mine (original No. 2AC284); collected by A. J. Collier and Sidney Paige in 1902 (lot 2985).

[5] Heer, Oswald, Die miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, No. 3, p. 64, pl. 14, figs. 1, 2, 1870.

Castaliites acutidentatus Hollick, n. sp.

Plate 41, Figure 3

Leaf of unknown shape and dimensions, sharply and irregularly dentate; nervation apparently flabellate, craspedodrome, the nerves forked, the branches terminating in the dentitions; secondary nervation fine, transverse, simple, forming a series of irregular, quadrangular areolae with the primaries.

This fragment of a leaf is evidently laterally compressed and wrinkled, so that the nervation appears to be contorted. The long, conspicuously forked nerve in the middle of the leaf, as represented in the figure, may be a main nerve or midrib extending into an acuminate apex; but this is merely a conjecture, based upon indications that are not conclusive. The secondary nerves, which appear to be bent and to diverge from the primaries at various angles, are probably uniform in arrangement under normal conditions.

This specimen is given a distinct specific rank, although it may be identical with *C. inordinatus*, the species last described, and perfect specimens, if brought to light in the future, may prove them to belong to one and the same species. The secondary nervation appears to be rather peculiar; but this feature is so obscurely defined in the other species of the genus that satisfactory comparison is impossible. The irregularly sharply dentate margin may be compared with that of the living *Castalia ampla* Salisbury.

Locality: Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Castaliites crenatidentatus Hollick, n. sp.

Plate 41, Figure 4

Leaf apparently cordate, about 5 centimeters in length by 5 centimeters in maximum width; margin coarsely triangular-crenate-dentate, terminating above in a curved, wedge-shaped, acuminate apex; nervation apparently palmate-flabellate, craspedodrome, consisting of a main median nerve with obscurely defined secondary nerves springing from its upper part, and three dichotomously forked lateral primaries on each side.

It is with some hesitation that I have included this leaf in the genus *Castaliites*, as its fragmentary condition renders satisfactory comparison impossible. In general appearance it is suggestive of the problematic genus and species *Protorrhipis buchi* Andrae,[6] from the Jurassic of Hungary; but this reference is to be regarded merely as a suggestion, in view of the fragmentary condition of our specimen.

[6] Andrae, K. J., Fossile Flora Siebenbürgens und des Banates: K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, No. 4, p. 36, pl. 8, fig. 1, 1855.

Locality: Coal Bluff, Herendeen Bay, Alaska Peninsula, original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Family MENISPERMACEAE

Genus MENISPERMITES Lesquereux

Menispermites reniformis Dawson

Plate 42, Figure 6; Plate 43, Figure 1

Menispermites reniformis Dawson, Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 23, pl. 4, fig. 12, 1882 [1883].

There can be but little doubt of the identity of our specimen with this species, although Dawson's figure is crude and his description very brief, namely, "Leaf broad, reniform, 11 centimeters broad and 7 centimeters in length, margins undulate. Five veined, but with two accessory veins, making seven in all." His figure, however, shows three lateral primaries on one side of the midrib and two on the other, or only six in all, including the midrib. The description and figure taken together, however, would indicate a leaf exactly like ours, only slightly broader and with marginal undulations rather than crenulations. In the circumstances I have thought it advisable to give a more extended and detailed description of the species that will include the characters shown in the two figures, as follows:

Leaves slightly inequilateral, orbicular-cordate or reniform, 7 centimeters in length by 7 centimeters in width, margin coarsely crenulate-dentate above, the dentitions diminishing in size below, merging into an undulate and entire margin at the base; nervation palmate from the base, craspedodrome; midrib somewhat flexuous, with two subopposite secondaries above the middle; lateral primaries, two prominent and one subsidiary on one side, one prominent and two subsidiary on the opposite side, forked or branched, the main nerves and their branches terminating above in the dentitions, the subsidiary basilar nerves and the branches above connected by cross nervation, forming a network of irregular marginal meshes, with fine nervilles that terminate in the adjacent crenulations.

These leaves evidently belong in the nonpeltate section of the genus that includes *Menispermites potomacensis* Berry,[7] and the question has been raised whether leaves of this type should be retained in the genus, especially if we are to accept *Menispermites obtusiloba* Lesquereux[8] as the generic type. Berry[9] has segregated the orbiculate-peltate species into a group, in which he includes *M. virginiensis* Fontaine and *M. tenuinervis* Fontaine and to which he gives the new generic name *Nelumbites*, by reason of certain resemblances to the leaves of *Nelumbo*. They are not symmetrically peltate, however, and they possess a more or less distinct midrib—features which seem rather to suggest a possible relationship with or at least a likeness to the *Nymphaea-Castalia* group of the Nymphaeaceae. The entire genus needs revision; but in the meantime the matter of principal importance is the identification of specimens, one with another, under any generic and specific name that may be recognized.

Localities: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 42, fig. 6). Yukon River, north bank, between Pickart's coal mine and Nulato (original No. 358); collected by F. C. Schrader in 1899 (lot 7471) (pl. 43, fig. 1).

Menispermites hederaeoides Hollick, n. sp.

Plate 42, Figure 5

Leaf of unknown shape, inequilateral (?), about 4.5 centimeters in length by about 7 centimeters in width, with a broad, entire, wavy, truncate base; midrib curved, weak, with two subopposite pairs of widely separated, sharply ascending, inward-curving secondary nerves; nervation palmate from the base; lateral primaries equal in rank with the midrib, two on one side, three on the other, spreading, branched, the lower branches of the lower lateral primaries extending along and subparallel to the basal margin.

This leaf, as indicated by its spreading lateral primaries, was apparently trilobate, and what are apparently the lower branches of the lower pair of lateral primaries may represent a pair of basilar lateral veinlets. From the general characters of the imperfectly preserved nervation the leaf is suggestive of either *Menispermites* or *Hedera* and might, with equal propriety, be referred to either genus. Only a perfect specimen could satisfactorily determine the probable generic affiliation. The shape of the leaf was apparently somewhat comparable with that of *Hedera cretacea* Lesquereux;[10] but the characters of the nervation are different and are more like those of *Menispermites*.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Menispermites communis Hollick, n. sp.

Plate 42, Figures 1, 2

Leaves subpeltate with broad cordate bases; nervation palmate, consisting of a straight midrib, a major

[7] Berry, E. W., Maryland Geol. Survey, Lower Cretaceous, p. 466, pl. 93, figs. 3, 4, 1911.

[8] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 94, pl. 25, fig. 1, 1894.

[9] Berry, E. W., op. cit., p. 462.

[10] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 127, pl. 18, fig. 1, 1892.

pair of spreading lateral primaries and two pairs of minor ones below, all radiating from the pelta at the base of the leaf; secondary nerves widely spaced on the midrib.

These leaves are too fragmentary for accurate description or comparison. They are apparently, however, of the same general specific type as *Menispermites acutilobus* Lesquereux,[11] from the Dakota sandstone of Kansas; and they are strikingly similar, so far as the basilar characters are concerned, to a specimen from the Magothy formation of Marthas Vineyard, Mass., referred provisionally to Lesquereux's species.[12]

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634).

Menispermites cordifolius Hollick, n. sp.

Plate 41, Figure 1

Leaf small, about 4 centimeters in diameter, orbiculate, subpeltate, deeply cordate at the base, entire, at least below; nervation consisting of a midrib and three pairs of flexuous, dichotomously forked lateral primaries, all radiating from the point of attachment of the petiole, the pair next to the midrib strongest, the pair traversing the basal lobes weakest, thinning out, curving toward and disappearing close to the margin.

It is impossible to determine satisfactorily whether this leaf is peltate or whether the appearance of peltation is due to overlapping of the lobes at the head of the deep, narrow basal sinus. The margin is entire at the base—the only part preserved—and the general characters of the leaf, as far as they are preserved, indicate that it was orbiculate in outline, with camptodrome nervation.

The orbiculate type of leaf in the genus is well represented by *Menispermites grandis* Lesquereux,[13] and the figures of this species show a broad, shallow curve or sinus in the basal margin that represents the equivalent of the narrow, deep sinus in our species.

Locality: Yukon River, north bank, 1 mile above Williams mine (original No. 38); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4641).

Menispermites septentrionalis Hollick, n. sp.

Plate 42, Figures 3, 4

Leaf of unknown form and dimensions, peltate; nervation palmate, radiating, consisting of a straight midrib, a pair of ascending, major lateral primaries, and lower spreading ones that become successively shorter and weaker, all with forking branches.

This leaf is apparently more or less comparable with *Menispermites grandis* Lesquereux,[14] from the Dakota sandstone of Kansas, but has stronger, more rigid nervation. It is also more or less suggestive of the leaf from the Fruitland formation of northwestern New Mexico designated *Ficus* sp. by Knowlton.[15]

Localities: Yukon River, south bank, about 25 miles below Mission Creek; collected by J. E. Spurr in 1896 (lot 1555) (pl. 42, fig. 3). Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 42, fig. 4).

Family MAGNOLIACEAE

Genus MAGNOLIA Linnaeus

Magnolia amplifolia Heer

Plate 44, Figure 2

Magnolia amplifolia Heer, Beiträge zur Kreide-Flora; I, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, p. 21, pl. 8, figs. 1, 2; pl. 9, fig. 1, 1869.

This leaf is evidently identical, specifically, with the specimen referred to the species by Lesquereux[16] from the Dakota sandstone of Kansas. The species was also identified[17] from the Magothy formation of Marthas Vineyard, Mass., on the strength of a rather fragmentary specimen. The Old World representatives of the species belong in the Cenomanian or Senonian of Bohemia and Moravia.

Locality: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250).

Magnolia lacoeana Lesquereux

Plate 44, Figure 1

Magnolia lacoeana Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 201, pl. 60, fig. 1, 1892.

This leaf, though somewhat longer in relation to its width than the species to which it is referred, is otherwise so closely similar to that species that to regard it as distinct would seem hardly to be justified, especially as it is associated with other un-

[11] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 78, pl. 14, fig. 2, 1883.

[12] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 62, pl. 12, fig. 8, 1906.

[13] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 80, pl. 15, figs. 1, 2, 1883.

[14] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 80, pl. 15, figs. 1, 2, 1883.

[15] Knowlton, F. H., Contributions to the geology and paleontology of San Juan County, N. Mex.; 4, Flora of the Fruitland and Kirtland formations: U. S. Geol. Survey Prof. Paper 98, p. 339, pl. 88, fig. 1, 1916.

[16] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 200, pl. 24, fig. 3, 1892.

[17] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 65, pl. 18, fig. 1, 1906.

doubted Dakota sandstone species in the collection from the same locality.

It is unfortunate that no complete specimen of the species has ever been figured. The type specimen lacks the apex, which, however, is described as "obtuse or abruptly pointed." Nevertheless, if we accept the several identifications of the species made by competent authorities it may be seen that they differ but little from one another. Newberry [18] figures two specimens from the Raritan formation of New Jersey, in one of which a lower portion only is shown, in the other an upper portion. The latter is apparently the only figure of the species extant in which the apex is shown, and whether or not the specimen actually belongs to this species may be regarded as open to question. I have figured two specimens from the Magothy formation of Marthas Vineyard, Mass.,[19] in which the lower parts only are shown. Berry [20] also figures two specimens, consisting only of lower portions, from the Magothy formation of Maryland; and the same author [21] figures a specimen from the Tuscaloosa formation of Alabama, in which both base and apex are missing.

The areal distribution of the species is therefore quite extensive, embracing Alaska, Kansas, and the Atlantic Coastal Plain from Massachusetts to Alabama. It is not recorded from the Old World.

Locality: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250).

Magnolia palaeauriculata Hollick, n. sp.

Plate 44, Figure 3

Leaf oblong-obovate, cordate-auriculate at the base, entire, about 11 centimeters in length by 7.25 centimeters in maximum width; nervation pinnate, camptodrome; midrib straight, thick; secondary nerves leaving the midrib at obtuse angles of divergence, curving upward and anastomosing near the margin.

This leaf represents a species of *Magnolia* comparable with certain living species such as *M. fraseri* Walter or *M. macrophylla* Michaux, in which the bases of the leaves are auriculate. A fossil species of similar habit is *M. hollicki* Berry,[22] from the Upper Cretaceous of the eastern United States—a species characterized by relatively small leaves of variable size and shape and, occasionally, a well-defined, auricled base. Newberry's Figure 4 is the particular figure that compares in outline most nearly with ours.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 54); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Genus LIRIODENDROPSIS Newberry

Liriodendropsis simplex (Newberry) Newberry

Plate 28, Figure 4b

Liriodendropsis simplex (Newberry), Newberry, The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 83, pl. 19, figs. 2, 3; pl. 53, figs. 1–4, 7, 1895 [1896].

Liriodendron simplex Newberry, Torrey Bot. Club Bull., vol. 14, p. 6, pl. 62, figs. 2–3 [excl. fig. 4], 1887.

The type represented by the many leaves that have been referred to this and allied species and varieties is one of considerable diversity, so far as size and shape are concerned; but the nervation is consistently characteristic throughout, and there can be little doubt that our leaf belongs to the species or variety or form to which it is here referred. The correct taxonomic position of the genus is open to question and has been questioned by nearly every author who has had occasion to study it; but in order to avoid further discussion, I have included it, tentatively, in the position to which the author of the genus originally assigned it.[23]

In its most restricted application the species has a distribution that includes the Raritan formation of New Jersey,[24] the Magothy formation of Staten Island and Long Island, N. Y., and Marthas Vineyard, Mass., [25] and the Tuscaloosa formation of Alabama.[26]

Locality: Yukon River, north bank, about $1\frac{1}{2}$ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642).

Family ANNONACEAE

Genus ASIMINA Adanson

Asimina knowltoniana Hollick, n. sp.

Plate 44, Figures 4, 5

Leaves petiolate, oblanceolate, entire, tapering above to a wedge-shaped, curved, obtuse apex and below to a narrow wedge-shaped base, 8.75 centimeters in length by 2.5 centimeters in width at a distance of 3.5 centimeters below the apex; nervation simply pinnate;

[18] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 73, pl. 15, figs. 1, 2, 1895 [1896].

[19] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 65, pl. 17, figs. 1, 2, 1906.

[20] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 832, pl. 70, figs. 1, 2, 1916.

[21] Berry, E. W., Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 91, pl. 17, fig. 9, 1919.

[22] Berry, E. W., Torrey Bot. Club Bull., vol. 36, p. 253, 1909 (=*Magnolia auriculata* Hollick, Torrey Bot. Club Bull., vol. 21, p. 61, pl. 179, figs. 6–7, 1894). Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 75, pl. 58, figs. 1–9, (10?), 11, 1895 [1896]. (Not *M. auriculata* Lamarck, 1783.)

[23] Newberry, J. S., op. cit. (Mon. 26), p. 82.

[24] Idem, p. 83, pl. 19, figs. 2, 3; pl. 53, figs. 1–4, 7.

[25] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 72, pl. 23, figs. 1–5, 7; pl. 24, figs. 4–9; pl. 25, figs. 4, 5, 7, 10–12; pl. 26, figs. 1b, c, d, 1906.

[26] Berry, E. W., Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 101, pl. 22, fig. 6, 1919.

secondary nerves numerous, subparallel, irregularly arranged, leaving the midrib at angles of approximately 45°, curving upward toward the extremities, thinning out and ultimately coalescing close to the margin.

This species resembles *Asimina eocenica* Lesquereux,[27] but that form does not possess the distinct oblanceolate outline of ours.

The specific name is given for Dr. F. H. Knowlton, of the U. S. Geological Survey, in recognition of his valued advice and assistance in the preparation of this paper.

Locality: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Order THYMELEALES

Family LAURACEAE

Genus LAURUS Linnaeus

Laurus antecedens Lesquereux

Plate 45, Figure 3; Plate 73, Figure 4c

Laurus antecedens Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 92, pl. 11, fig. 3, 1892.

These specimens appear to be identical with Lesquereux's species from the Dakota sandstone of Kansas, and the same species has also been identified in the Magothy formation of Long Island, N. Y.[28]

Localities: Yukon River, north bank, 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642) (pl. 45, fig. 3). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 73, fig. 4c).

Genus BENZOIN Fabricius

Benzoin venustum alaskanum Hollick, n. var.

Plate 45, Figure 2

Leaf palmately three-nerved from the base, trilobate above the middle, rounded from above the middle downward to a broad cuneate base, margin entire; median lobe conspicuously larger than the lateral ones, bluntly apiculate, enlarged in the middle; lateral lobes short, rounded, blunt; sinuses shallow, broad; lateral primaries ascending, ultimately bent slightly backward, with branches on the under sides that curve upward and become camptodrome along the margin; secondary nerves arranged in three subopposite pairs that leave the midrib at acute angles of divergence and curve upward toward the margin.

This leaf is so nearly like *Benzoin venustum* (Lesquereux) Knowlton[29] that whether it should be regarded as a variety or as specifically identical is open to question. In our specimen the lobes are more rounded and the secondary nerves diverge from their points of attachment at more obtuse angles than in Lesquereux's figures of the species, and there are other minor differences that may be seen better than they can be described; hence it seems advisable that the Alaskan leaf should be regarded as representing a variety of the original species.

It may also be of interest to compare these leaves with *Sassafras progenitor* Newberry,[30] from the Raritan formation of New Jersey, a species that includes leaves varying greatly in size, the smallest of which, however, is so strikingly like *Benzoin venustum* that it is difficult to escape the idea that they may be specifically identical. A comparison of Newberry's Figure 3 with Lesquereux's Figure 2 will at once demonstrate their close similarity. In fact, the indications appear to be that the Alaska, Kansas, and New Jersey specimens are all referable to a single species; but whether this species should be referred to the genus *Benzoin* or to the genus *Sassafras* may be regarded as a matter of individual judgment.

Locality: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250).

Genus PERSEA Gaertner

Persea hayana Lesquereux?

Plate 45, Figure 8

Persea hayana Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 103, pl. 16, fig. 6, 1892.

There does not appear to be any marked distinction between our specimen from Alaska and Lesquereux's figure of this species from the Dakota sandstone of Kansas, although our specimen is imperfect in its upper part, where the perfect leaf might show some character that would serve to differentiate it, and hence the identification is questioned. In many respects it is strikingly similar to the Tertiary lauraceous species *Laurus grandis* Lesquereux,[31] especially in the expanded upper part of the leaf, which is decidedly broader than in *Persea hayana;* and in any collection of Tertiary plants our specimen would prob-

[27] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 387, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 251, pl. 43, figs. 5–8, 1878.

[28] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 80, pl. 28, figs. 9, 10, 1906.

[29] Knowlton, F. H., A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 47, 1898 (=*Lindera venusta* Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 95, pl. 16, figs. 1, 2, 1892).

[30] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 88, pl. 27, figs. 1–3, 1895 [1896].

[31] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 251, pl. 58, figs. 1, 3, 1883.

ably be referred to the former species. In this connection it is also significant that our specimen is one of a mixed collection in which Tertiary plants (including a "*Laurus?* sp.") were identified by Knowlton.[32]

Locality: Pavlof Bay, east side, about 50 miles west of Portage Bay, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189).

Persea spatulata Hollick, n. sp.

Plate 45, Figure 7

Leaf spatulate-acuminate, entire, 7.5 centimeters in length by 2 centimeters in maximum width; secondary nerves irregularly pinnate in arrangement, mostly subopposite, leaving the midrib at acute angles of divergence below, at successively more and more obtuse angles above, curving upward and becoming camptodrome along the margin.

This is a well-defined species, apparently referable to *Persea* or some closely related lauraceous genus. Incidentally, however, it may be of interest to note its almost perfect resemblance to *Rhus bella* Heer,[33] from a supposed Tertiary horizon in Greenland. If the leaf represented by Heer's Figure 4 had been described as a Cretaceous species the probability is that no question would have been raised as to its specific identity with ours from Alaska.

Locality: Yukon River, north bank, Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962).

Genus **DAPHNOGENE** Unger

Daphnogene cocculoides Hollick, n. sp.

Plate 45, Figure 5

Leaf linear-lanceolate-elliptical, entire, about 6.25 centimeters in length by 1.75 centimeters in width across the middle; nervation consisting of a midrib two acrodrome lateral primary nerves, and a series of uniformly fine secondary nerves that diverge from the midrib at obtuse angles and connect with the lateral primaries above and are camptodrome between the lateral primaries and the margin, where they coalesce and form a delicate, undulate marginal nerve.

This specimen belongs to the general type of leaves that have been referred and transferred, from time to time, to the genera *Daphnogene*, *Cinnamomum*, *Cocculus*, *Paliurus*, and *Zizyphus;* and it closely resembles *Cocculus cinnamomeus* Velenovsky,[34] from the Cenomanian of Bohemia, but it is somewhat more slender and elongated, and its surficial characters appear to indicate relationship with the Lauraceae.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634).

Daphnogene turbulenta Hollick, n. sp.

Plate 45, Figure 6

Leaf oblong-elliptical, tapering to base and summit, entire, 7 centimeters in length by 2.75 centimeters in width across the middle; nervation consisting of a midrib and two acrodrome lateral primaries of equal rank with the midrib, that arise from the base of the leaf.

This leaf is given a distinct specific rank, not because it possesses obvious distinctive characters but, on the contrary, for the reason that it belongs to a type of leaf that includes so many forms closely resembling one another, to which different specific and generic names have been given, that it can not be referred exclusively to any particular described species, and individual opinion will always differ where such close similarity exists. As examples in this connection the following references may prove of interest: *Daphnogene cinnamomeifolia* (Brongniart) Unger, as depicted by Watelet[35] from the Eocene of France; *Cinnamomum newberryi* Berry,[36] from the Upper Cretaceous (Eutaw formation) of Georgia; *Ceanothus cretaceus* Dawson,[37] from the Upper Cretaceous of Vancouver Island; and *Paliurus ovalis* Dawson,[38] from the Upper Cretaceous (Mill Creek series) of Canada. Other leaf forms, practically indistinguishable from these, to which distinct specific names have been given, might readily be cited, but these are probably sufficient for purposes of comparison and as examples of expressions of opinion in regard to generic relationship and specific identity.

Locality: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639).

[32] Knowlton, F. H., in Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, p. 57, 1911. See also this paper, p. 5.

[33] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, No. 4, p. 482, pl. 56, figs. 3–5, 1869.

[34] Velenovsky, Josef, Die Flora der böhmischen Kreide-Formation, pt. 4: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 5, No. 1, p. 4 (65), pl. 8 (31), figs. 16–21, Wien, 1885.

[35] Watelet, Adolphe, Description des plantes fossiles du bassin de Paris, p. 177, pl. 50, fig. 17, Paris, 1866.

[36] Berry, E. W., The Upper Cretaceous and Eocene floras of South Carolina and Georgia: U. S. Geol. Survey Prof. Paper 84, p. 117, pl. 21, figs. 9–11, 1914.

[37] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 28, pl. 8, fig. 33, 1882 [1883].

[38] Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 14, pl. 4, fig. 4, 1885 [1886].

Genus DAPHNOPHYLLUM Heer

Daphnophyllum dakotense Lesquereux?

Plate 45, Figure 4

Daphnophyllum dakotense Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 99, pl. 51, figs. 1–4; pl. 52, fig. 1, 1892.

This leaf belongs to the type commonly included in the genus *Laurus*, or *Laurophyllum*, or *Daphnophyllum*, and it compares so closely with Lesquereux's species of *Daphnophyllum*, from the Dakota sandstone of Kansas, that at least provisional reference appears to be justified. Lesquereux's figures show more or less variation both in form and in nervation, and our specimen compares more closely with his Figure 2 on Plate 51 than that does with his Figure 1 on Plate 52. Another leaf with which it may also be compared is *Laurus hollicki* Berry,[39] from the Magothy formation of New Jersey, Delaware, and Maryland.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Genus CINNAMOMUM R. Brown

Cinnamomum dubiosum Hollick, n. sp.

Plate 45, Figure 1

Leaf obovate, inequilateral, entire, 6 centimeters in length by 3.75 centimeters in maximum width, rounded above to a broad, curved summit and below to a curved, wedge-shaped base, triple-nerved, apparently from close to the base; lateral primaries diverging from the midrib at acute angles, curving inward and extending close to the margin in the upper part of the leaf blade, where they thin out and apparently connect with and merge into fine secondary nerves from each side of the midrib.

Critical diagnostic characters in this leaf are either obscure or entirely lacking. The basal portion is missing, hence it is impossible to determine definitely whether the lateral primaries are basilar or suprabasilar. The apex was apparently abruptly apiculate. It is suggestive of certain of the forms of *Cinnamomum buchi* Heer,[40] but this is a strictly Tertiary species, and, in any event, the critical characters in our specimen are too poorly preserved for satisfactory comparison. It is possible, in fact, that the generic reference may be questioned, and that some other genus—*Paliurus*, *Ceanothus*, or *Zizyphus*—might be considered equally applicable.

Locality: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250).

Order PLATANALES

Family PLATANACEAE

Genus PLATANUS Linnaeus

Platanus? newberryana Heer

Plate 46, Figures 2, 3; Plate 47, Figure 3

Platanus? newberryana Heer, in Capellini and Heer, Les phyllites crétacées du Nebraska: Soc. helv. sci. nat. Nouv. mém., vol. 22, No. 1, p. 16, pl. 1, fig. 4, 1866.

A considerable variety of leaf forms have been referred to this species by Heer, Lesquereux, and subsequent writers, some of which might be regarded as distinct species. The particular figures with which our specimens appear to compare most closely are some by Heer[41] representing specimens from the Patoot beds of Greenland. In one or another of its forms it has been reported from the Dakota sandstone of Nebraska by Lesquereux[42] and from the Magothy (?) formation of Long Island, N. Y., by Pollard.[43]

Localities: Yukon River, north bank, near Nulato; collected by I. C. Russell in 1889 (pl. 46, fig. 2). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634) (pl. 46, fig. 3). Yukon River, north bank, about 6 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 47, fig. 3).

Platanus? newberryana conditionalis Hollick, n. var.

Plate 46, Figure 4; Plate 47, Figure 4; Plate 48, Figure 1

These leaves are similar to the lobed forms of *Platanus? newberryana* Heer as depicted by Lesquereux[44] from the Dakota sandstone of Nebraska and by Heer[45] from the Patoot beds of Greenland, except that in our specimens the dentition is conspicuously coarser. The particular figure that resembles ours most nearly in this feature is Heer's Figure 3, but in regard to this one he remarks[46] that it "belongs perhaps to another species."

In view of the variety of leaf forms that have been included in the species, and the fragmentary nature of our specimens, it has seemed advisable to give them varietal rank pending the time when better specimens may be available for comparison.

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[39] Berry, E. W., New York Bot. Gard. Bull., vol. 3, No. 9, p. 79, pl. 52, fig. 4, 1903.

[40] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 90, pl. 95, figs. 1–8, Winterthur, 1856.

[41] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, pl. 59, figs. 2, 6, 1883.

[42] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 72, pl. 8, figs. 2, 3; pl. 9, fig. 3, 1874.

[43] Pollard, C. L., New York Acad. Sci. Trans., vol. 13, p. 181, 1894.

[44] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, pl. 8, fig. 3, 1874.

[45] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, pl. 59, figs. 1, 3, 1883.

[46] Idem, p. 29.

Localities: Koyukuk River, west bank, about 39 miles above its mouth (original No. 333); collected by F. C. Schrader in 1899 (lot 7472) (pl. 46, fig. 4). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634) (pl. 47, fig. 4; pl. 48, fig. 1).

Platanus septentrionalis Hollick, n. sp.

Plate 47, Figures 1, 2; Plate 48, Figures 2–4; Plate 49, Figure 1

Leaves variable in size, trilobate; base broad, abruptly constricted close to and decurrent for a short distance on the petiole; margin coarsely dentate above, finely dentate in the lower part; nervation tripalmate, craspedodrome; secondary nerves irregularly disposed, mostly alternate, six on each side, leaving the midrib at various angles of divergence; lateral primaries suprabasilar, spreading, branched on the under sides, each lowest branch similarly branched from the under side.

These leaves apparently represent a new species of *Platanus* which has its nearest analogue in *P. shirleyensis* Berry,[47] from the Tuscaloosa formation of Alabama; but unfortunately, in connection with neither species are perfect specimens figured, and satisfactory comparison is impossible.

Locality: Yukon River, north bank, about 3 miles above Pickart's mine (original No. 3AH18); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3253).

Platanus latior (Lesquereux) Knowlton

Plate 51, Figure 2

Platanus latior (Lesquereux) Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 170, 1898.

Platanus aceroides? Goeppert var. *latior* Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 97, 1868.

Platanus primaeva Lesquereux, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 69, pl. 7, fig. 2; pl. 26, fig. 2, 1874; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 72, pl. 8, figs. 7, 8, 8a, b; pl. 10, fig. 1, 1892.

This specimen almost certainly represents the lower part of a leaf of this species, similar to the one depicted by Lesquereux under the name *Platanus primaeva* in his "Flora of the Dakota group," Plate 10, Figure 1.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

[47] Berry, E. W., Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 83, pl. 15, figs. 1–5, 1919.

Platanus latior intermedia Hollick, n. var.

Plate 75, Figure 1

This leaf is similar to *Platanus latior subintegrifolia* (Lesquereux) Knowlton,[48] from the Dakota sandstone of Kansas. It is obscurely trilobate, however, with apparently coarser dentition than in Lesquereux's variety, thus indicating a form intermediate between the latter and *P. latior grandidentata* (Lesquereux) Knowlton.[49]

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Platanus valida Hollick, n. sp.

Plate 75, Figure 2

Leaf expanded in its lower part, rounded to a broad, cuneate base; margin serrate-dentate; nervation tripalmate, craspedodrome; lateral primaries ascending at angles of about 45° from the midrib, subparallel with the secondary nerves next above, each giving off six or more forked branches from the under side, the branches and their ramifications each terminating in one of the teeth; secondary nerves irregularly disposed, widely spaced on each side of the midrib.

This leaf is somewhat similar in general appearance to *Platanus latior intermedia*, the specific variety last described, but the nervation is more ascending, and the dentition, as far as it is preserved, appears to be serrate rather than triangular-dentate.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 3AH29); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3268).

Platanus heerii Lesquereux

Plate 43, Figure 2; Plate 46, Figure 1; Plate 55, Figure 2

Platanus heerii Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 303, 1872; The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 70, pl. 8, fig. 4 [1]; pl. 9, figs. 1, 2, 1874; The Cretaceous and Tertiary floras: Idem, vol. 8, p. 44, pl. 3, fig. 1; pl. 7, fig. 5, 1883.

Knowlton, F. H., in Eakin, H. M., The Yukon-Koyukuk region, Alaska: U. S. Geol. Survey Bull. 631, p. 48, 1916.

Lesquereux included a considerable variety of leaf forms in this species, from the Dakota sandstone of Kansas—lobed and unlobed, dentate and entire—and his example was followed by Heer [50] in connection with

[48] Knowlton, F. H., A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 170, 1898 (=*Platanus primaeva subintegrifolia* Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 73, pl. 9, figs. 3, 4, 1892.)

[49] Idem, p. 170 (=*Platanus primaeva grandidentata* Lesquereux, op. cit., pl. 9, figs. 1, 2).

[50] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 72, pl. 7, figs. 1, 2; pl. 8, figs. 1, 2a; pl. 9, figs. 1, 2, 3a, 4, 1882.

leaves referred to the species from the Atane beds of Greenland.

The leaves represented by our Figure 2, Plate 43, and Figure 1, Plate 46, belong apparently to the unlobed form, with obscurely dentate margin, such as those depicted by Heer in his Figure 1, Plate 7, and Figure 2a, Plate 8; but the leaf represented by our Figure 2, Plate 55, represents a broader, possibly lobed form.

Unlobed forms, with dentate margins, are figured by Ward,[51] from the Eocene (?) of Wyoming, and Berry [52] has referred a number of fragmentary specimens from the Raritan formation of Maryland and the District of Columbia to the same species.

Localities: Yukon River, north bank, between Pickart's mine and Nulato (original No. 358); collected by F. C. Schrader in 1899 (lot 7471) (pl. 43, fig. 2). Yukon River, north bank, near Nulato; collected by I. C. Russell in 1889 (pl. 46, fig. 1). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 20); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4634) (pl. 55, fig. 2).

Platanus latibasalis Hollick, n. sp.

Plate 51, Figure 1

Platanoid leaf of unknown form and dimensions, with a broad, undulate-truncate base, terminating in abruptly constricted, short, rounded alations to the petiole; secondary nervation coarse, widely spaced, irregularly disposed, ascending, the lower two suprabasilar, inequidistant from the base of the leaf and simulating lateral primaries, with branches from the under sides.

This imperfect platanoid leaf is given a distinct specific name with some hesitation, as in its general characters, so far as they are discernible, it is suggestive of one of the forms of *Platanus primaeva* Lesquereux,[53] from the Dakota sandstone of Kansas, and of certain forms of *Platanus heerii* Lesquereux,[54] from the same horizon and locality. Possibly it might better be regarded as representing a variety of one or the other of these species, but its apparently unique basilar characters and the impossibility of identifying it satisfactorily with either one of these species to the exclusion of the other have seemed to justify giving to it a distinct specific rank.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

[51] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 552, pl. 40, figs. 8, 9, 1886.

[52] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 824, pl. 65, figs. 1–6; pl. 66, figs. 1–6; pl. 67, figs. 1–7, 1916.

[53] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 72, pl. 8, fig. 7, 1892.

[54] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 70, pl. 9, figs. 1, 2, 1874.

Platanus alata Hollick, n. sp.

Plate 49, Figures 2, 3

Leaves large, coarse, of unknown form and dimensions, the base extended into long alate borders to the petiole with numerous horizontal veinlets on each side; nervation consisting of a strong midrib and two or more pairs of stout, subopposite, widely spaced secondary nerves that leave the midrib at obtuse angles of divergence and soon curve upward, the lowest pair suprabasilar and presenting an appearance of lateral primaries, strongly and irregularly branched from the under side, the lower branches simulating the characters of the horizontal basilar veinlets below.

It is impossible to describe these leaves accurately or satisfactorily, by reason of their fragmentary condition. They evidently represent a large coarsely nerved species, probably lobed. The two specimens differ considerably in size, but the most striking specific characters are identical in each. They apparently have their nearest analogue in the Miocene species *Platanus appendiculata* Lesquereux.[55]

Localities: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258) (pl. 49, fig. 3). Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638) (pl. 49, fig. 2).

Platanus? sp.

Plate 50, Figures 1, 2

These fragmentary specimens represent two large platanoid leaves, possibly referable to *Platanus alata* or *Platanus latibasalis*, the two species last described, but they are too imperfect for satisfactory comparison.

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 50, fig. 1). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 50, fig. 2).

Platanus? grewiopsoides Hollick, n. sp.

Plate 28, Figure 5b; Plate 52, Figure 1

Leaf obovate-orbicular, asymmetric, 8 centimeters in length by 8 centimeters in maximum width, broadly wedged-shaped from above the middle to the apex,

[55] Lesquereux, Leo, Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, No. 2, p. 12, pl. 3, figs. 1–6; pl. 6, fig. 7b, 1878.

rounded below and terminating in an abruptly constricted, short, acute, cuneate base; margin coarsely serrate-dentate from the middle upward, becoming finely dentate and entire below; nervation pinnate subtripalmate, craspedodrome; midrib curved; secondary nerves five on each side, opposite or subopposite, subparallel, leaving the midrib at acute angles of divergence, except the upper ones, which subtend more obtuse angles, the lowest pairs simulating lateral primaries, suprabasilar, flexuous, branched on the under sides, the branches curving upward.

These leaves, although evidently more or less distorted, are apparently normally asymmetric or curved to one side. They possess the character of both *Platanus* and *Grewiopsis* and may be compared with the type of leaves represented by *Platanus?* sp. Knowlton,[56] from the Vermejo formation of southeastern Colorado, and *Grewiopsis populifolia* Ward,[57] from the Fort Union formation of Montana. The generic reference is questioned in view of the diverse opinions that have been expressed in regard to the generic affiliations of leaves of this general type, some of which have been referred to the genera previously mentioned and others to the genera *Cissites* and *Populites*,[58] in connection with many of which the resemblances are more apparent than the differences.

Localities: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 28, fig. 5b). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 52, fig. 1).

Genus CREDNERIA Zenker

Credneria inordinata Hollick, n. sp.

Plate 56, Figure 3; Plate 57, Figures 2, 3

Leaves averaging about 10 centimeters in length by about 10 centimeters in width across the expanded upper part, more or less irregular and asymmetric in shape, with an angular, obovate outline, obliquely truncate above and the apex turned slightly to one side; margin serrate-dentate and triangular-dentate, except at the broadly truncate wavy base; nervation pinnate, subpalmate, craspedodrome, consisting of a midrib and four or five irregularly disposed secondary nerves on each side, mostly subopposite, with one or more branches toward their extremities, for the most part from their under sides, lowest pair suprabasilar, with numerous branches on their under sides, mostly forked and extending to the dentitions of the adjacent margin; lamina of the leaf blade below the two basal secondary nerves traversed by a number of relatively strong secondary nervilles that leave the midrib at approximately right angles.

These leaves vary more or less in shape and, to a certain extent, in nervation, but not enough to warrant more than a possible varietal distinction. They are all similar in shape to the general type of leaf represented by *Credneria zenkeri asymmetrica* Richter[59] and *C. zenkeri denticulata* (Zenker) Richter;[60] but all of our specimens are more irregularly branched than either of these species, and the margins are dentate below as well as above the termini of the basal secondaries. The branching of the basal secondary branches and the craspedodrome character of these, coincident with the dentition of the adjacent margins, are also distinguishing features. The asymmetry of the upper part of the leaves is well exemplified in Figure 3, Plate 57; and in all our figures it may be seen that the branches of the basal secondaries are markedly different on the opposite sides of each leaf.

Localities: Yukon River, north bank, about 8 miles below Kaltag (original No. 3AH29); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3268) (pl. 56, fig. 3). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 57, figs. 2–3).

Credneria inordinata maxima Hollick, n. var.

Plate 58, Figures 1, 2

Pterospermites dentatus Heer, Newberry, The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 133, pl. 53, fig. 1, 1898.

Leaf asymmetrically orbicular-obovate, about 14 centimeters in length by about 14 centimeters in maximum width; margin triangular-serrate-dentate; nervation characteristic of the genus and species. Differs from the species mostly in its larger size.

These two figures represent a specimen identified by Newberry as the Tertiary species *Pterospermites den-*

[56] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 269, pl. 42, fig. 3, 1917.

[57] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 556, pl. 55, figs. 8–10, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 90, pl. 40, figs. 3–5, 1887.

[58] *Cissites affinis* (Lesquereux) Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 352, 1876; The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 67, 1883 (=*Populites affinis* Lesquereux, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 71, pl. 4, fig. 4, 1874). Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 28, pl. 57, fig. 4; pl. 58, fig. 1; pl. 59, fig. 7, 1883. Dawson, J. W., Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 12, pl. 4, fig. 2, 1885 [1886].

[59] Richter, P. B., Die Gattung *Credneria* und einiger seltenere Pflanzenreste: Beiträge zur flora der oberen Kreide Quedlinburgs und seiner Umgebung, pt. 1, p. 12, 5, figs. (4?), 5, Leipzig, 1905.

[60] Idem, p. 13, pl. 2, figs. 6, 7; pl. 6, figs. 1, 2 (=*C. denticulata* Zenker, Beiträge zur Naturgeschichte der Urwelt, p. 18, pl. 2, fig. E, Jena, 1833).

tatus Heer.[61] Figure 1 is a photograph of Newberry's figure. Figure 2 is a photograph of the left side of the specimen from which the drawing for Newberry's figure was made. The specimen was evidently broken across, in the direction indicated by the two arrow points in our Figure 1, and the right side of the specimen was lost. Our two figures are arranged on the plate so that the two representations of the left side of the specimen are contiguous and at the same angle, in order to facilitate comparison. It is evidently a *Credneria* that differs but little from *Credneria inordinata*, the species last described, and but for its larger size might properly be regarded as specifically identical with that species.

This is one of the specimens collected by W. H. Dall in 1866, and he has assured me that it came from the north bank of Yukon River in the vicinity of Nulato, a locality that is within the general region in which our specimens of *Credneria inordinata* were subsequently collected. The fossil flora of this region is now known to be of Cretaceous age; but the prevailing opinion at the time when Newberry's manuscript was prepared was that the sedimentary rocks of the region were of Tertiary age, and Newberry's identification of the specimen as a Tertiary species was probably influenced by and in deference to the then prevailing opinion. It is evident, however, that his identification was made with some reservation, for he qualifies it by the incidental remark, "if we accept that name for the species." A comparison with Heer's figures clearly shows that the identification was erroneous.

Locality: Yukon River, north bank, in the vicinity of Nulato; collected by W. H. Dall in 1866 (U. S. Nat. Mus. catalogue No. 7122).

Credneria spatiosa Hollick, n. sp.

Plate 59

Leaf large, about 18 centimeters in length by about 18 centimeters in width at a distance of 14 centimeters from the base, shape not known, asymmetric, broadest in the upper part, narrowed below to an oblique, truncate base; nervation consisting of a midrib and at least four pairs of subopposite secondary nerves, the upper ones flexuous, leaving the midrib at rather obtuse angles of divergence, the lower pair suprabasilar, simulating lateral primaries, leaving the midrib at acute angles of divergence, soon curving outward, with irregularly disposed, flexuous, occasionally forked branches on their under sides; marginal characters obscure; basilar veinlets horizontal or curved downward.

The general characters of this leaf are similar to those of the smaller allied species of the genus. It is clearly asymmetric, with a truncate base and an expanded upper part. Apparently it was broadest on the right side as represented in the figure, with the branches from the basal secondary on that side much larger and more strongly developed than on the other. It might, indeed, be taken for an exaggerated form of *Credneria inordinata* of the type depicted in Figure 3, Plate 56, and Figure 3, Plate 57.

Locality: Yukon River, north bank, refuse dump at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Credneria longifolia Hollick, n. sp.

Plate 60

Leaf large, about 20 centimeters in length by about 12 centimeters in width at a distance of 14 centimeters from the base, obovate, apparently asymmetric; margin entire, undulate, at least in the lower part; midrib curved; secondary nerves four or more on each side, irregularly disposed, widely spaced, flexuous, ascending at acute angles of divergence from the midrib, lower two subopposite, suprabasilar, with numerous widely spaced, flexuous branches on the under sides that curve irregularly upward and finally thin out and disappear along the margin; basilar veinlets prominent, the upper ones curving upward, the lower ones horizontal.

This leaf, in its perfect form, was apparently larger on one side than on the other, turned to one side in its upper part, and had the secondary nerves arranged differently on opposite sides of the midrib. The indications are that the base was truncate, after the manner characteristic of other species of the genus.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Credneria grewiopsoides Hollick, n. sp.

Plate 52, Figure 3; Plate 53, Figure 1

Leaves suborbicular, crenate-dentate above, becoming denticulate and entire below; nervation pinnate subpalmate, secondaries about six on each side of the midrib, subopposite, leaving the midrib at diverse angles of divergence, subparallel, flexuous, terminating in the dentitions, the basal pair strongest, simulating lateral primaries, with numerous branches on the under sides, of which the lower ones curve upward toward the margin and the upper ones extend to the margin and terminate in the dentitions. The larger of these specimens indicates a leaf that was apparently about 18 centimeters in length by about 20 centimeters in width across the middle.

In each of our specimens, unfortunately, the base is missing and only a small portion of the margin is

[61] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6, 7, [8, 9?], 1868.

preserved; but their identity with the genus *Credneria* appears to be unmistakable, although there is a resemblance to certain leaves that have been referred to the genus *Grewiopsis*, such as the general type represented by the Tertiary species *Grewiopsis credneriaeformis* Saporta,[62] which he lists in his table of affinities [63] as analogous to the Cretaceous species *Credneria denticulata* Zenker.[64] The latter species possesses general features that are similar to those of ours, but the dentitions are coarser and the base of the leaf is less rounded than in either of our specimens. Stiehler,[65] however, figures a specimen with a broader, more rounded base.

In outline our species more nearly resembles *Credneria acuminata* Hampe, as depicted by Stiehler,[66] *C. macrophylla* Heer,[67] and *C. zenkeri orbicularis* Richter.[68] All these species, however, have entire margins, as has also *Credneria protophylloides* Knowlton,[69] from the Vermejo formation of southeastern Colorado, which Knowlton compares, in respect to its general characters, with *C. integerrima* Zenker.[70]

Heer [71] refers a leaf from the Atane beds of Greenland, without discussion, to *C. integerrima*, but unfortunately all of the margin except a small portion of the lower part is missing in the figure, and it is impossible to determine whether or not the upper part of the margin was entire or dentate. A comparison of this figure with ours, however, shows so striking a resemblance in all its discernible characters that there seems to be no doubt of the mutual identity of the species nor of the error in Heer's determination of his specimen as *C. integerrima*.

Incidental reference may also here be made to *Protophyllum nanaimo* Dawson,[72] represented by a fragmentary figure of a large leaf from the Cretaceous of Nanaimo, Vancouver Island, which also may belong to our species; in that event Dawson's specific name would have precedence.

[62] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, No. 3, p. 404 (116), pl. 34 (13), fig. 7, 1868.

[63] Idem, p. 424.

[64] Zenker, J. C., Beiträge zur Naturgeschichte der Urwelt, p. 18, pl. 2, fig. E, Jena, 1833.

[65] Stiehler, A. W., Beiträge zur Kenntniss der vorweltlichen Flora des Kreidegebirges im Harze, 1–5: Palaeontographica, vol. 5, No. 2, p. 64, pl. 9, fig. 4, 1857.

[66] Idem, pl. 10, figs. 6, 7.

[67] Heer, Oswald, Beiträge zur Kreide-Flora; I, Flora von Moletein in Mähren: Soc. helv. sci. nat. Nouv. mém., vol. 23, No. 2, p. 16, pl. 4, 1869.

[68] Richter, P. B., Die Gattung *Credneria* und einige seltenere Pflanzenreste: Beiträge zur Flora der oberen Kreide Quedlinburgs und seiner Umgebung, pt. 1, p. 12, pl. 2, figs. 2–3, Leipzig, 1905.

[69] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 267, pl. 46, 1917.

[70] Zenker, J. C., Beiträge zur Naturgeschichte der Urwelt, p. 17, pl. 2, fig. F, Jena, 1883.

[71] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 78, pl. 36, fig. 4, 1882.

[72] Dawson, J. W., On the Cretaceous and Tertiary floras of British Columbia and the Northwest Territory: Roy. Soc. Canada Trans., vol. 1, sec. 4, art. 2, p. 28, pl. 8, fig. 35, 1882 [1883].

Localities: Yukon River, north bank, just above Pickart's mine (original No. 3AH18a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3254) (pl. 52, fig. 3). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 53, fig. 1).

Credneria mixta Hollick, n. sp.

Plate 56, Figure 4; Plate 57, Figure 1

Leaves about 9 centimeters in length by 7 centimeters in maximum width, ovate, asymmetric, the apex turned to one side, oblique, the base truncate, oblique; margin denticulate above, entire below; midrib flexuous; secondary nerves pinnately arranged, craspedodrome, four or five on each side, sharply ascending, alternate or subopposite, branched on the under sides toward the extremities, the lowest two suprabasilar, simulating lateral primaries, with branches on the under sides that diverge from the lateral primaries at obtuse angles and are either camptodrome or craspedodrome according to the entire or denticulate character of the adjacent margin; basilar veinlets horizontal.

The leaves appear to have the marginal characters of *Credneria grewiopsoides*, the species last described, and the nervation of *C. inordinata*. (See p. 86, pl. 56, fig. 3, and pl. 57, figs. 2, 3.) They differ slightly between themselves, and either specimen might be regarded merely as a form of some one or another of the species described in these pages. Their ovate rather than obovate outline is their principal distinguishing feature.

Localities: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 56, fig. 4). Yukon River, north bank, about 3 miles above Kaltag (original No. 3AH27); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3266) (pl. 57, fig. 1).

Credneria elegans Hollick, n. sp.

Plate 56, Figure 2

Leaf medium sized, of unknown shape, with a subcordate, truncate base and irregularly, coarsely serrate-dentate margin; midrib strong, with an abruptly enlarged base from the lower pair of secondary nerves downward; secondary nerves strong, irregularly disposed, leaving the midrib at acute angles of divergence, the lower pair subopposite, suprabasilar, each with three or more branches from the under side, all curving upward; basilar nervilles well defined, branched, the branches terminating in the teeth.

This beautiful leaf evidently represents a distinct species, and it is unfortunate that only the lower part is preserved. It is especially characterized by its broadly expanded base traversed by conspicuous nervilles. Also, the secondary nerves are more widely spaced, and the dentitions larger than in any other species.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 3AH29); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3268).

Credneria intermedia Hollick, n. sp.

Plate 55, Figure 1

Leaf about 13 centimeters in length by 14 centimeters in maximum width, with an obovate outline and a broad, wavy, entire, truncate base; nervation pinnate subpalmate; midrib flexuous, turned to one side in the upper part; secondary nerves alternate, five or more on each side, flexuous, the upper ones leaving the midrib at angles of about 45°, the lowest two subopposite, suprabasilar, simulating lateral primaries, diverging from the midrib at angles of about 60°, curving upward, with six or more slender branches on the under sides that curve upward and coalesce in a network of fine nervilles along the margin; basilar veinlets arched upward and ultimately bent downward to the margin.

This leaf appears to be intermediate in form between the larger and the smaller species of *Credneria* described in this volume. The margin is apparently entire in its lower part, and the general appearance of the leaf indicates that it was expanded and asymmetric in its upper part.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Credneria basinervosa Hollick, n. sp.

Plate 56, Figure 1

Leaf of medium size, shape unknown, widest in the upper part, narrowed below to a broad truncate, entire base; nervation pinnate subpalmate, arranged in four or more pairs of opposite, subparallel secondary nerves that leave the midrib at approximately uniform, acute angles of divergence, the lower pair basilar or subbasilar and simulating lateral primaries, somewhat spreading, with numerous subparallel branches on the under sides that extend sharply upward toward the margin; midrib straight, expanded between the two lower pairs of secondaries, subpeltate(?) at the extreme base of the leaf; basilar veinlets obscurely defined.

This leaf belongs in the group of species that have the midrib expanded in the lower part; but it is unique in having this expansion above instead of below the lower pair of secondaries. These secondaries are basilar or subbasilar instead of suprabasilar, and the leaf is apparently obscurely peltate at the extreme base; or possibly this apparent feature may represent merely an overlapping of the margin on each side.

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Credneria comparabilis Hollick, n. sp.

Plate 57, Figure 4

Leaf about 7.5 centimeters in length by about 6 centimeters in width above the middle, apparently ellipsoidal or obovate in outline, with a rounded base and entire margin; nervation pinnate, consisting of three or possibly four pairs of subopposite secondaries that leave the midrib at acute angles of divergence, the lower pair suprabasilar, with branches on the under sides that diverge from the secondaries at acute angles and curve slightly upward at their extremities; basilar veinlets apparently simple, upward curved.

This leaf presents a different general aspect from any other of the Alaskan species of *Credneria*. The secondary nerves and the branches from the basal pair are more rigid and erect than in any other of the species, and the base of the leaf was apparently rounded rather than truncate. It is suggestive of the figure designated "*Credneria* spec." by Heer,[73] from the Atane beds of Greenland; but in our specimen the base, which would provide a characteristic feature for identification, is defective, and Heer's figure lacks the upper part, so that no satisfactory comparison between them is possible.

Locality: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639).

Credneria? parva Hollick, n. sp.

Plate 65, Figure 5

Leaf small, obovate(?), approximately 2.5 centimeters in length by 1.75 centimeters in maximum width, terminating below in a cuneate, decurrent base; nervation subtripalmate; lateral primaries opposite, suprabasilar at a distance of about 4 millimeters above the base, sharply ascending at acute angles of divergence from the midrib, each with three or more subparallel ascending branches on the under or outer side; lower margin entire; basilar veinlets ascending, subparallel with the lower branches of the lateral primaries.

This imperfect little leaf, on account of its small size, is referred with some doubt to *Credneria*. The

[73] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 2, p. 111, pl. 32, figs. 20, 21, 1874.

only other recognized species of the genus with which it compares in size is one depicted by Kryshtofovich [74] under the name "*Credneria* aff. *integerrima* Zenk.,"[75] from the Cretaceous of the island of Sakhalin. The comparison with Zenker's species, however, refers only to similarity in shape, as may be seen by a glance at the two figures. It appears probable that a perfect leaf of our species would not be very different in character from the leaf figured by Kryshtofovich, although the indicated form of ours is narrower.

Locality: Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243).

Genus PARACREDNERIA Richter

Paracredneria crednerioides Hollick, n. sp.

Plate 54, Figure 1

Leaf apparently slightly inequilateral, roughly obovate-elliptical, with flattened sides, about 13 centimeters in length by 10 centimeters in width at the broadest part (above the middle), coarsely and irregularly triangular-dentate from just below the middle upward, entire or undulate below; nervation pinnate, craspedodrome; secondary nerves flexuous, widely spaced, irregularly disposed, forked or branched from the under sides, leaving the midrib at acute angles of divergence, curving upward, except close to the margin, where they bend slightly backward and terminate in the dentitions.

This fragmentary leaf has the nervation of *Paracredneria* and the characteristic obovate outline of *Credneria*. The apex is apparently turned to one side, the secondary nerves appear to be unequal in number on the two sides of the midrib, and there is a difference of about 1 centimeter in width between the two sides of the leaf, measured from the midrib to each opposite part of the margin. If complete the leaf would apparently show an outline similar to *Credneria zenkeri asymmetrica* Richter.[76]

The discovery in Alaska of this and apparently of one other new species of *Paracredneria*—a genus known heretofore from only one locality, in the Old World—is of considerable ecologic as well as paleontologic interest, especially as, until the discovery of the Alaskan species, the genus was represented only by a single known species.

Locality: Yukon River, north bank, about 3 miles above Pickart's mine (original No. 3AH18); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3253).

Paracredneria alaskana Hollick, n. sp.

Plate 54, Figures 2, 3

Leaves elliptical-ovate, asymmetric (?), about 13 centimeters in length by about 9 centimeters in width through the middle, remotely and broadly triangular-dentate from below the middle upward, irregularly wavy margined toward the base; apex turned or bent sideways; nervation pinnate, craspedodrome; secondary nerves about six or seven on each side, irregularly spaced and disposed, forked or branched, mostly curving upward at various angles of divergence close to the midrib, bending backward toward the margin, the lowest on each side simple, flexuous, extending to and gradually thinning out and disappearing in the margin.

These leaves are hardly to be distinguished from *Paracredneria fritschii* Richter,[77] and I am inclined to believe that they may eventually be determined to belong to that species. Unfortunately, both Richter's figures and ours represent imperfect specimens, and accurate comparison is impossible. It may be seen, however, that they possess certain peculiar and characteristic features in common. They are apparently asymmetric or inequilateral, one side being broader than the other; the secondary nerves are unequal in number on the two sides, and those on one side diverge from the midrib at acute angles, while those on the other diverge at obtuse angles; and the apex is bent or turned to one side. By comparing Richter's Figure 9 and our Figure 2 these features in common may be seen to be strikingly exemplified.

A species that is somewhat suggestive of ours is *Credneria? pachyphylla* Knowlton,[78] from the Eocene of the Yellowstone National Park, which is apparently a *Paracredneria* with entire margin.

Locality: Yukon River, north bank, about 3 miles below Blatchford's mine (original No. 3AH21); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3260).

Paracredneria? platanoidea Hollick, n. sp.

Plate 51, Figure 3

Leaf apparently rhomboidal or kite-shaped, with a broad, curved, truncate base abruptly constricted into short alate extensions on each side of the petiole; margin coarsely triangular-dentate above, entire be-

[74] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 52, fig. 9, 1918.

[75] Zenker, J. C., Beiträge zur Naturgeschichte der Urwelt, p. 17, pl. 2, fig. F, Jena, 1833.

[76] Richter, P. B., Die Gattung *Credneria* und einige seltenere Pflanzenreste: Beiträge zur Flora der oberen Kreide Quedlinburgs und seiner Umgebung, pt. 1, p. 12, pl. 5, figs. (4?), 5, Leipzig, 1905.

[77] Richter, P. B., Über die Kreidepflanzen der Umgebung Quedlinburgs: K. Gymn. Quedlinburg, pt. 2, Beil. Ostern Progr. No. 293, p. 15, 1905; Die Gattung *Credneria* und einige seltenere Pflanzenreste: Beiträge zur Flora der oberen Kreide Quedlinburgs und seiner Umgebung, pt. 1, p. 15, pl. 2, fig. 14; pl. 3, fig. 9, Leipzig, 1905.

[78] Knowlton, F. H., in Hague, Arnold, and others, Geology of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 742, pl. 101, fig. 6, 1899.

low; midrib rather slender, turned to one side at the apex; secondary nerves four on each side, widely spaced, branched toward the extremities, the upper ones subopposite, the lowest two opposite, suprabasilar, with branches from the under sides; basilar nervilles crowded.

The alate base of this leaf resembles that of certain species of *Platanus*, the broad upper part is suggestive of a typical *Credneria*, and the ultimate nervation is like that of *Paracredneria*. The apex is turned to one side in the manner characteristic of the latter two genera, but this feature may be merely due to distortion in this individual specimen. In the circumstances a provisional reference to the genus *Paracredneria* appears to be justified, with a specific appellation indicative of the platanoid character of its base.

Locality: Yukon River, north bank, about 6 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259).

Paracredneria? sp.

Plate 53, Figure 2

This specimen represents the apical portion of a leaf that is apparently referable to this genus. It was collected at the same locality as the two specimens of *Paracredneria alaskana* Hollick (see p. 90, pl. 54, figs. 2–3), and it is contained in a matrix of identically the same kind. No satisfactory inference can be drawn from this single fragment, however, as to the form or dimensions.

Locality: Yukon River, north bank, about 3 miles below Blatchford's mine (original No. 3AH21); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3260).

Genus PROTOPHYLLUM Lesquereux

Protophyllum? sp.

Plate 74, Figure 6

This fragment of a large pinnate-veined, sharply dentate leaf apparently belongs to a species of *Protophyllum*, as indicated by the broadly spreading, backward bent, lower secondary nerves—a feature that is characteristic of the genus.

The conspicuously dentate margin serves to differentiate it from most of the larger species of the genus; otherwise it might be taken for a form of *Protophyllum sternbergii* (Lesquereux) Lesquereux.[79]

Among the dentate species with which it may be compared are *Protophyllum praestans* Lesquereux[80] and *P. multinerve* (Lesquereux) Lesquereux,[81] and probably it belongs to one of these species or to one closely allied.

It is unfortunate that the specimen is too fragmentary for satisfactory identification, as it is the only representative of the genus thus far found in any of the Alaskan collections. This genus is typical of the Dakota sandstone and its equivalents, however, so that even in its fragmentary condition the specimen is of value in indicating the geologic age of the horizon in which it was collected.

Incidentally it is of interest to note that the two species *P. sternbergii* and *P. multinerve* are recorded by Berry[82] from the Raritan formation of Maryland and the District of Columbia; and Newberry[83] has described one species, *P. obovatum*, from the Raritan formation of New Jersey.

Locality: Yukon River, south bank, about 25 miles below Mission Creek; collected by J. E. Spurr in 1896 (lot 1555).

Genus PSEUDOPROTOPHYLLUM Hollick, n. gen.

Leaves varying greatly in size, peltate, orbicular or ovoid; nervation craspedodrome, pinnate subpalmate, consisting of a strong midrib and about five pairs of subopposite or, occasionally, opposite ascending secondary nerves, the lowest pair strongest and simulating lateral primaries, with branches on the under sides, mostly forked or branched and terminating in the margin; basilar veinlets numerous, forked, branched, or occasionally simple and anastomosed, radiating laterally and downward from the short, more or less thickened portion of the midrib below the basal pair of secondary nerves, and terminating in the margin.

This leaf genus includes species that vary in size, but all are peltate near the base, similar to *Protophyllum* as originally defined and generally recognized, and have subpalmate and secondary nervation similar to *Credneria*.

The only leaf heretofore described that may be included in the genus without question is *Protophyllum boreale* Dawson,[84] from the Cretaceous of Peace River, Northwest Territory. This species is not a *Protophyllum* and should be relegated to the new genus under the name *Pseudoprotophyllum boreale* (Dawson) Hollick, n. comb.

[79] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 101, pl. 16; pl. 18, fig. 2, 1874; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 189, pl. 42, fig. 1, 1892 (=*Pterospermites sternbergii* Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 425, 1873).

[80] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 188, pl. 41, figs. 2–3; pl. 42, figs. 3–4, 1892.

[81] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept. vol. 6, p. 105, pl. 18, fig. 1, 1872; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 191, pl. 43, fig. 2; pl. 65, fig. 1, 1892 (=*Pterospermites multinerve* Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 302, 1872).

[82] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 828, pl. 62, figs. 1–3; pl. 63, figs. 1–2; pl. 64, fig. 3; p. 829, pl. 63, fig. 3; pl. 64, figs. 1–2, 1916.

[83] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 128, pl. 38, fig. 4, 1895 [1896].

[84] Dawson, J. W., On the Cretaceous and Tertiary floras of British Columbia and the Northwest Territory: Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 28, pl. 4, fig. 13, 1882 [1883].

Only three other heretofore described species appear to be possibly referable to *Pseudoprotophyllum*—namely, *Protophyllum undulatum* Lesquereux,[85] *Protophyllum crenatum* Knowlton,[86] and the species represented by a leaf figured by Lesquereux [87] without any accompanying name or description in the text.

Pseudoprotophyllum emarginatum Hollick, n. sp.

Plate 52, Figure 2a; Plate 65, Figure 3

Leaves small, orbiculate, about 3 to 3.75 centimeters in diameter, peltate, entire, emarginate with a deep wedge-shaped apical sinus; nervation craspedodrome, pinnate subpalmate, consisting of a midrib and three pairs of strongly upward-curving secondary nerves, the lower pair with five upward-curving branches on their under sides that extend to and terminate in the margin; basilar veinlets, curved, anastomosed, radiating laterally and downward from the short, slightly enlarged basal portion of the midrib below the lower pair of secondary nerves; tertiary nervation conspicuously uniform, at right angles to the secondary nerves and branches throughout.

These leaves have the general outline and nervation of *Credneria*, and they might easily be mistaken for a species of that genus except for the peltation. The margin is described as entire, but critical examination reveals what appear like minute denticulations. These, however, may be due to the fine granular structure of the matrix.

Localities: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 52, fig. 2a). Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243) (pl. 65, fig. 3).

Pseudoprotophyllum venustum Hollick, n. sp.

Plate 62, Figures 3, 4; Plate 73, Figure 1

Leaves ovate or oval, 9 to 10 centimeters in length by 8 to 8.5 centimeters in width, peltate at a distance of about 4 millimeters from the somewhat asymmetric base; margin irregularly triangular-dentate and crenate-dentate; nervation craspedodrome, pinnate subpalmate; midrib normally straight; secondary nerves five on each side, opposite or subopposite, subparallel, leaving the midrib at angles of about 30°, all of approximately equal rank, the lowest pair suprabasilar, simulating lateral primaries, with four or five branches on the under sides that curve upward, the lower ones forked; basilar veinlets horizontal from the sides of the midrib and radiating downward from the base.

This appears to be a distinct species, more symmetrical than the others in the genus, with straighter, more uniform nervation and a shorter peltate base. The fragmentary specimens represented by Figures 3 and 4 on Plate 62 are included with some doubt. Their general characters, however, appear to agree with those of the more perfect specimen, and they are all included in collections made in the same general locality.

Locality: Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243).

Pseudoprotophyllum viburnifolium Hollick, n. sp.

Plate 62, Figures 5, 6

Leaves varying in size, about 3 to 5 centimeters in length by 2.5 to 3.8 centimeters in width, ovate (?), peltate at a distance of 1 to 3 millimeters from the blunt, wedge-shaped base; margin denticulate; midrib straight; nervation craspedodrome, pinnate subpalmate; secondary nerves five on each side, subopposite, subparallel, leaving the midrib at angles of about 25°, the lowest ones suprabasilar, branched on the under sides, the branches either forked or simple; basilar veinlets extending from the sides of the midrib at right angles or nearly so, obscure at the base.

These leaves are of the same general type as *Pseudoprotophyllum venustum*, the species last described, with straight, parallel secondary nervation and a short peltate base. The character of the nervation is suggestive of certain species of *Viburnum*, living and fossil, and of *Grewiopsis viburnifolia* Ward [88]; but the peltate base precludes the possibility of considering it in connection with either of these genera.

Localities: Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243) (pl. 62, fig. 5). Yukon River, north bank, about 1 mile above Williams mine (original No. 38); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4641) (pl. 62, fig. 6).

Pseudoprotophyllum crenulatum Hollick, n. sp.

Plate 66, Figure 1

Leaf 11 centimeters in length by 14 centimeters in width across the middle, orbicular-reniform, peltate; apex rounded, flattened, somewhat oblique; base rounded-truncate; margin sinuate-crenulate-dentate; midrib thick below, thin above, flexuous, curved to one

[85] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 189, pl. 42, fig. 2, 1892.
[86] Knowlton, F. H., idem, p. 190, pl. 65, fig. 7.
[87] Lesquereux, Leo, idem, pl. 63, fig. 1.

[88] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 555, pl. 55, fig. 7, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 89, pl. 40, fig. 2, 1887.

side in its upper part; secondary nervation craspedodrome, pinnate subpalmate, arranged in five subopposite pairs above, and an opposite suprabasilar pair below that simulate lateral primaries, all diverging from the midrib at different angles but all curving more or less upward, each of the lowest pair with six branches on its under side, the branches mostly branched or forked toward their extremities, the main branches and their subdivisions terminating in the crenulations of the margin; basilar veinlets more or less branched and anastomosed, radiating laterally and downward from the midrib.

It is unfortunate that this leaf, in which the principal diagnostic characters are well preserved, should be distorted by wrinkling on one side, so that the complete normal outline is not indicated in the figure. It evidently, however, was broader than long and appears to have been obscurely trilobate. The inward-turned side of the leaf is clearly due to distortion and is not a specific character.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Pseudoprotophyllum dentatum Hollick, n. sp.

Plate 65, Figures 1, 2; Plate 66, Figures 2, 3; Plate 67; Plate 73, Figure 3

Leaves orbiculate, peltate, 11 centimeters in length by 13 centimeters in width, sharply and irregularly dentate; nervation craspedodrome, pinnate subpalmate, consisting of a slightly curved midrib with four or five pairs of subopposite, ascending, secondary nerves, the lowest pair simulating lateral primaries, each with six or seven branches on the under side, the lower branches forked three times, the intermediate ones twice or once, the upper ones simple, each main and subsidiary branch terminating in a marginal dentition; basilar veinlets mostly forked, radiating laterally and downward and terminating in the adjacent teeth.

These leaves appear to be slightly oblique at the base; but the apparent obliquity may represent merely imperfections in the margins.

Two leaves that are more or less suggestive of this species may be found figured by Lesquereux,[89] but without any name or description in the text. They are designated "*Protophyllum denticulatum* sp. nov." in the accompanying explanation of the plate; but by referring to the description and figure of that species[90] it will at once be apparent that there is no possible specific relationship between Figures 1 and 2 on Plate 63 and *P. denticulatum*, and the inference seems to be unavoidable that the explanatory designation is erroneous and that it was probably included inadvertently.[91]

It is with some hesitation that the imperfect specimen represented by Figure 3, Plate 73, is included in the species. The entire margin is lacking, and the base is only partly preserved; but the nervation is well defined throughout, and this agrees in its characters with those of *P. dentatum.* Also, the specimen was found at the same locality with the type of the species (pl. 65, fig. 1), and both are included in the same collection.

Localities: Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 65, fig. 1; pl. 73, fig. 3). Yukon River, north bank, just above Williams mine (original No. 3AH30); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3269) (pl. 65, fig. 2). Yukon River, south bank, about 25 miles below Mission Creek; collected by J. E. Spurr in 1896 (lot 1555) (pl. 66, figs. 2, 3). Yukon River, north bank, 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642) (pl. 67).

Pseudoprotophyllum crassum Hollick, n. sp.

Plate 68

Leaf large, 19 centimeters in length by 19 centimeters in width across the middle, coriaceous, ovate-orbicular, obscurely trilobate, with a wavy margin and an auriculate, alate, or possibly peltate base; midrib abruptly thickened between the basal secondaries and the pair above, and again below the basal secondaries; nervation coarse, pinnate subpalmate; secondary nerves opposite and subopposite below, alternate above, diverging from the midrib at approximately equal angles of about 45°, flexuous, mostly forked toward the extremities, craspedodrome, lowest pair suprabasilar, simulating lateral primaries, irregularly branched on the under sides; basilar nervilles radiating laterally and downward from the midrib at a distance of 5 millimeters below the basal secondaries.

This is apparently an obscurely trilobate, peltate leaf, the middle basilar extension of which has dis-

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[89] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, pl. 63, figs. 1, 2, 1892.

[90] Idem, p. 193, pl. 36, fig. 9.

[91] In order that the two figures above cited may have a specific title by which they may be recognized and referred to, the following name is proposed for the species and a brief description appended:

Protophyllum lesquereuxii Hollick, n. name (=Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, pl. 63, figs. 1–2, no name or description in text, 1892).

Leaves roughly oblate or triangular-ovate, asymmetric, peltate at a distance of 1 centimeter from the base; margin unevenly and sharply triangular-dentate and denticulate; base obliquely truncate; midrib turned to one side at the apex; nervation pinnate, craspedodrome; secondary nerves mostly opposite or subopposite, leaving the midrib at various angles of divergence, the upper ones at acute and the lower ones at obtuse angles, all except the upper ones branched on the under side; basilar veinlets forked or simple, radiating laterally and downward from the midrib.

integrated, exposing the upper part of the petiole, which normally would be hidden from view; or the specimen may represent the back of the leaf, with the petiole pressed against the underlying lamina. The texture was evidently coarse or coriaceous and the nervation strong, as may be seen by the almost perfect preservation of the tertiary nervation throughout.

Locality: Yukon River, north bank, about 10 miles above Nulato (original No. 2AC249); collected by A. J. Collier and Sidney Paige in 1902 (lot 2964).

Pseudoprotophyllum comparabile Hollick, n. sp.

Plate 63, Figure 1; Plate 70, Figures 1, 2; Plate 71, Figure 2; Plate 73, Figure 2

Leaves of medium size, peltate, with undulate, denticulate margins; nervation pinnate subpalmate, consisting of a straight midrib and several pairs of subopposite secondary nerves, the lowest pair flexed or somewhat angled, with irregularly disposed branches on the under sides that are mostly forked toward their extremities, where they anastomose and form a network of polygonal areolae, the ultimate nervilles terminating in the margin; basilar veinlets of two ranks, the upper or outer ones forked and relatively strong, the lower or inner ones mostly simple, fine, and occasionally anastomosed toward their extremities, all starting from the extreme base of the midrib.

These leaves appear to represent a form intermediate in size between the largest and smallest species of the genus. Their general characters differ but little from those of other species of the genus, and the minor differences are shown more clearly in the figures than it is possible to describe them in words.

A comparison of our figures with the figure of *Protophyllum boreale* Dawson [92] indicates not only generic but specific identity, and if this apparent identity should be satisfactorily verified the name of our species, under the rules of priority, would become *Pseudoprotophyllum boreale* (Dawson) Hollick, n. comb., and this name would also be applied to Dawson's specimen, as discussed on page 91.

Another species that is evidently closely analogous is *Protophyllum crenatum* Knowlton,[93] which might be regarded as belonging in the genus *Pseudoprotophyllum;* but the specimen upon which the species is based is too imperfect and too poorly depicted for satisfactory specific comparison.

It is unfortunate that in each of our specimens the upper part is missing, so that the species can not be adequately described, but the basilar characters appear to be sufficiently distinct for its specific differentiation. In particular it may be noted that all the basilar nervilles start from the extreme base of the midrib—none from either side.

Localities: Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243) (pl. 63, fig. 1). Yukon River, north bank, about 17 miles below Nulato (original No. 33); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4639) (pl. 70, fig. 1). Yukon River, north bank, about 1 mile above Pickart's mine (original No. 3AH18a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3254) (pl. 70, fig. 2). Yukon River, north bank, in the vicinity of Nulato; collected by W. H. Dall in 1866 (pl. 71, fig. 2). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 73, fig. 2).

Pseudoprotophyllum dalli Hollick, n. sp.

Plate 71, Figure 1

Pterospermites dentatus Heer, Newberry, The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 133, pl. 54, fig. 4, 1898.

Size and shape of leaf not known; base peltate, rounded; nervation pinnate subpalmate; secondary nerves leaving the midrib at angles of about 40°, alternate, widely spaced or separated, the lowest two, simulating lateral primaries, with branches from the under sides; midrib abruptly thickened from the lowest secondary downward; basilar nervilles numerous, conspicuous, the upper ones, extending laterally from the sides of the midrib, curved or flexed and branched, simulating fine secondary nerves, the lower ones, radiating from the base of the midrib, bent downward, curved or flexed, and branched.

This figure is a photographic reproduction of Newberry's figure of another of the specimens collected in Alaska by W. H. Dall that Newberry referred to the Tertiary species *Pterospermites dentatus* Heer,[94] as discussed under *Credneria inordinata maxima* (p. 86). It is evident that the specimen was very imperfect, but enough is shown in the figure to indicate that it apparently represents a species of *Pseudoprotophyllum.* The arrangement of the basilar secondary nerves, however, is unique and possibly abnormal, as they are separated from each other at their points of attachment to the midrib by a vertical distance of 1.5 centimeters. If they were opposite or subopposite the leaf might be provisionally referred to *Pseudoprotophyllum comparabile*, the species last described; but in the circumstances a distinct specific designation seems to be desirable. For purposes of comparison a figure of the species last mentioned, taken from a specimen found

[92] Dawson, J. W., On the Cretaceous and Tertiary floras of British Columbia and the Northwest Territory: Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 28, pl. 4, fig. 13, 1882 [1883].

[93] Knowlton, F. H., in Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 190, pl. 65, fig. 7, 1892.

[94] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6, 7, (8, 9?), 1868.

in Doctor Dall's collection, is included in the same plate. (See fig. 2.)

Locality: Yukon River, north bank, in the vicinity of Nulato; collected by W. H. Dall in 1866.

Pseudoprotophyllum magnum Hollick, n. sp.

Plate 69, Figures 1, 2; Plate 70, Figure 3; Plate 72, Figures 1, 2; Plate 73, Figure 4a

Leaves large, orbiculate, peltate, about 16 centimeters in length by 18 centimeters in width; margin dentate above, denticulate below; nervation craspedodrome, pinnate subpalmate, consisting of a strong midrib and three or more pairs of subopposite, widely spaced, upward-curving secondary nerves, the lowest pair strongest, simulating lateral primaries, with five or six branches on the under sides, the upper branches upward curved and forked, the lower mostly straight and simple; basilar veinlets flexuous, forked, and anastomosed into a network that covers the basal portion of the lamina of the leaf, the main veinlets extending to and terminating in the adjacent teeth.

The exact shape of these leaves is not determinable from the available specimens, all of which are defective in their upper parts; but apparently their width was somewhat greater than their length, and the base was more or less asymmetrical. They may perhaps represent a large form of *Pseudoprotophyllum comparabile* (see p. 94; pl. 68, fig. 1; pl. 70, figs. 1, 2; pl. 71, fig. 2; pl. 73, fig. 2); but until other and more perfect specimens of both are available for comparison and satisfactory identification a specific distinction between them may be assumed.

A somewhat analogous species is *Protophyllum undulatum* Lesquereux,[95] in which, however, the lower secondary nerves are more inclined to the horizontal and are less differentiated in rank from the upper secondaries than they are in this and in other species of *Pseudoprotophyllum*.

Localities: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 69, fig. 1); Yukon River, north bank, about 7 miles below Blatchford's mine (original No. 3AH20); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3259) (pl. 69, fig. 2). Yukon River, north bank, about 8 miles below Kaltag (original No. 3AH29); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3268) (pl. 70, fig. 3). Yukon River, north bank, in the vicinity of Nulato; collected by W. H. Dall in 1866 (pl. 72, figs. 1, 2). Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 73, fig. 4a).

[95] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 189, pl. 42, fig. 2, 1892.

Pseudoprotophyllum? basielongatum Hollick, n. sp.

Plate 65, Figure 4

Leaf about 5 centimeters in length by 3.5 centimeters in width across the middle, apparently ovoid-elliptical; narrowed below to an obscurely peltate, wedge-shaped base; margin crenate-dentate; midrib thickened in its lower part; nervation pinnate, craspedodrome; secondary nerves ascending, irregularly disposed, lowest ones relatively remote from the base of the midrib, each with three or four upward-curving branches on the under side; basilar veinlets horizontal or nearly so.

Although this leaf is referred to the genus *Pseudoprotophyllum*, the narrow, elongated base and the lengthy basal portion of the midrib below the points of attachment of the lowest secondary nerves represent a modification and an exaggeration, respectively, of the generic characters that are sufficiently striking to cause the generic reference to be questioned.

The genus *Anisophyllum* Lesquereux[96] was considered as a possible generic affiliation but was discarded as being too poorly defined. So far as I am aware only one species has been added to this genus since Lesquereux's time—namely, *Anisophyllum* sp. Dawson,[97] from the Upper Cretaceous of Vancouver Island. This species agrees with ours in shape and apparently in its secondary nervation, so far as may be judged from the rather poor figure; but the margin is indicated as entire, whereas ours is dentate. Unfortunately the basal extremity of our leaf is missing, so that the relations between the midrib and the petiole can not be determined.

Locality: Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635).

Genus PSEUDOASPIDIOPHYLLUM Hollick, n. gen.

Leaves palmately trilobed, rounded or truncate to a broad peltate base; margin dentate; nervation craspedodrome, tripalmate below, pinnate above; lateral primaries suprabasilar, opposite, branched on the under sides and on the upper sides toward the extremities; secondary nerves opposite below, becoming subopposite and alternate above.

The leaves of this genus are platanoid in nervation but with a peltate base similar to *Aspidiophyllum* and *Protophyllum*. I was at first inclined to refer them to *Pseudoprotophyllum*, but the lobing was recognized as a distinctive character, and it has been deemed advisable to regard them as representing a heretofore

[96] Lesquereux, Leo, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 98, 1874. Type *Anisophyllum semi-alatum* (Lesquereux) Lesquereux, op. cit., p. 98, pl. 6, figs. 1–5=*Quercus semialata* Lesquereux, Am. Jour. Sci., 2d ser., vol. 46, p. 96, 1868.

[97] Dawson, J. W., On the Cretaceous and Tertiary floras of British Columbia and the Northwest Territory: Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 28, pl. 8, fig. 34, 1882 [1883].

undescribed genus. They occupy one extreme of a series of closely related leaf forms with peltate bases, of which the species of *Protophyllum* with pinnate nervation is at the opposite extreme, and those included in *Pseudoprotophyllum*, with subpalmate nervation, occupy the middle.

Pseudoaspidiophyllum platanoides Hollick, n. sp.

Plate 62, Figures 1, 2

Leaves broadly trilobate, rounded below to a peltate base; margin undulate or sparingly undulate-dentate; teeth blunt; nervation craspedodrome, tripalmate below, pinnate above; midrib straight; lateral primaries suprabasilar, opposite, diverging from the midrib at angles of about 45°, curving slightly upward for a short distance, then continuing almost straight, with about six branches on the under sides and two on the upper toward the extremities; secondary nerves arranged in three widely spaced, opposite or approximately opposite pairs with the habit of direction of the lateral primaries, the upper ones subtending more obtuse angles of divergence than the lower ones; basilar veinlets extending at right angles from the sides of the midrib and radiating downward from the base.

This species, which is the type of the genus, has the nervation and general aspect of a *Platanus*. It is lobed, at least on one side, but this does not necessarily imply that the same feature occurs to an equal extent on the opposite side, and as may be noted by careful examination of the figure, the leaf does not appear to be strictly equilateral. It apparently represents a unique type of leaf, of which it would be very interesting to obtain a perfect specimen.

Locality: Yukon River, south bank, about 1½ miles below Seventymile Creek (original No. 80); collected by G. C. Martin in 1914 (lot 6815).

Pseudoaspidiophyllum latifolium Hollick, n. sp.

Plate 63, Figure 3; Plate 64, Figures 1, 2

Leaves palmately trilobed with a broad, truncate, peltate (?) base, about 14 centimeters in length by about 18 centimeters in width between the extremities of the lateral lobes; middle lobe large, broadly wedge shaped; lateral lobes relatively small, triangular, tapering to the blunt apices; margin triangular-dentate; teeth blunt; nervation craspedodrome; secondary nerves opposite below, becoming alternate above, subparallel, leaving the midrib at approximately equal angles of about 45°, curving slightly upward; lateral primaries suprabasilar, leaving the midrib at obtuse angles of divergence, widely spreading, branched on the under sides and on the upper sides toward the extremities; basilar veinlets conspicuous, at right angles to the sides of the midrib.

The platanoid aspect of these leaves might cause them to be referred to the genus *Platanus* were it not for the apparent peltate character of the bases. It is unfortunate that in no specimen is a perfect base preserved; but certain peltate characters are obvious, and others are strongly indicated, so that this feature may be assumed to be present in normal leaves.

Localities: Yukon River, south bank, about 3 miles below Seventymile Creek (original No. 3AH4); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3243) (pl. 63, fig. 3). Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248) (pl. 64, figs. 1, 2).

Pseudoaspidiophyllum singulare Hollick, n. sp.

Plate 63, Figure 2

Leaf trilobate, 12 centimeters in length by about 12 centimeters in width across the expanded lower part; middle lobe largest, rounded, terminating in a blunt acuminate apex; lateral lobes relatively small, short, obtusely triangular, rounded below to the broad, truncate, peltate base; margin undulate-dentate; nervation craspedodrome, tripalmate below, pinnate above, weak, irregular; lateral primaries suprabasilar, with two relatively strong branches on the under sides and several weak ones on the under and upper sides toward the extremities, all more or less branched and connected by finer cross nervation; basilar veinlets horizontal from the sides of the midrib, forked and bent downward toward the extremities, and finer nervilles radiating from the base of the midrib to the margin.

This species, represented by a single specimen, is similar in outline to *P. latifolium*, the species last described, but the nervation is more irregular and much thinner or weaker throughout. In fact, the irregular, attenuated character of the nervation and the way in which it thins out toward the extremities of its ramifications constitute a unique feature.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Pseudoaspidiophyllum memorabile Hollick, n. sp.

Plate 61

Leaf 20 centimeters or more in length by 20 centimeters or more in maximum width, trilobate or subtrilobate; margin wavy-dentate; nervation pinnate tripalmate; lateral primaries suprabasilar, diverging from the midrib at obtuse angles, rather abruptly curved upward and then becoming straight, branched on the under sides, the branches irregularly arranged, subhorizontal, forked toward the extremities, ultimately craspedodrome; secondary nerves three or four on each side of the midrib, arranged in subopposite pairs, leaving the midrib at obtuse angles of divergence, soon abruptly bent or curved upward, then continuing almost straight or slightly curved backward and finally forking, the ultimate ramifications craspedodrome to the dentitions; tertiary nervation subhorizontal above, at right angles to the secondaries below, mostly simple and slightly bent, occasionally forked and reticulated.

It is with some hesitation that I have included this species in the genus *Pseudoaspidiophyllum*, for the reason that the essential basilar characters are destroyed, and it is impossible to determine if the leaf was peltate. The lateral primaries, however, are undoubtedly suprabasilar. It may also be noted that they are not exactly opposite and that the upper one is stronger than the other and more distinctly curved. The secondary nerves on the same side as the stronger lateral primary also appear to possess similar characters, indicating that the leaf was not strictly equilateral.

Locality: Yukon River, north bank, about 3 miles below Blatchford's mine (original No. 3AH21); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3260).

Order ROSALES

Family MALACEAE

Genus SORBUS Linnaeus

Sorbus alaskana Hollick, n. sp.

Plate 74, Figure 1

Leaf inequilateral, apparently obovate, irregularly lobate; lobes short, triangular, apiculate; margin denticulate; nervation pinnate, craspedodrome; midrib curved, convex toward the broad side of the leaf; secondary nerves irregularly spaced, subtending acute angles with the midrib and curving upward; tertiary nervation conspicuous, profuse, the nerves curving upward and terminating in the denticulations of the margin and traversing the lamina of the leaf irregularly between the secondaries, where they merge into finer quaternary cross nervation.

This imperfect leaf is difficult to identify generically with any degree of satisfaction, and it is referred to the genus *Sorbus* with some hesitation, especially as that genus has apparently not been heretofore recorded from any horizon below the Tertiary.

Locality: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Family LEGUMINOSAE

Genus COLUTEA Linnaeus

Colutea primordialis Heer

Plate 74, Figure 4

Colutea primordialis Heer, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 99, pl. 27, figs. 7–11; pl. 43, figs. 7, 8, 1882.

This leaf or leaflet is clearly identical with Heer's species from the Atane beds of Greenland and with the leaf described and figured by Hollick[98] from the Magothy formation of Long Island, N. Y.; but it is doubtful if certain other leaves referred to the species from other localities in the United States[99] are properly referable to the species as defined and figured by Heer.

Another question, which it may be pertinent to suggest in this connection, is whether or not Heer's *Colutea primordialis* may merely represent one of the small forms of *Liriodendron meeki* Heer[1] from the same beds, especially the leaves represented by his Figures 4 and 6 on Plate 22.

Locality: Pavlof Bay, east side, about 50 miles west of Portage Bay, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189).

Genus LEGUMINOSITES Bowerbank

Leguminosites yukonensis Hollick, n. sp.

Plate 73, Figure 4b; Plate 74, Figure 5

Leaflets normally attached to a common petiole, 1.3 to 2.75 centimeters in length by 1.3 to 1.9 centimeters in width across the middle, entire, elliptical, tapering about equally to each end; apex apiculate; base wedge-shaped; nervation simply pinnate; midrib straight; secondary nerves leaving the midrib at various angles of divergence, curving upward and continuing close to the margin, where they thin out and disappear.

The specimen represented by Figure 4b on Plate 73 includes, apparently, a terminal and one lateral leaflet of a trifoliolate leaf, such as is characteristic of several genera in the Leguminosae. The terminal leaflet appears to be slightly the broader.

It is possible that these leaves may be specifically identical with some one or another of the several de-

[98] Hollick, Arthur, Torrey Bot. Club Bull., vol. 21, p. 56, pl. 174, fig. 2, 1894.

[99] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 148, pl. 13, figs. 8, 9, 1892. Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 97, pl. 19, figs. 4, 5, 1895 [1896]. Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 845, pl. 75, fig. 3, 1916.

[1] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 87, pl. 18, fig. 4c; pl. 22, figs. 1a, 1b, 2–13; pl. 23, figs. 3–8; pl. 25, fig. 5a; pl. 45, figs. 13a, 13b, 1882.

scribed species of *Leguminosites;* but certain of these species are inadequately figured, and several identifications of the species are open to question, hence I have thought it advisable to designate our specimens by a new specific name.

Localities: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252) (pl. 73, fig. 4b). Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 74, fig. 5).

Genus CASSIA Linnaeus

Cassia alaskana Hollick, n. sp.

Plate 74, Figures 2, 3

Leaves or leaflets inequilateral, asymmetric, 8 centimeters in length by 3.5 centimeters in width across the middle, tapering above to a blunt, acuminate, slightly curved apex, rounded below and broadly cuneate or truncate on one side of the base, sharply cuneate on the opposite side; margin entire; midrib curved above and below, in opposite directions; nervation simply pinnate, camptodrome; secondary nerves diverging from the midrib at obtuse angles on the rounded side of the leaf, especially in the lower part, and at acute angles on the opposite side, curving upward and anastomosing close to the margin.

These specimens probably represent leaflets of a compound leaf such as are common in a number of genera in the Leguminosae. They are similar in general appearance to the European Tertiary species *Cassia phaseolites* Unger,[2] and they evidently belong either in that genus or in one closely related.

Localities: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962) (pl. 74, fig. 2). Yukon River, north bank, about 16 miles below mine No. 1, or 17 miles below Kaltag (original No. 40); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4643) (pl. 74, fig. 3).

Order GERANIALES

Family ZYGOPHYLLACEAE

Genus GUAJACUM Linnaeus

Guajacum informe Hollick, n. sp.

Plate 75, Figure 3

Leaf or leaflet irregular in shape, asymmetric, expanded in the middle, 2.5 centimeters in length by 1.8 centimeters in width; entire; with a blunt, wedge-shaped apex and a base rounded on one side and concave-truncate on the other; midrib sinuous; secondary nerves irregularly pinnate, subtending various angles with the midrib, camptodrome close to the margin.

This leaf or leaflet is referred to the genus *Guajacum* on account of its striking resemblance to the living *G. breynii* as figured by Ettingshausen.[3] It is apparently a perfect leaf, although the irregular outline and the erratic disposition of the nervation give it an abnormal appearance, as if its characteristic features might be due to distortion.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Order SAPINDALES

Family ANACARDIACEAE

Genus COTINUS Adanson

Cotinus cretacea Hollick, n. sp.

Plate 75, Figure 4

Leaf broadly spatulate or obovate, entire, 4 centimeters in length by 2.75 centimeters in maximum width; nervation pinnate, camptodrome; midrib curved; secondary nerves irregularly spaced, alternate below, opposite above, leaving the midrib at angles of about 45°, extending almost straight until they curve abruptly upward near the margin, where they thin out and connect by fine tertiary cross nervation.

So far as I am aware the genus *Cotinus* has not heretofore been recognized in any formation of Cretaceous age; and but three fossil species, all of Tertiary age, appear to be recorded, of which the only American species is *Cotinus fraterna* (Lesquereux) Cockerell,[4] from the Miocene of Colorado. Of these three species the one that resembles ours most closely is *Cotinus antilopum* (Unger) Schenk,[5] from Greece, in which the discernible characters are almost identical. Incidentally, however, it may be remarked that each of these species is hardly distinguishable from certain of the leaf forms of the living *Cotinus cotinoides* (Nuttall) Britton, and it is evident that the type of leaf represented by all three species is an ancient one that has persisted throughout a long period of geologic time.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

[2] Unger, Franz, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 188 [58], pl. 66 [45], figs. 1–9, 1850.

[3] Ettingshausen, C. F. von, Die Blatt-Skelete der Dicotyledonen, pl. 78, fig. 2, Wien, 1861.

[4] Cockerell, T. D. A., Torreya, vol. 6, p. 12, 1906 (=*Rhus fraterna* Lesquereux, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 192, pl. 41, figs. 1, 2, 1883).

[5] Schenk, August, in Zittel, Karl von, Handbuch der Palaeontologie, pt. 2, Palaeophytologie, p. 542, München and Leipzig, 1890 (=*Rhus antilopum* Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 27, p. 79 [55], pl. 14, fig. 16, 1867).

Family CELASTRACEAE

Genus CELASTRUS Linnaeus

Celastrus herendeenensis Hollick, n. sp.

Plate 76, Figures 1–4

Leaves oblong-ovate, about 14 centimeters in length by 5.5 centimeters in width, rounded at the base; margin denticulate; nervation pinnate; secondary nerves numerous, irregularly disposed, subparallel, diverging from the midrib at acute angles, curving slightly upward, connecting with the tertiary nervation near the margin, forming a network of quadrate areolae with fine nervilles extending into and terminating in the denticulations; tertiary nervation more or less bent or flexuous, forming quadrate or polygonal areolae.

These leaves were apparently rugose, with coarse, prominent nervation. They resemble *Celastrus pterospermoides* Ward,[6] from the Fort Union formation of Montana, but are much finer in both nervation and dentition.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Celastrus pseudocurvinervis Hollick, n. sp.

Plate 76, Figure 5

Leaf of unknown dimensions, curved and narrowed above to a slender tip; margin serrate-denticulate below, undulate above; nervation pinnate, camptocraspedodrome; midrib curved; secondaries curved upward, merging at their extremities into connecting tertiary nerves with fine nervilles extending to and terminating in the teeth and undulations of the margin.

This species is so closely similar to *Celastrus curvinervis* Ward[7] from the Fort Union formation of Montana, that I was at first inclined to regard them as identical. The only apparent difference between them is that in Ward's species the teeth are indicated as coarser and somewhat more serrate than in ours. He figures, however, two quite different forms under the same specific name, and his Figure 4 may be excluded if his Figure 3, with which our specimen may be compared, is to be taken as the type of the species.

Another leaf with which an interesting comparison may be made is *Fraxinus johnstrupi* Heer,[8] from the Tertiary beds of Greenland, which resembles ours as closely as the species previously mentioned. The specimens, however, are too fragmentary for satisfactory comparison.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Family ACERACEAE

Genus ACER Linnaeus

Acer collieri Hollick, n. sp.

Plate 78, Figure 5

Leaf broadly trilobate in the upper part, tapering and slightly rounded below to a wedge-shaped base; lobes relatively short, approximately equal in size, the middle one pyramidal in outline, the lateral ones broad and spreading, all with blunt, acuminate apices; margin bluntly triangular-dentate above, entire toward the base; nervation tripalmate from the base, pinnate above, craspedodrome throughout; secondary nerves six on each side, subopposite, subparallel, leaving the midrib at acute angles of divergence; lateral primaries leaving the midrib at acute angles of divergence and curving slightly outward or downward with two or three curved branches on the upper sides and numerous simple or occasionally branched, more or less flexuous branches on the under sides.

This leaf is referred to the genus *Acer* with some hesitation, as it possesses some features that are suggestive of the Platanaceae; but the basal portion, which would probably show important diagnostic characters, is missing.

If the generic reference to *Acer* is correct this leaf represents one of the oldest and most fully developed species thus far recorded in connection with the genus. *Acer antiquum* Ettingshausen,[9] from the Cenomanian of Saxony, is, so far as I am aware, the only supposed representative of the genus recorded from an equivalent geologic horizon in the Old World, and this species might equally well be referred to the genus *Acerites* and included in the protean species *Acerites multiformis* Lesquereux,[10] from the Dakota sandstone of Kansas. The only heretofore recorded American Cretaceous species are *Acer amboyense* Newberry,[11] based upon specimens of fruit from the Raritan formation of New Jersey; *Acer minutum* Hollick,[12] a small leaf from the Magothy (?) formation of Staten Island,

[6] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 555, pl. 53, figs. 3–6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 80, pl. 35, figs. 3–6, 1887.

[7] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 555, pl. 53, figs. 9, 10, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 82, pl. 36, figs. 3, 4, 1887.

[8] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 118, pl. 80, figs. 1–3, 1883.

[9] Ettingshausen, C. F. von., K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 55, pt. 1, p. 259, pl. 3, fig. 17, 1867.

[10] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 156, pl. 34, figs. 1–9, 1892.

[11] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 106, pl. 46, figs. 5–8, 1895 [1896].

[12] Hollick, Arthur, New York Acad. Sci. Trans., vol. 12, p. 35, pl. 3, fig. 6, 1892; The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 89, pl. 33, fig. 14, 1906.

N. Y.; and *Acer paucidentatum* Hollick,[13] based upon more or less fragmentary leaf remains from the Magothy formation of New Jersey. The discovery of so large and well developed a representative of the genus in the early Upper Cretaceous flora of Alaska is therefore somewhat of a surprise.

The specific name is given in honor of Mr. A. J. Collier, the collector.

Locality: Yukon River, north bank, about 26 miles below Nulato and about 4 miles below Bluff Point (original No. 2AC264); collected by A. J. Collier and Sidney Paige in 1902 (lot 2983).

Genus ACERITES Viviani

Acerites multiformis Lesquereux

Plate 78, Figure 3

Acerites multiformis Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 156, pl. 34, figs. 1–9, 1892.

This leaf evidently belongs in the genus *Acerites*, and it agrees so closely with certain of Lesquereux's figures that its specific identity can hardly be doubted, especially when compared with his Figures 4 and 7. This species has been made to include such diverse leaf forms that almost any leaf with the generic characters of *Acerites* could be referred to it—for example, *Acer antiquum* Ettingshausen,[14] from the Cretaceous of Saxony, which may be merely an Old World representative of *Acerites multiformis*.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Genus RULAC Adanson (=NEGUNDO Moench)

Rulac quercifolium Hollick, n. sp.

Plate 29, Figure 1a; Plate 77, Figures 1–10; Plate 78, Figure 7b

Leaves or leaflets variable in size and shape, mostly triangular ovate and asymmetric, irregularly crenate-dentate or undulate-dentate, terminating above in a blunt apical tooth, below in a wedge-shaped base; nervation pinnate, craspedodrome; secondary nerves irregularly disposed, diverging from the midrib at various angles, each terminating in one of the marginal irregularities.

These leaves are exceedingly variable, and yet it seems impossible to separate them satisfactorily into distinct species or varieties. In several of the specimens they have the appearance of leaflets attached to a common petiole, and if this were a character of the species, a variation in the size and shape of the leaflets might be expected. If it were not for the apparent compound character of the leaves their general appearance might indicate or suggest relationship to the genus *Quercus*; but apparently a few of the specimens—those that are symmetrical in outline—represent terminal leaflets, while the others—those that are asymmetric in outline, with irregular margins—represent lateral leaflets, and relationship with the living *Negundo aceroides* Moench (=*Acer negundo* Linnaeus) and with the fossil species *Negundo triloba* Newberry[15] is strikingly indicated.

Other species that resemble one or another of our specimens, all from Cretaceous horizons, are *Myrica thulensis* Heer,[16] from the Atane beds of Greenland; *Myrica praecox* Heer,[17] from the Patoot beds of Greenland; and *Quercus baueri* Knowlton,[18] from the Montana group of New Mexico. Heer's figure of *Myrica praecox* is interesting, especially when compared with our Figure 5 on Plate 77; and if these two figures were the only ones available for comparison they might be regarded as specifically identical.

Localities: Chignik Bay, about 2 miles northeast of Alaska Packers Association cannery, Alaska Peninsula (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 29, fig. 1a; pl. 77, figs. 4–10; pl. 78, fig. 7b). Port Moller, 2 miles up the canyon west from Mud Bay, Alaska Peninsula (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187) (pl. 77, fig. 1). Chignik Lagoon, south side, near entrance, Alaska Peninsula (original No. 49); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5295) (pl. 77, figs. 2–3).

Family SAPINDACEAE

Genus SAPINDUS Linnaeus

Sapindus morrisoni Lesquereux MS., Heer

Plate 78, Figure 1

Sapindus morrisoni Lesquereux MS., Heer, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 96, pl. 40, figs. 1a, 1b, 1c; pl. 41, fig. 3; pl. 43, figs. 1a, 1b; pl. 44, figs. 7, 8, 8b, 1882; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 39, pl. 65, fig. 5, 1883.

Lesquereux, The Cretaceous and Tertiary floras; U. S. Geol. Survey Terr. Rept., vol. 8, p. 83, pl. 16, figs. 1, 2, 1883; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 158, pl. 35, figs. 1, 2, 1892; Minnesota Geol. and Nat. Hist. Survey Final Rept., vol. 3, pt. 1, p. 17, pl. A, figs. 11, 12, 1893.

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[13] Hollick, Arthur, New York Acad. Sci. Trans., vol. 16, p. 132, pl. 14, figs. 2, 3, 1897.

[14] Ettingshausen, C. F. von, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 55, pt. 1, p. 259, pl. 3, fig. 17, 1867.

[15] Newberry, J. S., Lyceum Nat. Hist. New York Annals, vol. 9, p. 57, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 115, pl. 31, fig. 5, 1898.

[16] Heer, Oswald, Die Kreide-Flora der arctischen Zone: Flora fossilis arctica, vol. 3, No. 3, p. 107, pl. 31, figs. 1, 1b, 1874.

[17] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 21, pl. 55, fig. 4, 1883.

[18] Knowlton, F. H., Flora of the Fruitland and Kirtland formations: U. S. Geol. Survey Prof. Paper 98, p. 337, pl. 86, figs. 5, 6, 1916.

A considerable variety of leaf forms of the general type represented by our specimen have been referred to this species by Heer from the Atane and Patoot beds of Greenland; by Lesquereux from the Dakota sandstone of the western United States; by Hollick [19] from the Magothy (?) formation of Staten Island and Long Island, N. Y., and Marthas Vineyard, Mass.; and by Berry [20] from the Magothy formation of New Jersey and the Black Creek and Tuscaloosa formations of the southeastern United States. Whether or not these are all properly referable to the species must remain largely a matter of individual opinion; but there can be but little doubt that our specimen from Alaska is identical with the species as depicted by Lesquereux in the "Flora of the Dakota group."

It is of interest to note that the manuscript of Lesquereux's unpublished description of the species, with figures, based upon specimens supposed to have come from the Dakota sandstone of Morrison, Colo., was apparently transmitted to Heer, who recognized the species as identical with certain leaves from the Atane beds of Greenland and applied Lesquereux's manuscript name to them in his "Flora fossilis arctica," volume 6, page 96, published in 1882, where he cites "Lesquereux Cretac. Flora neue Folge Taf. XVI. Fig. 1." This citation apparently refers to the manuscript of Lesquereux's "Cretaceous and Tertiary floras," which was not published until 1883. Thus the Greenland specimens represent the type of the species by reason of priority in the publication of Heer's work, although the original manuscript description was based upon the specimens from Morrison, Colo.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248a).

Sapindus apiculatus Velenovsky

Plate 78, Figure 2

Sapindus apiculatus Velenovsky, Die Flora der böhmischen Kreideformation, pt. 3: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 4, No. 1, p. 6 [53], pl. 7 [22], figs. 1–8, Wien, 1884.

This well-defined species, originally described from the Cretaceous of Bohemia, has been reported from the Magothy formation of New Jersey and Long Island, N. Y.,[21] although the identity of these specimens with Velenovsky's species may be questioned. There can be but little doubt, however, in regard to the specific identity of the specimen from Alaska.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

Genus **PAULLINIA** Linnaeus

Paullinia minutidenticulata Hollick, n. sp.

Plate 37, Figure 2

Leaf oblong-elliptical, about 18 centimeters in length by 7 centimeters in width across the middle; margin wavy, irregularly and minutely denticulate; nervation pinnate, campto-craspedodrome; secondary nerves irregularly arranged and spaced, simple or rarely abnormally flexed or branched, subtending somewhat more acute angles with the midrib on one side than on the other, the upper ones leaving the midrib at angles of approximately 45°, the lower ones at more obtuse angles, mostly camptodrome near the margin, with fine nervilles extending from the marginal loops to the denticulations.

This species is more or less suggestive of the type of leaf represented by *Juglans denticulata* Heer,[22] from the Tertiary of Greenland, from which it differs, however, in its greater width at base and summit and the more obtuse angles subtended by the secondary nerves with the midrib. Both the base and the summit of our leaf are missing, and hence the terminal outline at each end can only be inferred from the trend of the margin and the relative obliquity of the secondary nerves at the broken ends. Apparently it was less elongated basally and apically than *Juglans denticulata* Heer and was more like the leaf from the same locality and horizon referred by Heer [23] to *Juglans bilinica* Unger.

On the strength of its resemblance to the species mentioned I was at first inclined to refer our specimen to the genus *Juglans*; but I am now convinced that such reference would be erroneous, and I think that Heer's generic identifications of the several species included in this general type of minute or obscurely denticulate leaves might well be made the subject of critical study and careful comparison.

Locality: Yukon River, north bank, about 13 miles below Melozi telegraph station (original No. 3AH12); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3249).

[19] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 90, pl. 33, figs. 16–20, 1906.

[20] Berry, E. W., New York Bot. Gard. Bull., vol. 3, p. 83, pl. 47, figs. 2, 3, 1903; The Upper Cretaceous and Eocene floras of South Carolina and Georgia: U. S. Geol. Survey Prof. Paper 84, p. 49, pl. 9, fig. 6, 1914; Upper Cretaceous floras of the eastern Gulf region in Tennessee, Mississippi, Alabama, and Georgia: U. S. Geol. Survey Prof. Paper 112, p. 112, 1919.

[21] Hollick, Arthur, New York Acad. Sci. Trans., vol. 16, p. 133, pl. 13, figs. 1–2, 1897; The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 91, pl. 33, fig. 21, 1906.

[22] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, No. 4, p. 483, pl. 56, figs. 6–9a, 1869; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 101, pl. 75, figs. 2–10; pl. 85, figs. 1, 2, 1883. (Not *Juglans denticulata* O. Weber, 1852.)

[23] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 100, pl. 69, fig. 8, 1883.

Order RHAMNALES

Family RHAMNACEAE

Genus RHAMNUS Linnaeus

Rhamnus herendeenensis Hollick, n. sp.

Plate 78, Figures 8–10

Leaves irregularly oblong-elliptical, from 4 to 6.5 centimeters in length and from 1.5 to 3 centimeters in width; base cuneate, one side more acute than the other, giving an inequilateral appearance to the leaf; margin entire; nervation simply pinnate, acrodrome; midrib flexuous; secondary nerves three to five on each side, irregularly alternate, subtending acute angles with the midrib, extending sharply upward, curving and thinning out close to the margin, where they apparently merge into one another; tertiary nervation obscurely defined, apparently fine, closely spaced, straight, and at right angles to the secondaries throughout.

It is unfortunate that all three of the specimens figured to represent the type of this species are imperfect in an identical way, and this gives an appearance of inequilateral obliquity to the bases of the leaves that may be somewhat exaggerated.

The generic reference may perhaps be questioned, by reason of the conspicuous acrodrome nervation, which is also characteristic of the genus *Cornus;* but the obscure, fine, closely spaced tertiary nervation would seem to indicate relationship to the Rhamnaceae rather than to the Cornaceae. It is apparently referable to the same general type of leaf as *Rhamnites berchemiaformis* Berry,[24] from the Eocene (Wilcox formation) of eastern Texas.

Localities: Chignik Bay, Alaska Peninsula, shore opposite end of long spit that reaches the end of the lagoon and about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521) (pl. 78, fig. 8). Mine [Coal?] Creek, Herendeen Bay, Alaska Peninsula (original No. 30); collected by H. M. Eakin in 1908 (lot 5184) (pl. 78, figs. 9–10).

Genus RHAMNITES Forbes

Rhamnites cornifolius Hollick, n. sp.

Plate 78, Figure 4

Leaf irregularly oblong-elliptical, slightly inequilateral, entire, 4.75 centimeters in length by 2.5 centimeters in width across the middle, rounded to the apiculate apex and tapering below to an acute cuneate base; nervation simply pinnate; secondary nerves irregularly spaced and disposed, numerous, leaving the midrib at angles of approximately 45° on one side and at somewhat more obtuse angles on the other, all curving upward and thinning out close to the margin.

This leaf possesses similar characters to one of the specimens of *Rhamnites apiculatus* Lesquereux,[25] from the Dakota sandstone of Kansas, which might almost be regarded as a small form of our species; but the other leaves which Lesquereux[26] includes in the species are very different and could scarcely be regarded as specifically identical with ours.

Two other species that are strikingly similar in appearance to ours are *Cornus holmiana* Heer[27] and *Cornus thulensis* Heer,[28] both from the Patoot beds of Greenland. The secondary nervation of these two species is suggestive of *Rhamnites* rather than of *Cornus*, and our leaf might possibly be regarded as specifically identical with one or the other.

Locality: Yukon River, north bank, just above Pickart's mine (original No. 3AH18a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3254).

Genus PALIURUS Linnaeus

Paliurus visibilis Hollick, n. sp.

Plate 79, Figure 4

Leaf oblong-lanceolate, entire, 3 centimeters in length by 1.5 centimeters in width at a distance of 5 millimeters above the cuneate base; tapering rather abruptly to the blunt apex; nervation acrodrome, tripalmate from the base; midrib straight; lateral primaries with irregularly disposed branches on the outer sides that coalesce and form a camptodrome network between the laterals and the margin.

This species is somewhat remarkable for its relatively strong and well-defined nervation, the primary and secondary nerves being all of approximately equal rank.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Paliurus pseudopinsonensis Hollick, n. sp.

Plate 79, Figures 5–6

Leaf elliptical, 4.25 centimeters in length by 2.5 centimeters in width at about the middle; margin entire; apex rounded, blunt; base rounded-cuneate; nervation palmate, consisting of a straight midrib, an inner pair of simple acrodrome primaries, with branches above on the outer sides, and an outer pair, simple below, becoming looped and camptodrome

[24] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 285, pl. 71, fig. 3, 1916.

[25] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 171, pl. 37, fig. 12, 1892.

[26] Idem, figs. 8–11, 13.

[27] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 36, pl. 62, fig. 12; pl. 64, figs. 6–7, 1883.

[28] Idem, p. 37, pl. 62, figs. 9, 10a, 11.

above, where they join with and merge into the secondary and tertiary nervation, forming a marginal network of rounded, polygonal areolae.

This leaf bears a striking resemblance to *Zizyphus pinsonensis* Berry,[29] from the Lagrange formation of western Tennessee, and except that Berry's species has a more acute, wedge-shaped base the two would be difficult to separate. The apex in each specimen is missing, unfortunately, but the indications are that each was rounded and blunt.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Genus ZIZYPHUS Linnaeus

Zizyphus pseudomeeki Hollick, n. sp.

Plate 29, Figure 6b; Plate 79, Figure 3

Leaves short petiolate, oval-elliptical, about 4 centimeters in length by 3 centimeters in width, rounded to the base, crenate above the middle, entire below; nervation palmate, slightly suprabasilar, acrodrome, consisting of a weak midrib, a pair of simple, curved inner primaries of equal rank with the midrib, with secondary branches on the outer sides that connect with and merge into an outer, somewhat weaker pair, the latter more or less irregular or looped above with fine nervilles extending to and terminating in the marginal crenations.

In each of these specimens, unfortunately, the upper part is missing and the apical character can not be determined. In some respects they are suggestive of certain of the leaves of *Zizyphus meeki* Lesquereux,[30] a Tertiary species that includes a considerable variety of leaf forms. A specimen referred to the species by Ward,[31] from the post-"Laramie" of Wyoming, resembles ours more closely than any of those figured by Lesquereux, and if our species should be found to possess an apiculate or tapering apex the resemblance to Ward's figure would be very close.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Zizyphus varietas Hollick, n. sp.

Plate 78, Figures 6, 7a

Leaves petiolate, ovate-lanceolate, 3 to 3.5 centimeters in length by 2 to 2.5 centimeters in maximum width, tapering above to the apex and below to the rounded, cuneate base; margin crenate-dentate from below the middle upward, entire below; nervation acrodrome from the base, consisting of a midrib and a pair of simple, curved inner primaries with secondary branches that connect with and merge into an obscure, irregular outer pair, the latter with fine nervilles extending to and terminating in the teeth.

It is possible that these leaves may represent only a variety of *Zizyphus pseudomeeki*, the species last described; but the abrupt point of marginal demarkation between the relatively long upper, dentate part and the brief lower, entire part appears to be a sufficiently differentiating character.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Zizyphus electilis Hollick, n. sp.

Plate 79, Figure 7

Leaf petiolate, elliptical, with a blunt apex and a rounded base, 3 centimeters in length by 2.25 centimeters in width across the middle, denticulate from below the middle upward, entire below; nervation palmately acrodrome, suprabasilar; primary nervation consisting of a straight midrib, a pair of relatively strong, simple inner laterals and a weaker exterior pair that are simple below and looped above, where they merge into the secondary nerves connecting with the inner primaries and give off fine nervilles that extend to and terminate in the denticulations.

This delicate little leaf is sufficiently different from the other species of *Zizyphus* with which it is associated to warrant specific distinction. The suprabasilar feature of the primary nervation is well defined. The inner pair of primaries start at a distance of about 2 millimeters above the base of the leaf; the outer pair at a distance of about 1 millimeter. The midrib is abruptly thickened from the junction of the inner primaries downward and merges into the equally thick petiole below.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Zizyphus abnormalis Hollick, n. sp.

Plate 79, Figure 8

Leaf ovate-lanceolate, 4.75 centimeters in length by 2.5 centimeters in maximum width, tapering above to the apex and below to a rounded cuneate base; margin obscurely crenate-serrate-dentate in the upper part; nervation tripalmate from the base, one lateral primary simple, curved, acrodrome, the opposite one

[29] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 280, pl. 71, fig. 7, 1916.

[30] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 388, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 275, pl. 51, figs. 10–14, 1878.

[31] Ward, L. F., U. S. Geol. Survey Sixth Ann. Rept., p. 554, pl. 52, fig. 1, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 74, pl. 33, fig. 5, 1887.

flexed or angled, diverging from the midrib, thinning out and disappearing close to the margin in the upper part of the leaf, each with branches on the outer side that are camptodrome below and craspedodrome above; secondary nervation represented by a single nerve that leaves the midrib at an obtuse angle, curves upward, and ultimately coalesces with the attenuated end of the adjacent lateral primary.

It is possible that this species may be based upon an abnormal leaf. The inequilateral character of the nervation is peculiar. If only the left side of our leaf were preserved, its reference to the genus *Zizyphus* would hardly be questioned, whereas the opposite side, taken by itself, would probably be referred to some other genus. The general zizyphoid characters of the leaf, however, appear to be dominant.

Locality: Yukon River, north bank, at Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962).

Family VITACEAE

Genus VITIS Linnaeus

Vitis inequilateralis Hollick, n. sp.

Plate 80, Figure 1

Leaf asymmetric, inequilateral, obscurely lobed on the larger side, about 6 centimeters in length by 7 centimeters in width, sharply triangular-dentate except near the rounded, obliquely truncate, slightly cordate base; nervation craspedodrome throughout to the marginal dentitions; midrib flexuous, curved toward the smaller side; secondary nerves four or five on each side of the midrib, opposite or subopposite, upper ones branched or forked near their extremities, basal pair conspicuously unequal, the longer one with five subparallel branches on the lower side and three, irregularly spaced, on the upper side, the shorter branch with similar but weaker branches.

This leaf, unquestionably representing a well-defined species of *Vitis*, appears to be markedly different from any heretofore described Cretaceous species of the genus, and more like the general type of certain Tertiary species, such as *Vitis rotundifolia* Newberry,[32] from Admiralty Inlet, Alaska.

Locality: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

[32] Newberry, J. S., U. S. Nat. Mus. Proc., vol. 5, p. 513, 1883; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 51, fig. 2 in part; pl. 53, fig. 3, 1898. (Not *V. rotundifolia* Michaux, 1803.) (=*Vitis alaskana* Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 103, 1908.)

Vitis paleotruncata Hollick, n. sp.

Plate 80, Figure 3

Leaf small, 2 centimeters in length by 2.5 centimeters in maximum width, asymmetric, with an oblique, truncate base, rounded on one side, bilobate on the other with one minor and one major lobe, the latter bilobed on the under side; margin crenate-dentate; midrib curved and turned to the rounded side of the leaf; nervation craspedodrome, consisting of the midrib, a single lateral primary extending from the base of the leaf to the apex of the major lobe with branches on the under and upper sides, a basal secondary nerve, and two pairs of opposite secondaries above.

This perfectly preserved and well-defined specimen evidently represents a leaf normally asymmetric—not one in which the asymmetry is due to distortion, as might be inferred from a superficial glance at the figure.

Locality: Yukon River, north bank, about 5 miles above Louden station [Nahochatilton] (original No. 22); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4635).

Vitis venusta Hollick, n. sp.

Plate 80, Figure 4

Leaf 13 centimeters in length by 18 centimeters in width across the expanded lower part, broadly ovate-reniform somewhat asymmetric, obscurely trilobate, rounded below to a broad, curved, truncate, subcordate base, and tapering above to an acuminate apex; margin irregularly and acutely triangular-dentate; midrib curved or bent to one side; nervation craspedodrome, subtripalmate; secondary nerves irregularly disposed, the upper ones alternate, leaving the midrib at angles of approximately 45°, branched toward the extremities, the main nerves and their branches each terminating in one of the teeth; lower two on each side opposite, the basilar pair simulating lateral primaries, slightly suprabasilar, spreading, each with about six almost horizontal branches on the under side and two or three on the upper side.

The general appearance of this leaf suggests the genus *Platanus*, but the curvature of the midrib and the arrangement of the secondary nerves on each side indicate that it is asymmetric, with one side (the left in our specimen) broader and more rounded than the other, as in many other species of *Vitis*.

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Vitis populoides Hollick, n. sp.

Plate 79, Figure 1

Leaf 4 centimeters in length by 4 centimeters across the widest part, ovate-triangular, somewhat asymmetric, rounded and cordate at the base, narrowed above to a wedge-shaped apex; margin dentate except at the base; teeth unequal in size and shape, mostly narrow, long, blunt-apiculate; nervation palmate from the base, craspedodrome; midrib with two weak secondary nerves on each side, toward the summit; lateral primaries in two pairs, the upper pair relatively strong and dichotomously forked, the lower pair weak, with branchlets on the under sides.

This leaf is so much like *Populus craspedodroma* Ward,[33] from the Fort Union formation (Eocene) of Montana, that it is somewhat difficult to regard them as distinct species. The outline and nervation in each are practically identical, and apparently our leaf also had a prolonged apex. In our specimen the teeth are longer, but so also is the entire leaf, and the generic identity is strongly supported by a perusal of Ward's discussion,[34] in which he says:

> It is with grave doubt that I refer this beautiful impression to the genus *Populus* rather than to *Hedera* or *Vitis*. * * * The principal nerves pass directly into the teeth, which have the peculiar narrow but blunt form characteristic of the Vitaceae.

Ward[35] has also described and figured three leaves of diverse but somewhat similar characters to ours, from the same horizon and locality as *Populus craspedodroma*, under the name *Vitis cuspidata*. It is probable that both of these species belong in the same genus with ours and that the former is also closely related, if not identical, specifically.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Genus CISSITES Debey MS., Heer

Cissites pseudoplatanus Hollick, n. sp.

Plate 80, Figure 2

Leaf about 8 centimeters in length by 8 centimeters in width, orbicular, with an acuminate apex and an acute wedge-shaped base; margin coarsely undulate-dentate in the upper part; teeth broadly triangular, obtuse; nervation tripalmate, craspedodrome; midrib straight; secondary nerves opposite, three on each side, slightly curved upward, subparallel, the lowest pair leaving the midrib at angles of about 45°, the upper pairs subtending more obtuse angles; lateral primaries leaving the base of the midrib at acute angles of divergence, almost straight or slightly flexed, subparallel with the secondaries, branched on the under sides.

This leaf is of the same general type as *Cissites affinis* (Lesquereux) Lesquereux,[36] from the Dakota sandstone of Kansas. It differs in the more rigid and regular secondary nervation and in the coarser dentition. The specific designation is suggested by reason of its platanoid aspect.

Locality: Yukon River, north bank, just above Williams mine (original No. 3AH30); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3269).

Cissites comparabilis Hollick, n. sp.

Plate 79, Figures 9, 10

Leaves quinquelobate, with a wedge-shaped base abruptly decurrent on the petiole; lobes irregularly lobo-dentate, lower ones largest; nervation consisting of a midrib with two prominent pairs of subopposite secondaries, which extend to the ends of the lobes, and a smaller pair above, the lower pair suprabasilar, all with branches which extend to the marginal dentitions.

In relegating these leaves to the genus *Cissites* I have followed the example of other authorities in their reference of leaves of similar characters and general appearance, although it is perhaps unfortunate that the generic name implies relationship with the genus *Cissus* and other allied genera of the Vitaceae in which the leaves are characterized by strictly basilar lower secondaries.

The type of the genus is *Cissites insignis* Heer,[37] from the Dakota sandstone of Nebraska. It is based on a fragment of a lobed leaf of which the base is lacking; but Heer gives a restoration of the entire leaf (fig. 4) in which the lower pair of secondaries is shown as suprabasilar. This arrangement of these nerves must therefore be regarded as a generic character. Subsequently the same author described similar fragmentary remains from the Atane beds of Greenland under the name *Cissites formosus* Heer;[38] but in these specimens also the bases are lacking. However, he gives a restoration of the species (fig. 8) in which the lower pair of secondaries is shown as suprabasilar; and Lesquereux[39] figures a specimen, referred to *C. formosus*, from the Dakota sandstone

[33] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey Sixth Ann. Rept., p. 550, pl. 36, fig. 1, 1886; Types of the Laramie flora, U. S. Geol. Survey Bull. 37, p. 21, pl. 8, fig. 3, 1887.

[34] Op. cit. (Bull. 37), p. 22.

[35] Ward, L. F., U. S. Geol. Survey Sixth Ann. Rept., p. 554, pl. 51, figs. 9–11, 1886; U. S. Geol. Survey Bull. 37, p. 71, pl. 32, figs. 6–8, 1887.

[36] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 352, 1876 (=*Populites affinis* Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 423, 1873, and *Platanus affinis* Lesquereux, The Cretaceous flora: U. S. Geol. Survey Terr. Rept., vol. 6, p. 71, pl. 4, fig. 4, 1874.

[37] Heer, Oswald, in Capellini, J., and Heer, O., Phyllites crétacées du Nebraska: Soc. helv. sci. nat. Nouv. mém., vol. 22, No. 1, p. 19, pl. 2, figs. 3, 4, 1866.

[38] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 85, pl. 21, figs. 5–8, 1882.

[39] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 161, pl. 21, fig. 5, 1892.

of Kansas, in which this character is well defined. Newberry[40] also refers a number of leaves from the Raritan formation of New Jersey to the species but expresses some doubt in regard to the validity of certain ones; and of his eight figures only one (fig. 4) is shown as having suprabasilar lower secondaries.

Berry[41] describes and figures a variety of *C. formosus*, from the Magothy formation of Maryland, which he calls *Cissites formosus magothiensis*. The base is lacking in the specimen, but a restoration is made, and in this the lower secondaries are indicated as suprabasilar in accordance with the description.

A large number of platanoid and *Aralia*-like leaves have been referred to the genus, such as *Cissites harkerianus* Lesquereux, *C. heerii* Lesquereux, *C. obtusilobus* Lesquereux, *C. ingens* Lesquereux, *C. ingens parvifolia* Lesquereux, *C. alatus* Lesquereux, and *C. panduratus* Knowlton; others with more or less entire margins, such as *C. populoides* Lesquereux and *C. brownii* Lesquereux; and multilobed and dissected forms such as *C. parvifolius* (Fontaine) Berry. It is evident that all these diverse forms can not possibly belong in one genus or hardly in one family, and, on taxonomic grounds, a revision of the entire group is urgently needed.

Localities: Yukon River, north bank, about 14 miles below Melozi telegraph station (original No. 3AH13); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3250) (pl. 79, fig. 9). Yukon River, north bank, between Pickart's mine and Nulato (original No. 3AH18d); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3256) (pl. 79, fig. 10).

Cissites yukonensis Hollick, n. sp.

Plate 79, Figure 11

Leaf iregularly lobo-dentate, narrowed above to an obliquely prolonged apex, cordate at the base; nervation palmate from the base, apparently three lateral primaries on one side of the midrib and two on the other, the outer ones spreading, the inner pair ascending and conspicuously forked in their upper parts, each main branch terminating in the apex of a lobe; midrib sharply flexed or angled above and forked, a branch springing from each of the angles and terminating in the apex of a lobe.

This leaf appears to be somewhat asymmetric at the base and with the apex turned to one side. In some respects it is suggestive of certain leaves that have been referred to the genus *Menispermites*; but it is clearly in the same generic category as *Cissites dentatolobatus* Lesquereux,[42] from the Dakota sandstone of Kansas, which might be regarded merely as a more deeply lobed form of our species. Some of the points of resemblance between them are striking, and their differences are no greater than are those that may be noted in connection with the many diverse forms that have been included under the one specific name *Cissites formosus* Heer[43] as discussed in connection with *Cissites comparabilis*, the species last described.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Genus AMPELOPSIS Michaux

Ampelopsis? multesima Hollick, n. sp.

Plate 79, Figure 2

Leaf compound, consisting of a terminal and two or more lateral leaflets, each approximately 2.5 centimeters in length by 1.5 to 2 centimeters in width, apparently elliptical or obovate, with wedge-shaped, entire bases; margin irregularly dentate in the upper part; nervation pinnate, craspedo-camptodrome.

This specimen is too fragmentary for either satisfactory description or comparison. It apparently represents a compound leaf, and it may have had more than the three leaflets that are preserved. The lower margin of one of the leaflets is distinctly dentate, and it may be assumed that the same character was shown by the others, in their upper parts. The terminal leaflet is petiolate, but whether or not the others were can not be determined. The generic reference is questioned, inasmuch as the missing parts of the leaflets may possess important diagnostic characters which, if perfect specimens are obtained, might indicate some other generic relationship.

Locality: Yukon River, north bank, about 16 miles below mine No. 1 and about 17 miles below Kaltag (original No. 40); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4643).

Order MALVALES

Family TILIACEAE

Genus TILIA Linnaeus

Tilia cretacea Hollick, n. sp.

Plate 82, Figure 3

Leaf asymmetric, rounded to the blunt apex on one side, oblique on the opposite side, apparently cordate at the base, 10 centimeters in length by 9.5 centimeters in width across the expanded lower part about 4 centimeters from the base; margin sharply denticulate-dentate, the teeth arranged in a double series, the smaller between the larger; nervation pinnate subpal-

[40] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 107, pl. 47, figs. 1–8, 1895.

[41] Berry E. W., Maryland Geol. Survey, Upper Cretaceous, p. 855, pl. 78, fig. 4, 1916.

[42] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 164, pl. 66, fig. 4, 1892.

[43] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 85, pl. 21, figs. 5–8, 1882.

mate, craspedodrome; midrib straight; secondary nerves almost straight, arranged in five subopposite or opposite, subparallel pairs that ascend at angles of 30° to 45° from the midrib, the upper ones subtending the lesser angles, the lowest pair simulating lateral primaries, slightly suprabasilar, branched on the under sides, the basilar branch on the larger side of the leaf with branches similarly arranged; basilar nerves one on each side of the midrib.

No representative of the genus *Tilia*, so far as I am aware, has been heretofore recorded from any Cretaceous horizon, although six Tertiary species from America and about thirty from the Old World have been described. *Tilia dubia* (Newberry) Berry,[44] from New Jersey was described by Newberry as a Cretaceous species; but the deposit in which it was found was subsequetly ascertained to be of late Tertiary or Pleistocene age. Our Alaskan specimen is therefore the first Cretaceous species in the genus to be recorded, and if the facts are as indicated it represents the oldest known ancestral type of the genus. It is unfortunate that the leaf is somewhat fragmentary, so that a complete descriptoin is not possible; but the characters that are preserved are sufficiently well defined to identify it generically and to differentiate it from other described species.

Locality: Yukon River, north bank, 1½ miles above Williams mine (original No. 36); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4642).

Genus GREWIA Linnaeus

Grewia alaskana Hollick, n. sp.

Plate 82, Figure 1

Leaf petiolate, orbicular-cordate, slightly inequilateral, 6 centimeters in length, exclusive of the petiole, by 6 centimeters in width; margin crenate-dentate except at the base, the crenations largest just above the middle, diminishing in size above and below; apex obtuse; base broadly cordate; nervation palmate from the base, campto-craspedodrome; lateral primaries three on each side, ascending, consisting of a strong inner pair and a weak exterior and intermediate pair, with upward and inward curving branches on the outer sides that connect by fine cross nervation near the margin and give off fine short nervilles that extend to and terminate in the crenations; secondary nerves two on each side of the midrib above the middle, weak and inconspicuous, merging into the inner lateral primaries toward the summit.

The genus *Grewia* has not been heretofore recognized, so far as I am aware, in any formation older than Eocene; but the generic characters in our specimen appear to be well defined, and the species resembles certain forms of *Grewia crenata* (Unger) Heer,[45] especially those from Svalbard.[46] In fact, the differences are so slight that our specimen might be regarded as merely varietally rather than specifically different from *G. crenata*. In ours the basal sinus is broader and shallower, the crenations are somewhat coarser, and the lateral primaries are less spreading.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Genus GREWIOPSIS Saporta

Grewiopsis yukonensis Hollick, n. sp.

Plate 81

Leaf rhomboid-ovate, about 18 centimeters in length by about 18 centimeters in width across the middle, obscurely trilobate, tapering to the acuminate apex, rounded and narrowed to the base; margin remotely and finely undulate-dentate above, undulate and entire below; nervation pinnate subpalmate; secondary nerves simple, opposite below, alternate above, craspedodrome, leaving the midrib at obtuse angles of divergence, soon bending and curving upward, lowest two simulating lateral primaries, each with simple, upward-curved branches on the under side that extend to and thin out along the margin, and a forking branch on the upper side toward the extremity.

This species is analogous to the general type of leaf represented by *Grewiopsis acuminata* Lesquereux[47] and *G. walcotti* Lesquereux,[48] from the so-called "Laramie" formation of Utah. Our specimen agrees essentially with these species in form, nervation, and marginal characters, and but for its much larger size might almost be regarded as a form or variety of the species last named.

Locality: Yukon River, north bank, about 12 miles below Melozi telegraph station (original No. 3AH11); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3248).

Genus APEIBOPSIS Heer

Apeibopsis atwoodi Hollick, n. sp.

Plate 82, Figure 2

Leaf oval or oblong, entire, rounded below to a cordate base; nervation simply pinnate, camptodrome; secondary nerves diverging from the base of the mid-

[44] Berry, E. W., Torreya, vol. 7, p. 81, 1907 (=*Tiliaephyllum dubium* Newberry, The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 109, pl. 15, fig. 5, 1895).

[45] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 42, pl. 109, figs. 12–21; pl. 110, figs. 1–11, Winterthur, 1859 (=*Dombeyopsis crenata* Unger, Genera et species plantarum fossilium, p. 448, Vienna, 1850).

[46] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, No. 1, p. 84, pl. 19, figs. 12a, 13, 14, 16, 17, 1876.

[47] Lesquereux, Leo, U. S. Nat. Mus. Proc., vol. 10, p. 44, pl. 3, figs. 12, 13; pl. 4, figs. 1, 2, 1887.

[48] Idem, p. 45, pl. 4, figs. 3, 4.

rib at right angles, the upper nerves diverging at successively decreasing angles, ascending, branched toward the extremities on the under sides; tertiary nervation at right angles to the secondaries throughout, slightly bent outward or upward, simple in the basal part of the leaf, occasionally branched or forked above.

This leaf is different from all other described Cretaceous species of the genus, but it has a more or less close resemblance to *Apeibopsis deloesi* (Gaudin) Heer,[49] from the Miocene of Switzerland. It differs, however, in the closer approximation of the lower four or five secondary nerves and the distinct branching of the upper secondaries toward their extremities.

The specific name is given in honor of Mr. W. W. Atwood, by whose party the material containing the specimen was collected.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Family STERCULIACEAE

Genus STERCULIA Linnaeus

Sterculia atwoodi Hollick, n. sp.

Plate 83, Figure 6

Leaf oblong-ovate, about 9.5 centimeters in length by 6.3 centimeters in width across the middle, broadly cordate at the base, rounded to the apex; margin minutely denticulate in its upper part, entire below; nervation pinnate, craspedodrome above, camptodrome below; midrib somewhat flexuous; secondary nerves strong, irregularly alternate, sharply ascending, the two lower ones respectively basilar and suprabasilar, simulating lateral primaries, branched on the outer sides; tertiary nervation almost straight, at right angles to the secondaries, forming quadrangular areolae, irregularly disposed and connected at the base, forming a network of polygonal areolae.

This well-defined, almost perfect leaf is apparently identical with those from the Patoot beds of Greenland referred to *Sterculia variabilis* Saporta[50] by Heer,[51] despite the fact that this is a "Paleocene" species. Furthermore, comparison with Saporta's figures shows only a remote resemblance, sufficient to indicate generic but not specific identity. I have no hesitation, therefore, in referring the Alaskan specimen to a new species and, at least tentatively, in regarding the Greenland specimens as specifically identical with it.

The species is named in honor of Mr. W. W. Atwood, by whom the specimen was collected.

Locality: Yukon River, north bank, at Pickart's mine (original No. 26); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4638).

Sterculia basiauriculata Hollick, n. sp.

Plate 83, Figure 5

Leaf ovate, with a broad, auriculate-cordate base; nervation pinnate tripalmate; lateral primaries apparently suprabasilar, subopposite, branched on the under sides; secondary nerves pinnately arranged in four or more subparallel, ascending, opposite or subopposite pairs; tertiary nervation at right angles to the secondaries, almost straight, forming quadrangular areolae.

This leaf apparently belongs in the same genus with the species last described, although it is almost equally suggestive of the genus *Cissus*. The character of the base where it joins the petiole is not well defined, but there is an obscure indication of overlapping, in which case only the upper lateral primary would be suprabasilar.

Locality: Yukon River, north bank, about 17 miles above Nahochatilton (original No. 2AC236); collected by A. J. Collier and Sidney Paige in 1902 (lot 2963).

Genus PTEROSPERMUM Schreber, 1791 (not Arber, 1914)

Pterospermum conforme Hollick, n. sp.

Plate 83, Figure 3

Leaf oblong, inequilateral, 6 centimeters in length by 4.5 centimeters in width, rounded above to a blunt apex and below to an oblique truncate-cordate base; margin irregularly wavy, with one broad, blunt tooth below the middle on the broader side; midrib somewhat flexuous; nervation craspedo-camptodrome; secondary nerves craspedodrome to the marginal inequalities, pinnately arranged, the lowest two opposite, arising from the base, with fine branches on the under sides that thin out and coalesce or disappear along the margin, the basilar branch on each side simulating a lateral basilar veinlet; upper secondaries subopposite, three on each side, those on the broader side diverging from the midrib at more obtuse angles than those opposite, all irregularly branched or forked toward the extremities on both under and upper sides.

This leaf is referred to the living genus *Pterospermum* instead of to the fossil genus *Pterospermites* for the reason that it appears to resemble the former more closely than it does the latter as originally defined. *Pterospermites vagans* Heer,[52] the type of the genus,

[49] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 41, pl. 109, figs. 9–11, Winterthur, 1859 (=*Pterospermum deloesi* Gaudin, Soc. vaud. sci. nat. Bull., vol. 4, p. 425, 1885).

[50] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, No. 3, p. 400 [42], pl. 33 [12], figs. 6, 7, 1868.

[51] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 38, pl. 57, fig. 7, 1883.

[52] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 36, pl. 109, figs. 1–5, Winterthur, 1859.

was founded on fossil seeds, while *Pterospermites integrifolius* Heer [53] and *P. dentatus* Heer [54] the first fossil leaves that were referred by the author to the genus are, respectively, subpeltate and peltate. This feature may therefore be regarded as a generic character; although subsequently a number of species of nonpeltate leaves were included in the genus by Heer and other writers.

Our specimen is nonpeltate and resembles the figure of *Pterospermum* sp. by Ettingshausen [55] more closely than it resembles any of the peltate forms of *Pterospermites;* although it apparently belongs with the nonpeltate type of leaves represented by *Pterospermites modestus* Lesquereux [56] and *P. longiacuminatus* Lesquereux,[57] from the Dakota sandstone of Kansas. In any critical revision of the genus the species of the type of those last mentioned might better be excluded and referred to some one or another allied genus, such as *Pterospermum* or *Sterculia.*

Locality: Port Moller, 2 miles up the canyon, west from Mud Bay, Alaska Peninsula (original No. 35), collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5187).

Order MYRTALES

Family TRAPACEAE

Genus TRAPA Linnaeus

Trapa? microphylla Lesquereux

Plate 84, Figure 4

Trapa? microphylla Lesquereux, U. S. Geol. and Geog. Survey Terr. Bull. 5, ser. 2, p. 369, 1876; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 295, pl. 61, figs. 16–17a, 1878.

Detached leaves of this species are included in a number of pieces of matrix from the Chignik Bay region, in one of which they occur massed in layers, in a dark-gray shale, without any other associated vegetation. They vary somewhat in shape and size, as do the type specimens from the Upper Cretaceous (Mesaverde formation) of Wyoming, figured by Lesquereux.

Thus far none of the characteristic fruits of *Trapa* have been found associated with these leaves in any of our collections; although Heer [58] described and figured such fruits from Tertiary rocks at Port Graham, Kenai Peninsula, under the name *Trapa borealis*, without, however, any accompanying leaves of the genus. As far as I am aware the only record of the leaves and fruit having been found associated together was made by Dawson [59] in connection with specimens from the Upper Cretaceous (?) of Alberta. He referred the leaves (figs. 19, 19a) to *Trapa microphylla* Lesquereux and the fruit (fig. 19b) to *T. borealis* Heer.

Specimens of leaves were described and figured by Ward [60] from the Eocene (Fort Union formation) of Montana, and by Knowlton [61] from the Upper Cretaceous (?) of the Yellowstone National Park and the Tertiary (?) Lance formation of Wyoming.

The reference of these leaves to the genus *Trapa* must be regarded as provisional only. Their original reference to the genus was questioned by Lesquereux; and Knowlton, in his discussion of the specimens from the Yellowstone National Park,[62] says: "These curious but well-marked leaves can not possibly belong to the genus *Trapa* as we now understand it, but as I am at present absolutely unable to suggest any other affinity I can do nothing but leave their correct determination to be settled by future workers."

Closely similar leaves were described and figured by Newberry [63] under the name *Neuropteris angulata*, in connection with which he says: "Scattered pinnules of this plant were found in Cretaceous shales lying upon a bed of lignite north of Oraybe, in the Moqui country [New Mexico]." A comparison of Newberry's figure with figures and specimens of *Trapa? microphylla* shows them, unquestionably, to be generically identical, even though Newberry classified his specimens as representing a species of the Paleozoic fern genus *Neuropteris*. Whether or not they should be regarded as specifically identical, however, may still be regarded as an open question.

Locality: Chignik River just below Long Bay, Alaska Peninsula (original No. 54); collected by W. W. Atwood in 1908 (lot 5296).

Order UMBELLALES

Family ARALIACEAE

Genus ARALIA Linnaeus

Aralia wellingtoniana Lesquereux

Plate 84, Figure 1

Aralia wellingtoniana Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 131, pl. 21, fig. 1; pl. 22, figs. 2–3, 1892.

Although this specimen is imperfect the characters that are preserved are identical with those of the

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[53] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 122, pl. 9, fig. 14a, 1868.

[54] Idem, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6, 7 (8, 9?).

[55] Ettingshausen, C. F. von, Die Blatt-Skelete der Dicotyledonen, pl. 49, fig. 6, Vienna, 1861.

[56] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 186, pl. 58, fig. 5, 1892.

[57] Idem, pl. 59, fig. 3.

[58] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, No. 2, p. 38, pl. 8, figs. 9–14, 1869.

[59] Dawson, J. W., Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 31, pl. 2, figs. 19, 19a, 19b, 1886.

[60] Ward, L. F., U. S. Geol. Survey Sixth Ann. Rept., p. 554, pl. 49, figs. 2–5, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 64, pl. 28, figs. 2–5, 1887.

[61] Knowlton, F. H., in Hague, Arnold, and others, Geology of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 661, pl. 77, figs. 3, 4, 1899. Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 62, pl. 5, fig. 7, 1900.

[62] Op. cit. (Mon. 32), p. 661.

[63] Newberry, J. S., in Ives, J. C., Report upon the Colorado River of the West: 36th Cong., 1st sess., Ex. Doc. 90, p. 131, pl. 3, fig. 5, 1861.

species to which it is referred, especially the three-lobed form from the Dakota sandstone of Kansas depicted by Lesquereux (pl. 21, fig. 1), and the specimen from the Raritan formation of New Jersey figured by Newberry.[64]

Locality: Yukon River, north bank, about 16 miles below mine No. 1 (original No. 40); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4643).

Aralia parvidens Hollick, n. sp.

Plate 84, Figure 2

Leaf trilobate, deeply divided, finely dentate, or denticulate, about 18 centimeters in length from base to summit of middle lobe; middle lobe longer and apparently broader than the laterals, about 4 centimeters in width near the middle, decreasing in width below and above; lateral lobes ascending, almost uniform in width, approximating 3 centimeters, slightly narrowed below and apparently tapering above; midrib and lateral primaries strong, about equal in rank; secondary nerves fine, ascending at acute angles of divergence from the primaries, curving upward toward the margin and throwing off slender nervilles that terminate in the dentitions.

I was at first inclined to regard this specimen as a large form or variety of *Aralia wellingtoniana* Lesquereux, partly for the reason that it belongs in the same collection that includes the specimen last described and referred to that species. It differs, however, not only in size but more especially in the much finer and more numerous marginal denticulations. Both species evidently belong in the same group with *Aralia saportana* Lesquereux.[65]

Locality: Yukon River, north bank, about 16 miles below mine No. 1 (original No. 40); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4643).

Aralia pseudoplatanoidea Hollick, n. sp.

Plate 83, Figure 4

Leaf symmetrically trilobate, entire, rounded-cuneate from about the middle downward; lobes rounded-triangular, obtusely apiculate, the apical lobe relatively long and narrow, the lateral lobes short, broad unilobodentate on the outer sides; midrib straight, thickened from the junction of the lateral primaries downward; secondary nervation sparse, fine, camptodrome; lateral primaries craspedodrome, suprabasilar, subtending acute angles with the midrib, each with a prominent branch extending at an acute angle of divergence from the lower part to the apex of the adjacent lobodentition.

There can be but little doubt that this leaf represents the same generic type as *Sassafras* (*Araliopsis*) *platanoides* Lesquereux[66] from the Dakota sandstone of Kansas. The salient characters in each are practically identical; but our leaf is smaller, the lobes are less rounded in outline, and the angles of divergence of the lateral primaries and their branches are more acute.

Whether these and other more or less similar leaves should be regarded as related to *Sassafras*, or *Platanus*, or *Cissites*, or *Aralia* need not be here considered; but anyone who may be interested in this question may find it discussed by Berry[67] in connection with the flora of the Raritan formation of Maryland.

Locality: Pavlof Bay, east side, Alaska Peninsula (original No. 44); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5189).

Aralia polymorpha Newberry

Plate 84, Figure 3

Aralia polymorpha Newberry, The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 118, pl. 39, figs. 1–5, 1895.

Under this name a number of diverse forms are figured by Newberry from the Raritan formation of New Jersey, of which Figure 1 agrees so closely with our specimen that its identity can hardly be questioned.

As far as I am aware the species has not been heretofore recorded from elsewhere than the type locality in New Jersey.

Locality: Yukon River, north bank, at Blatchford's mine, between Nulato and Kaltag (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Genus HEDERA Linnaeus

Hedera macclurii Heer?

Plate 30, Figure 2b

Hedera macclurii Heer, Flora fossilis arctica, vol. 1, p. 119, pl. 17, figs. 1a, 2c, 3, 4, 5a, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, No. 4, p. 476, pl. 52, fig. 8c, 1869; Die miocene Flora und Fauna Spitzbergens: Idem, vol. 2, No. 3, p. 60, pl. 13, figs. 29–32a, 33, 1870; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, No. 1, p. 78, pl. 18, figs. 1a, 2, 1876; Miocene Flora der Insel Sachalin: Idem, vol. 5, No. 3, p. 44, pl. 7, fig. 9b?, 1878; Beiträge zur miocenen Flora von Nord-Canada: Idem, vol. 6, No. 3, p. 16, pl. 3, figs. 4, 5, 1880; Die fossile Flora Grönlands, zweiter Theil: Idem, vol. 7, p. 117, pl. 66, fig. 2, 1883.

This leaf is referred only tentatively to this species, as it is too imperfectly preserved for satisfactory comparison; but its general characters, as far as they can be seen, appear to be identical with those of Heer's

[64] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 114, pl. 26, fig. 1, 1895 [1896].

[65] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Bull., vol. 1, No. 5, p. 394, 1875 [1876]; The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 61, pl. 8, figs. 1–2; pl. 9, figs. 1–2, 1883.

[66] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 58, pl. 7, fig. 1, 1883.

[67] Berry, E. W., Torrey Bot. Club Bull., vol. 38, p. 413, 1911; Maryland Geol. Survey, Upper Cretaceous, p. 878, 1916.

species, especially when comparison is made with his Figure 5a, Plate 17, volume 1; Figure 30, Plate 13, volume 2; and Figure 2, Plate 18, volume 4.

Hedera macclurii was formerly supposed to be a strictly Tertiary species, but Kryshtofovich [68] has published the results of recent observations which indicate, at least so far as the island of Sakhalin is concerned, that the beds in which the species occurs are of Cretaceous age. In his discussion of *Hedera macclurii* he says:

> This Arctic species, which was regarded before as Tertiary, can be identified with one of our species occurring in the Mgach. * * * Most of the described floras which contain the present species are of doubtful age, but the Mgach flora * * * is no doubt Cretaceous.

This statement, of course, raises the question whether or not all the leaves referred by Heer to the species actually belong in it, and it is a significant fact that he himself questions the identity of his specimen from the island of Sakhalin.

It should also be remarked that our specimen is highly suggestive of *Hedera primordialis* Saporta,[69] to which Newberry [70] referred a number of leaves from the Raritan formation of New Jersey, some of which, especially his Figures 2, 4, and 7 on Plate 37, are as much like certain forms of *Hedera macclurii* as they are like *Hedera primordialis*. In fact if all the diverse leaf forms referred to these two species by various authorities were grouped together it would be a very difficult matter to separate them satisfactorily.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Hedera platanoidea Lesquereux?

Plate 27, Figure 6b

Hedera platanoidea Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 351, pl. 3, fig. 3, 1876; The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 65, pl. 3, figs. 5–6, 1883.

Our leaf is too fragmentary for accurate comparison or positive identification, but the basilar characters are those of Lesquereux's species, and the secondary nervation, as far as it is preserved, is strongly indicative of that species. In any event our leaf would be included in the same genus with it, and provisional specific identity appears to be justified.

Locality: Yukon River, south bank, about 1½ miles below Seventymile Creek (original No. 80); collected by G. C. Martin in 1914 (lot 6815).

[68] Kryshtofovich, A. [N.], On the Cretaceous flora of Russian Sakhalin: Coll. Sci. Imp. Univ. Tokyo Jour., vol. 40, art. 8, p. 59, fig. 14. 1918.

[69] Saporta, Gaston de, Le monde des plantes avant l'apparition de l'homme, p. 200, fig. 29, Paris, 1879.

[70] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 113, pl. 19, figs. 1, 9; pl. 37, figs. 1–7, 1895 [1896].

Hedera schraderi Hollick, n. sp.

Plate 83, Figure 1

Leaf obliquely ovate-reniform, entire, 6 centimeters in length by 7 centimeters in width, broadly wedge-shaped above, rounded-truncate below; apex obtuse; base abruptly subcordate or emarginate; nervation pinnate, craspedodrome; midrib straight; secondary nerves five on each side, subopposite, subparallel, diverging from the midrib at angles of about 45°, the basilar pair with branches from the under sides that subtend acute angles with the secondaries and curve upward along the margin.

This leaf is suggestive of the type represented by *Hedera platanoidea* Lesquereux,[71] from the Dakota sandstone of Kansas, and the leaf from the Cenomanian of Bohemia referred by Velenovsky [72] to *Hedera primordialis* Saporta,[73] although it is very doubtful if Velenovsky's specimen is referable to this species, as may be seen by comparison of the figures.

The specific name is given in honor of the collector, Mr. F. C. Schrader.

Locality: Koyukuk River, west bank, about 39 miles above its mouth (original No. 333); collected by F. C. Schrader in 1899 (lot 7472).

Hedera vera Hollick, n. sp.

Plate 83, Figure 2

Leaf small, 4 centimeters in length by 3.5 centimeters in width across the base, triangular cordate, subtrilobate; margin undulate; nervation palmate from the base, craspedo-camptodrome; midrib supporting two pairs of subopposite, widely separated, upward-curved secondary nerves that extend to and disappear in the marginal undulations; lateral primaries two on each side of the midrib, the inner pair radiating at an angle of about 45°, the outer or lower pair approximately horizontal, forked toward their extremities, the ultimate branches extending to and disappearing along the border of the margin; basilar veinlets obscurely defined.

This leaf is very similar in appearance to certain of the common leaf forms of the living *Hedera helix* Linnaeus, and also to the Tertiary species *H. strozzii* Gaudin,[74] and it is interesting to find an ancestral Cretaceous species in which the leaf form is so closely

[71] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 351, pl. 3, fig. 3, 1876; The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 65, pl. 3, figs. 5–6, 1883.

[72] Velenovsky, Josef, Die Flora der böhmischen Kreideformation, pt. 1: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 2, Nos. 1–2, p. 26 [19], pl. 8 [6], fig. 7, Wien, 1882.

[73] Saporta, Gaston de, Le monde des plantes avant l'apparition de l'homme, p. 200, fig. 29, Paris, 1879.

[74] Gaudin, C. T., Mémoire sur quelques gisements de feuilles fossiles de la Toscane: Soc. helv. sci. nat. Nouv. mém., vol. 16, No. 3, p. 37, pl. 12, figs. 1–3, 1858.

similar in its appearance to recent and living forms of this type.

Locality: Yukon River, north bank, about 13 miles above Kaltag (original No. 3AH26); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3265).

Hedera curva Hollick, n. sp.

Plate 29, Figures 3a, 4a; Plate 82, Figure 4

Leaves of medium size, variable in shape, trilobate; lobes rounded, obtuse; middle lobe expanded, broadly undulate; margin entire; base broad and rounded or narrowed to wedge shape; nervation tripalmate from the base; midrib supporting several irregularly disposed, camptodrome secondary nerves above that merge into the tertiary nerves and form a network of polygonal areolae along the margin; lateral primaries craspedodrome to the apices of the lobes, each one connected on its under side with a marginal veinlet by a series of fine nervillose branches.

These leaves appear to vary somewhat in form; but the genus to which they apparently belong is notably heterophyllous. The specimen represented by Figure 3a, Plate 29, is apparently much narrower than the other two, but this feature is probably more apparent than real and may be accounted for by the evident distortion of the leaf, as indicated by the wrinkled upper middle portion, which has apparently resulted in more or less lateral constriction. It is with some hesitation that these leaves are referred to the genus *Hedera*, as they are also suggestive of *Passiflora*—a genus as heterophyllous as *Hedera*—but the minor critical characters appear to favor *Hedera*. They apparently belong to the type of leaf represented by *Hedera malaisai* Saporta and Marion,[75] from the "Paleocene" of Belgium.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Family CORNACEAE

Genus CORNUS Linnaeus

Cornus forchhammeri Heer

Plate 30, Figure 3a; Plate 86, Figure 2

Cornus forchhammeri Heer, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 85, pl. 44, fig. 13, 1882.

Our leaves appear to be slightly less rounded or ovate than Heer's species from the Atane beds of Greenland; and the same may be said of a leaf referred to the species by Berry,[76] from the Magothy formation of Maryland, which differs also in having more numerous secondary nerves than appear in Heer's figure and in ours; but that all are referable to one and the same species appears to be reasonably certain.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Cornus rhamnoides Hollick, n. sp.

Plate 86, Figure 3

Leaf oval-elliptical, wedge-shaped at base and summit, 7.2 centimeters in length by 3.8 centimeters in width across the middle; margin entire; apex apiculate; nervation simply pinnate, campto-acrodrome; midrib thin above, thick below; secondary nerves opposite or subopposite, five on each side, leaving the midrib at angles of about 40°, curving upward, thinning out and merging into one another near the margin; tertiary nervation rather widely spaced, flexed or almost straight, at right angles to the midrib and secondaries throughout.

It is difficult to decide whether this leaf should be regarded as belonging to the Cornaceae or to the Rhamnaceae. It appears to be slightly inequilateral—a character which is common to certain species in both *Cornus* and *Rhamnus* and therefore is of no distinctive diagnostic value in deciding between them; but the subopposite character of the secondary nervation and the relatively wide spacing of the tertiary nerves would appear to indicate generic relationship with *Cornus* rather than with *Rhamnus*.

Locality: Mine [Coal] Creek, Herendeen Bay, Alaska Peninsula (original No. 30); collected by H. M. Eakin in 1908 (lot 5184).

Cornus benjamini Hollick, n. sp.

Plate 85, Figures 4b, 5

Leaves varying in size from 1.5 centimeters in length by 9 millimeters in width to 3.5 centimeters in length by 1.9 centimeters in width, ovate-elliptical, entire, tapering above to an acuminate, wedge-shaped apex; nervation well defined, pinnate subacrodrome; secondary nerves three or four on each side of the midrib, irregularly alternate, subparallel, leaving the midrib at acute angles of divergence, curving sharply upward, ultimately thinning out and disappearing in or close to the margin, the upper ones extending to the apex.

It is possible that these leaves may represent small forms of the species from the same locality referred to *Cornus forchhammeri* Heer, the species first described; but leaves so small could not be included in the species without amending the specific description. If similar

[75] Saporta, Gaston de, and Marion, A. F., Revision de la flore heersienne de Gelinden: Acad. roy. Belgique Mém. cour. et sav. étrang., vol. 41, No. 3, p. 76, pl. 12, fig. 3, 1878.

[76] Berry, E. W., Maryland Geol. Survey, Upper Cretaceous, p. 885, pl. 82, fig. 1, 1916.

leaves of intermediate size should be found, however, it might be advisable to regard them all as specifically identical.

The species is named for Mr. Marcus Benjamin, of the United States National Museum, in recognition of his many years of conscientious scientific literary work in connection with that institution.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Cornus ceterus Hollick, n. sp.

Plate 86, Figure 1

Leaf oblong-lanceolate, about 8 centimeters in length by 2.5 centimeters in width, entire, abruptly rounded and broadly wedge-shaped at the base; secondary nervation pinnate, alternate, subacrodrome, consisting of three or four nerves on each side of the midrib, all starting from below the middle of the leaf, leaving the midrib at acute angles of divergence, curving upward, becoming attenuated and finally disappearing close to the margin, the upper ones apparently extending to the apex.

This leaf is apparently identical generically with other similar but broader leaves from the same locality referred to *Cornus forchhammeri* Heer. (See p. 112, pl. 30, fig. 3a; pl. 86, fig. 2.) It is, however, conspicuously oblong instead of ovate.

Locality: Chignik River, just below Long Bay, Alaska Peninsula (original No. 55); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5297).

Division GAMOPETALAE

Order ERICALES

Family ERICACEAE

Genus ANDROMEDA Linnaeus

Andromeda? sp. Hollick

A fragmentary lanceolate, simply pinnately nerved leaf was provisionally identified as a species of *Andromeda*, largely by reason of its apparent resemblance to *A. grandifolia* Berry,[77] a common species in the early Upper Cretaceous (Raritan and Tuscaloosa formations) of the eastern United States; but even the generic identification must be regarded as merely tentative.

Locality: Yukon River, north bank, below Blatchford's mine (original No. 3AH24); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3263).

Order PRIMULALES

Family MYRSINACEAE

Genus MYRSINE Linnaeus

Myrsine gaudini (Lesquereux) Berry

Plate 30, Figure 1b

Myrsine gaudini (Lesquereux) Berry, Torrey Bot. Club Bull., vol. 36, p. 262, 1909.

Myrsinites? gaudini Lesquereux, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 115, pl. 52, fig. 4, 1892.

This species, described and figured by Lesquereux from the Dakota sandstone of Kansas, is hardly to be distinguished from *Myrsine elongata* Newberry,[78] from the Raritan formation of New Jersey, and they may well be regarded as one and the same species, although the latter is slightly narrower. A specimen from the Magothy formation of Long Island, N. Y., figured by Hollick[79] and referred to Newberry's species, is apparently identical with Lesquereux's species and with our specimen from Alaska.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Order EBENALES

Family SAPOTACEAE

Genus SAPOTACITES Ettingshausen

Sapotacites alaskensis Hollick, n. sp.

Plate 85, Figure 1

Leaf spatulate-obovate, entire, 6 centimeters in length by 3 centimeters in maximum width, rounded above to an obtuse, emarginate apex, tapering below to a narrow, acute, decurrent base; nervation pinnate; secondary nerves leaving the midrib at obtuse angles of divergence, curving upward and coalescing with the tertiary nervation along the margin.

This leaf resembles *Sapotacites obovata* Velenovsky,[80] from the Cenomanian of Bohemia; but the base of our specimen is narrower and more tapering than is indicated in Velenovsky's figure, and the secondary nerves appear to subtend more obtuse angles with the midrib. In its general features it also resembles *Myrica emarginata* Heer,[81] from the Atane beds of Green-

[77] Berry, E. W., Torrey Bot. Club Bull., vol. 34, p. 204, pl. 15, fig. 3, 1907 (=*A. latifolia* Newberry, The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 120, pl. 33, figs. 6–8, 10; pl. 36, fig. 10, 1895 [1896]; not *A. latifolia* Wright, 1870).

[78] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 122, pl. 22, figs. 1–3, 1895 [1896].

[79] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 102, pl. 39, fig. 13, 1906.

[80] Velenovsky, Josef, Die Flora der böhmischen Kreideformation, pt. 3: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 4, No. 1, p. [50] 3, pl. [18] 3, fig. 6, Wien, 1884.

[81] Heer, Oswald, Die fossile Flora Grönlands, erster Theil: Flora fossilis arctica, vol. 6, pt. 2, p. 66, pl. 41, fig. 2; pl. 46, fig. 12e, 1882.

land, but it is more expanded laterally in the upper part, and the apex is more constricted. In either event, however, the generic designation is open to question, and our leaf might about equally well be referred to the genus *Bumelia*, as may be seen by comparison with the living *B. lanuginosa* Persoon, in which the leaves are often more or less emarginate at the apices.

Locality: Yukon River, north bank, at Blatchford's mine (original No. 3AH19); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3258).

Family DIOSPYRACEAE

Genus DIOSPYROS Linnaeus

Diospyros steenstrupi Heer

Plate 85, Figure 2

Diospyros steenstrupi Heer, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 32, pl. 64, figs. 1a, 1b, 1883.

The nervation of this species from the Patoot beds of Greenland, as depicted by Heer, is so peculiar, especially as represented in his Figure 1a, and the nervation of our specimen matches it so closely, that the specific identity of the two can hardly be questioned.

Fragmentary specimens from the Dakota sandstone of Kansas are doubtfully referred to the species by Lesquereux,[82] but their identity may well be questioned, as compared with ours. A specimen from the Cretaceous (Magothy?) formation of Staten Island, N. Y., was also referred to the species by Hollick [83] but was subsequently [84] referred to *Diospyros provecta* Velenovsky. So far as I am aware the occurrence of the species has not been elsewhere recorded.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Diospyros cornifolius Hollick, n. sp.

Plate 85, Figure 3

Leaf ovate, tapering above to the apex and rounded below to the broad, cuneate base; margin entire; nervation camptodrome; secondary nerves eight on each side, irregularly spaced, leaving the midrib at varying angles of divergence, curving upward, thinning out, approaching and finally coalescing through the tertiary nervation along the margin.

[82] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 111, pl. 16, fig. 9, 1892.

[83] Hollick, Arthur, New York Acad. Sci. Trans., vol. 12, p. 34, pl. 3, fig. 8, 1892.

[84] Hollick, Arthur, The Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 104, pl. 40, fig. 10, 1906.

This leaf is described as a new species, although it might be regarded as a form of the variable species *Diospyros primaeva* Heer,[85] from the Cretaceous of Nebraska, and as depicted by Lesquereux [86] from the Dakota sandstone of Kansas; and it may also be compared with *Diospyros vancouverensis* Dawson,[87] from the Upper Cretaceous of Vancouver Island. It is difficult also, to escape the idea that the leaves described and figured under the names *Cornus holmiana* Heer [88] and *Cornus thulensis* Heer,[89] from the Patoot beds of Greenland, belong in the genus *Diospyros* rather than in *Cornus*, if the secondary nervation is correctly depicted, and that they are closely related to our species.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery (original No. 958); collected by T. W. Stanton in 1904 (lot 3521).

Order RUBIALES

Family CAPRIFOLIACEAE

Genus VIBURNUM Linnaeus

Viburnum simile Knowlton?

Plate 85, Figure 8

Viburnum simile Knowlton, in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 277, pl. 49, fig. 3, 1917.

The identity of this leaf with Knowlton's species from the Vermejo formation of southeastern Colorado is questioned by reason of its fragmentary condition. It is also suggestive of *Viburnum whymperi* Heer,[90] from the Tertiary of Greenland, to which Knowlton [91] has doubtfully referred several specimens from the Montana group of Wyoming. *Viburnum simile* appears to be a valid species, however, and I have but little doubt that if our specimen were perfect its identity with this species would be verified.

Locality: Chignik Bay, Alaska Peninsula, about 2 miles northeast of Alaska Packers Association cannery; collected by T. W. Stanton in 1904 (lot 3521).

[85] Heer, Oswald, in Capellini, J., and Heer, O., Les phyllites crétacées du Nebraska: Soc. helv. sci. nat. Nouv. mém. vol. 22, No. 1, p. 19, pl. 1, figs. 6, 7, 1866.

[86] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon. 17, p. 109, pl. 20, figs. 1–3, 1892.

[87] Dawson, J. W., Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 28, pl. 8, fig. 32, 1882 [1883].

[88] Heer, Oswald, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 36, pl. 62, fig. 12; pl. 64, figs. 6, 7, 1883.

[89] Idem, p. 37, pl. 62, figs. 9–11.

[90] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, No. 4, p. 475, pl. 46, fig. 1b, 1869.

[91] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 72, pl. 17, fig. 1; pl. 18, fig. 1; pl. 19, fig. 3, 1900.

Viburnum sp.

Plate 85, Figures 6, 7

These leaves are too fragmentary for either adequate description or satisfactory comparison. They apparently represent a species of *Viburnum* with rugose texture and strong nervation; but there is nothing definitely indicative of the marginal characters.

A leaf that is somewhat similar in general appearance to our specimens, but considerably smaller and less pronounced in its surface features, is *Viburnum simile* Knowlton,[92] the species last described, from the Vermejo formation of southeastern Colorado; but the reference to this species is to be regarded merely as a suggestion.

Locality: Coal mine in Coal Bluff, Herendeen Bay, Alaska Peninsula (original No. 31); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5185).

Viburnum grossecrenatum Hollick, n. sp.

Plate 86, Figure 4

Size and shape of leaf not known, apparently about 19 centimeters in length by 18 centimeters in width, narrowed above to a wedge-shaped apex(?); margin coarsely and obtusely crenate; nervation subpalmate, craspedodrome; midrib somewhat flexuous; secondary nerves few in number, widely spaced, alternate, ascending, the upper ones forked toward their extremities, the lower ones with forking branches from their under sides, the lower branches forked in a similar manner.

This imperfect specimen apparently represents a leaf that may be compared with the general type of Viburnums with broadly ovate or rhomboidal outline and palmate or subpalmate nervation. It is much larger than any fossil species with which it may be satisfactorily compared, but, except for its larger size, it is suggestive of *Viburnum crassum* Knowlton,[93] from the Vermejo formation of northeastern New Mexico. In the description of this species Knowlton describes the apex as "apparently truncate * * * but with apparently about five low, broad, obtuse lobes." A careful examination of his Figure 3, however, indicates that these apparent characters may be due, at least in part, to imperfection of preservation. In any event the marginal inequalities are in the nature of crenations rather than lobes, and the margin might be more accurately defined as lobo-crenate rather than lobed.

[92] Knowlton, F. H., in Lee, W. T., and Knowlton, F. H., Geology and paleontology of the Raton Mesa and other regions in Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, p. 277, pl. 49, fig. 3, 1917.

[93] Idem, p. 277, pl. 52, figs. 3, 4.

Locality: Yukon River, north bank, sandstone immediately below Pickart's mine (original No. 3AH18b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3255).

Viburnum zizyphoides Heer

Plate 85, Figure 9

Viburnum zizyphoides Heer, Die fossile Flora Grönlands, zweiter Theil: Flora fossilis arctica, vol. 7, p. 34, pl. 60, fig. 2, 1883.

There can be but little doubt in regard to the identity of our specimen with this well-defined, unique species, as depicted by Heer, from the Patoot beds of Greenland. Heer's specimen is larger than ours, but otherwise the two compare perfectly in every detail. The species has not been heretofore recorded from elsewhere than the type locality in Greenland.

Locality: Yukon River, north bank, Fossil Bluff, about 6 miles above Nahochatilton (original No. 2AC238); collected by A. J. Collier and Sidney Paige in 1902 (lot 2962).

Viburnum arcuatile Hollick, n. sp.

Plate 85, Figure 10

Leaf asymmetric, turned to one side, with a curved, cuneate base; margin coarsely and sharply triangular-serrate-dentate above, entire below; midrib strongly curved; secondary nervation irregularly pinnate, craspedodrome, ascending, the upper nerves branched toward the extremities, each nerve and branch terminating in one of the teeth.

The imperfect preservation of this specimen renders accurate and complete description impossible; but enough of the characters are preserved to identify it in the event of more perfect specimens being discovered. The pronounced asymmetry does not appear to be due to distortion but to be a normal character of the leaf, coincident with the curved or arcuate midrib.

Locality: Yukon River, north bank, about 8 miles below Kaltag (original No. 35); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4640).

DICOTYLEDONAE OF UNCERTAIN RELATIONSHIP

Genus PHYLLITES Brongniart

Phyllites crassus Hollick, n. sp.

Plate 74, Figure 7

Size and shape of leaf unknown, coriaceous, nervation coarse, flexuous or angled, forked, craspedodrome; margin coarsely triangular-dentate.

This is evidently only a fragment of what was apparently a large leaf of leathery texture. The indicated central nerve may or may not represent a midrib, and the entire system of nervation preserved on the fragment may merely represent the upper, branching portion of a large lateral nerve. The visible features are suggestive of the Nymphaeaceae, the Menispermaceae, and the Araliaceae; but it would be hazardous to infer even the family affiliation of the leaf from such a fragment.

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Phyllites sp.

Plate 6, Figure 6c

Locality: Yukon River, north bank, about 6 miles above Nahochatilton (original No. 3AH16); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Phyllites sp.

Plate 30, Figure 4b

Locality: Yukon River, north bank, about 6 miles below Blatchford's mine (original No. 3AH22); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Phyllites sp.

Plate 30, Figure 4c

This specimen and the two previously listed as *Phyllites* sp. are too obscurely defined to warrant any attempt at description or generic identification. They are interesting, however, as indicating the association of dicotyledonous angiosperms and certain ancient types of gymnosperms that is one of the characteristic features of the early Upper Cretaceous flora of Alaska.

Locality: Yukon River, north bank, about 6 miles below Blatchford's mine (original No. 3AH22); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3252).

Genus PHYTORADICULARIA Hollick, n. gen.

Phytoradicularia dubia Hollick, n. sp.

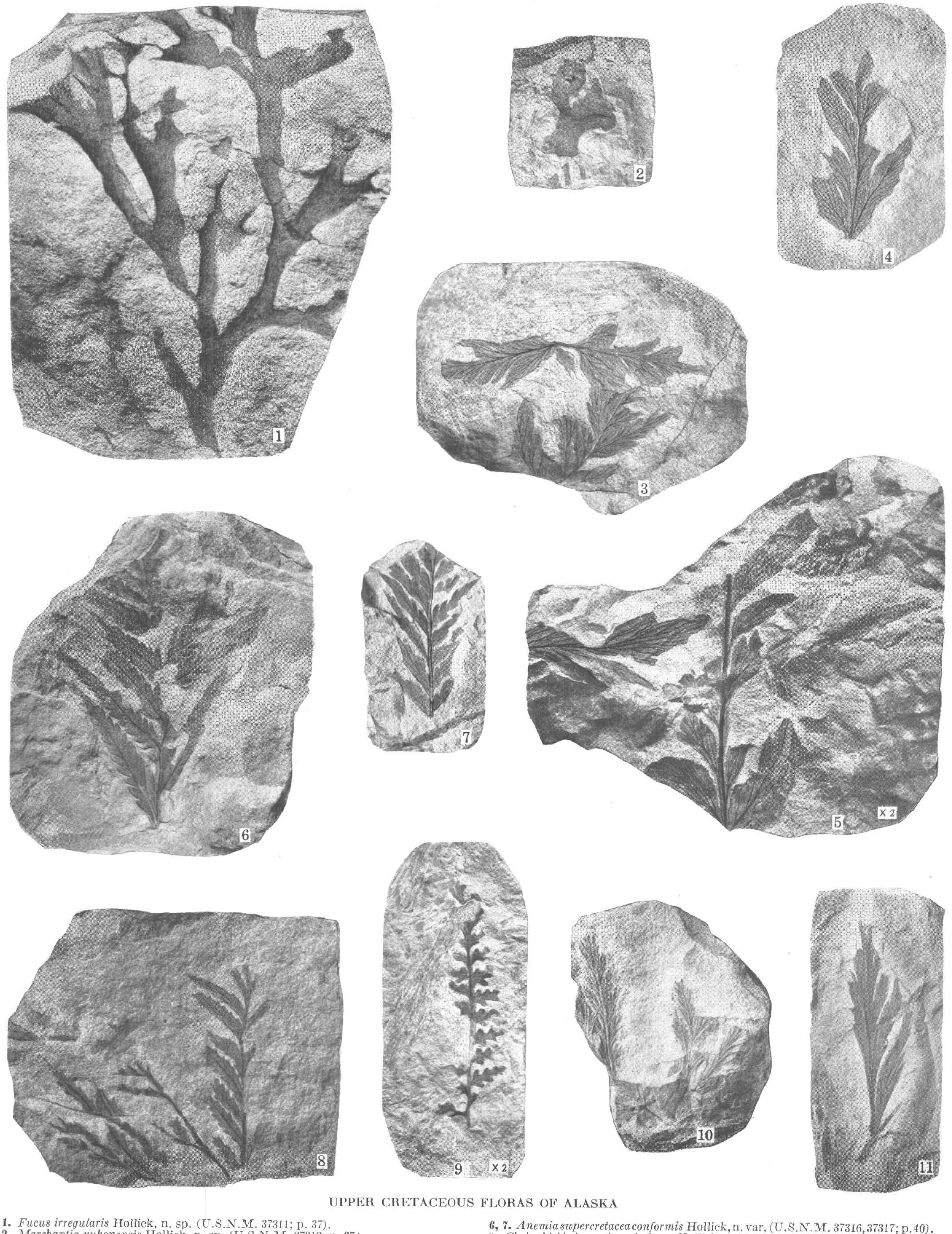
Plate 2, Figure 10

Organism consisting of a slender stem about 4 centimeters in length, arising from a cluster of numerous rootlike, irregular branches with small sporelike bodies, or tubercles, attached.

This problematic organism presents the appearance of tuberculate rootlets attached to a stem. These characters, however, may or may not possess any diagnostic value, and the systematic relationships of the specimen can not be even inferred, satisfactorily, from them. It is described and figured in order that it may be identified in the event of similar or better-preserved specimens being discovered in the future.

Locality: Coal Creek, right branch, below first side stream, Herendeen Bay, Alaska Peninsula; collected by Sidney Paige in 1905 (lot 3708).

PLATES 1–86



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Fucus irregularis* Hollick, n. sp. (U.S.N.M. 37311; p. 37).
2. *Marchantia yukonensis* Hollick, n. sp. (U.S.N.M. 37312; p. 37).
3-5. *Asplenium foersteri* Debey and Ettingshausen? (U.S.N.M. 37313, 37314, 37315; p. 38).
6, 7. *Anemia supercretacea conformis* Hollick, n. var. (U.S.N.M. 37316, 37317; p. 40).
8. *Cladophlebis browniana infirma* Hollick, n. var. (U.S.N.M. 37318; p. 39).
9. *Stachypteris inenarrabilis* Hollick, n. sp. (U.S.N.M. 37319; p. 40).
10, 11. *Asplenium johnstrupi* (Heer) Heer? (U.S.N.M. 37320, 37321; p. 39).

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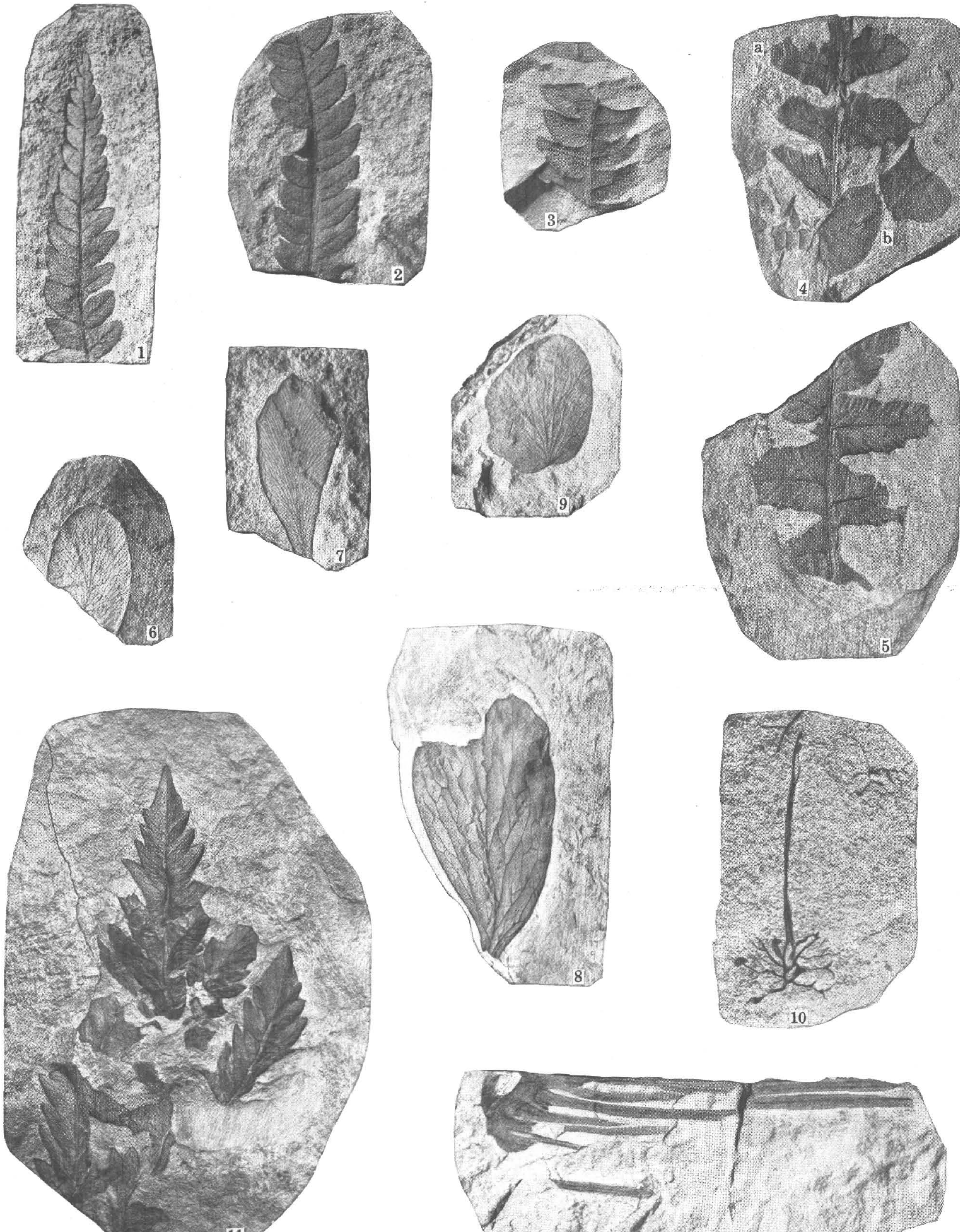
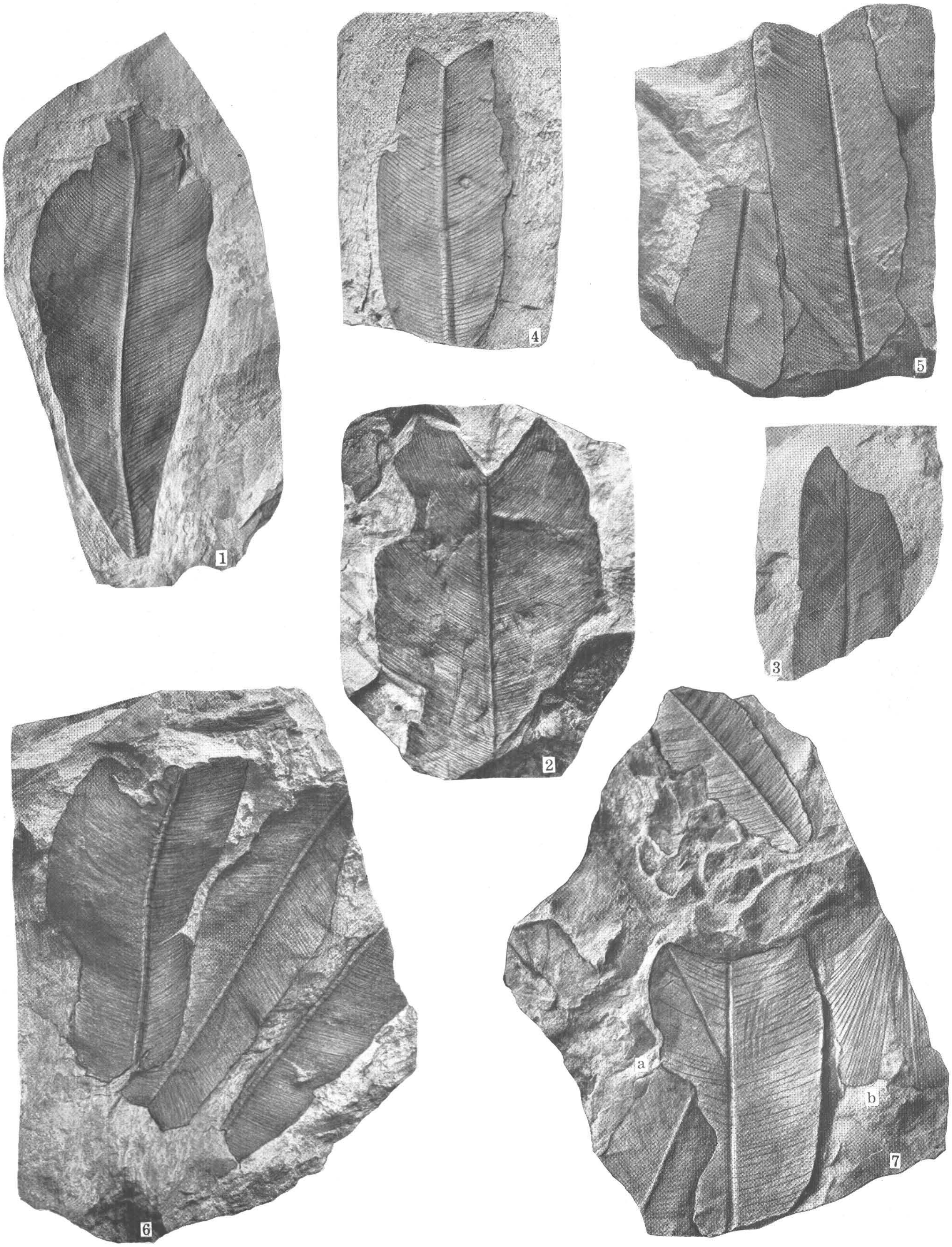


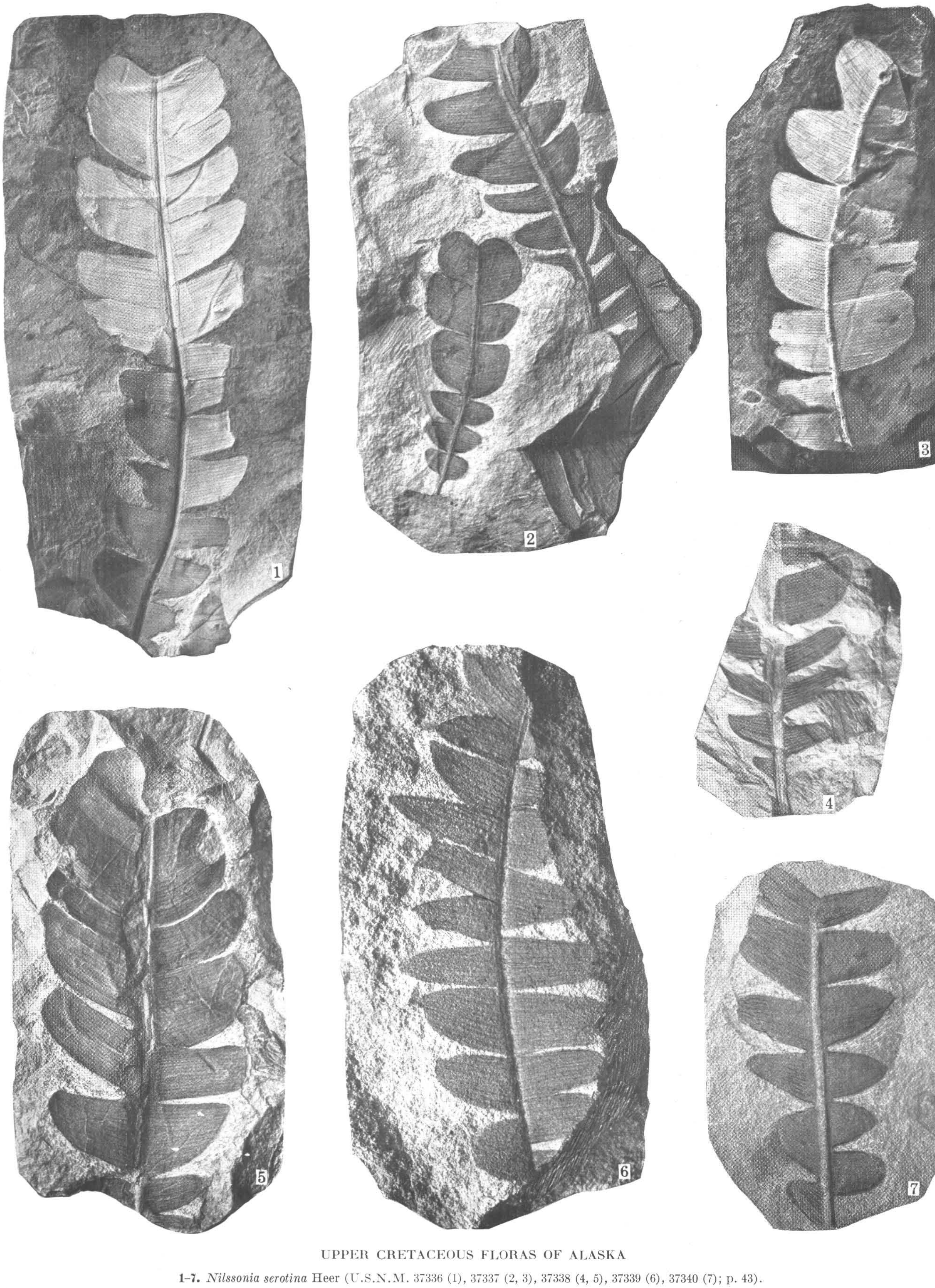
UPPER CRETACEOUS FLORAS OF ALASKA

1-3. *Cladophlebis septentrionalis* Hollick, n. sp. (U.S.N.M. 37322 (1, 2), 37323 (3); p. 39).
4a, 5. *Phegopteris alaskensis* Hollick, n. sp. (U.S.N.M. 37324; p. 38).
4b. *Ginkgo minor* Hollick, n. sp. (U.S.N.M. 37325; p. 50).
6. *Sagenopteris suspecta* Hollick, n. sp. (U.S.N.M. 37326; p. 41).
7. *Sagenopteris paucireticulata* Hollick, n. sp. (U.S.N.M. 37327; p. 41).
8. *Sagenopteris variabilis* (Velenovsky) Velenovsky (U.S.N.M. 37328; p. 41).
9. *Phyllocladites dubiosus* Hollick, n. sp. (U.S.N.M. 37329; p. 52).
10. *Phytoradicularia dubia* Hollick, n. sp. (U.S.N.M. 37330; p. 116).
11. *Pteris nitida* Hollick, n. sp. (U.S.N.M. 37331; p. 39).
12. *Cycadites?* sp. (U.S.N.M. 37332; p. 42).



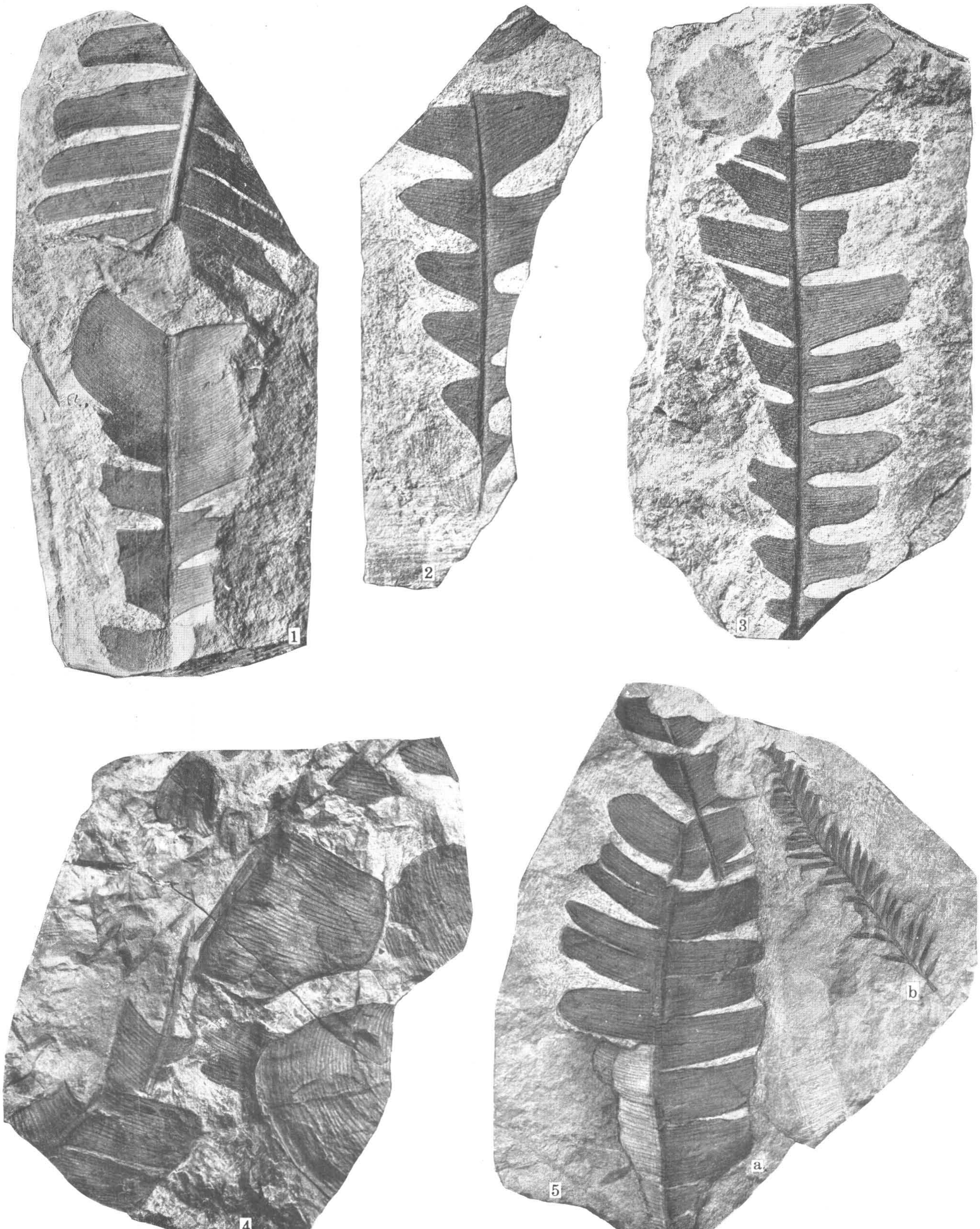
UPPER CRETACEOUS FLORAS OF ALASKA

1–7a. *Nilssonia yukonensis* Hollick, n. sp. (U.S.N.M. 37333 (1–3), 37334 (4–7a); p. 42).
7b. *Ginkgo pseudoadiantoides* Hollick, n. sp. (U.S.N.M. 37335; p. 49).



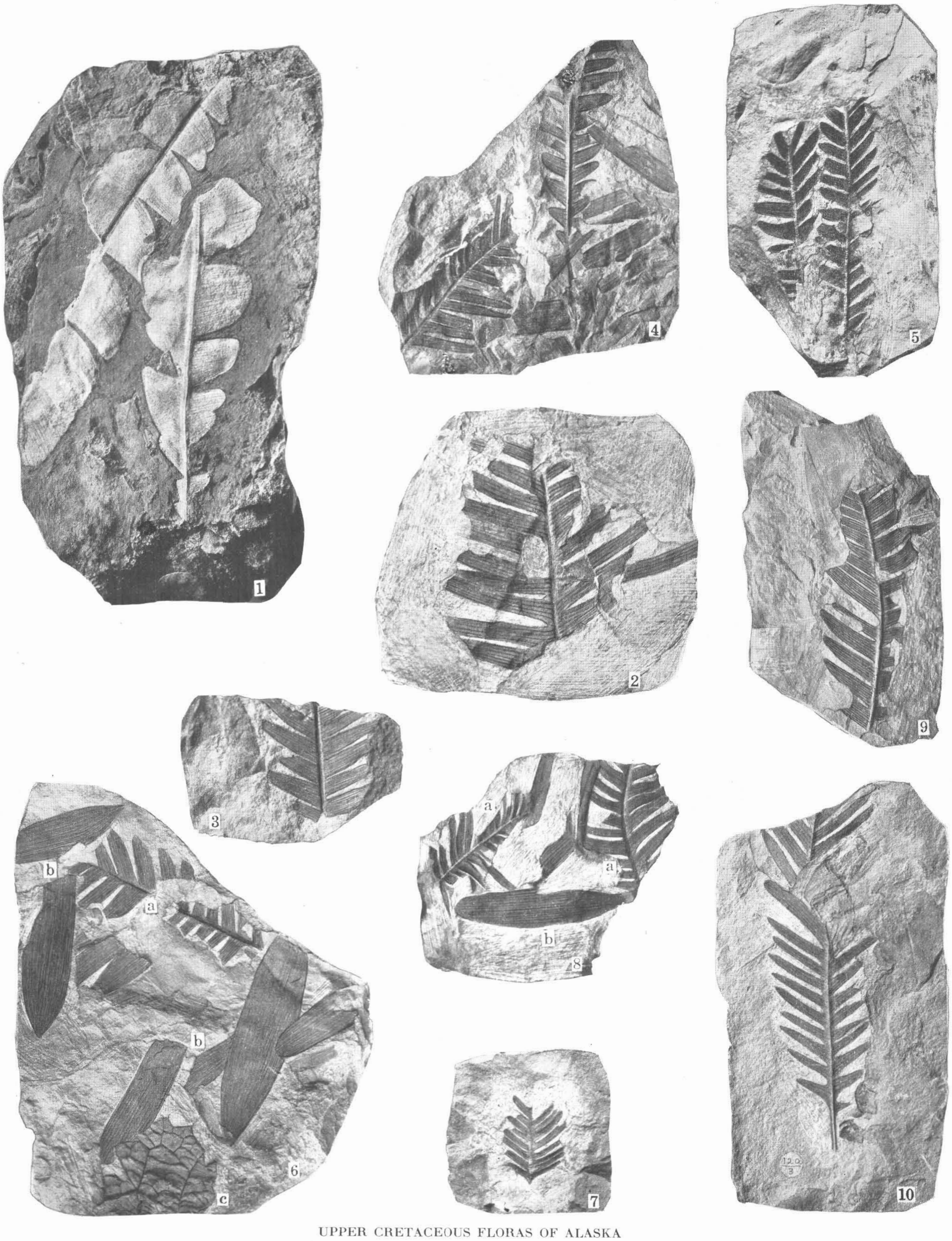
UPPER CRETACEOUS FLORAS OF ALASKA

1–7. *Nilssonia serotina* Heer (U.S.N.M. 37336 (1), 37337 (2, 3), 37338 (4, 5), 37339 (6), 37340 (7); p. 43).



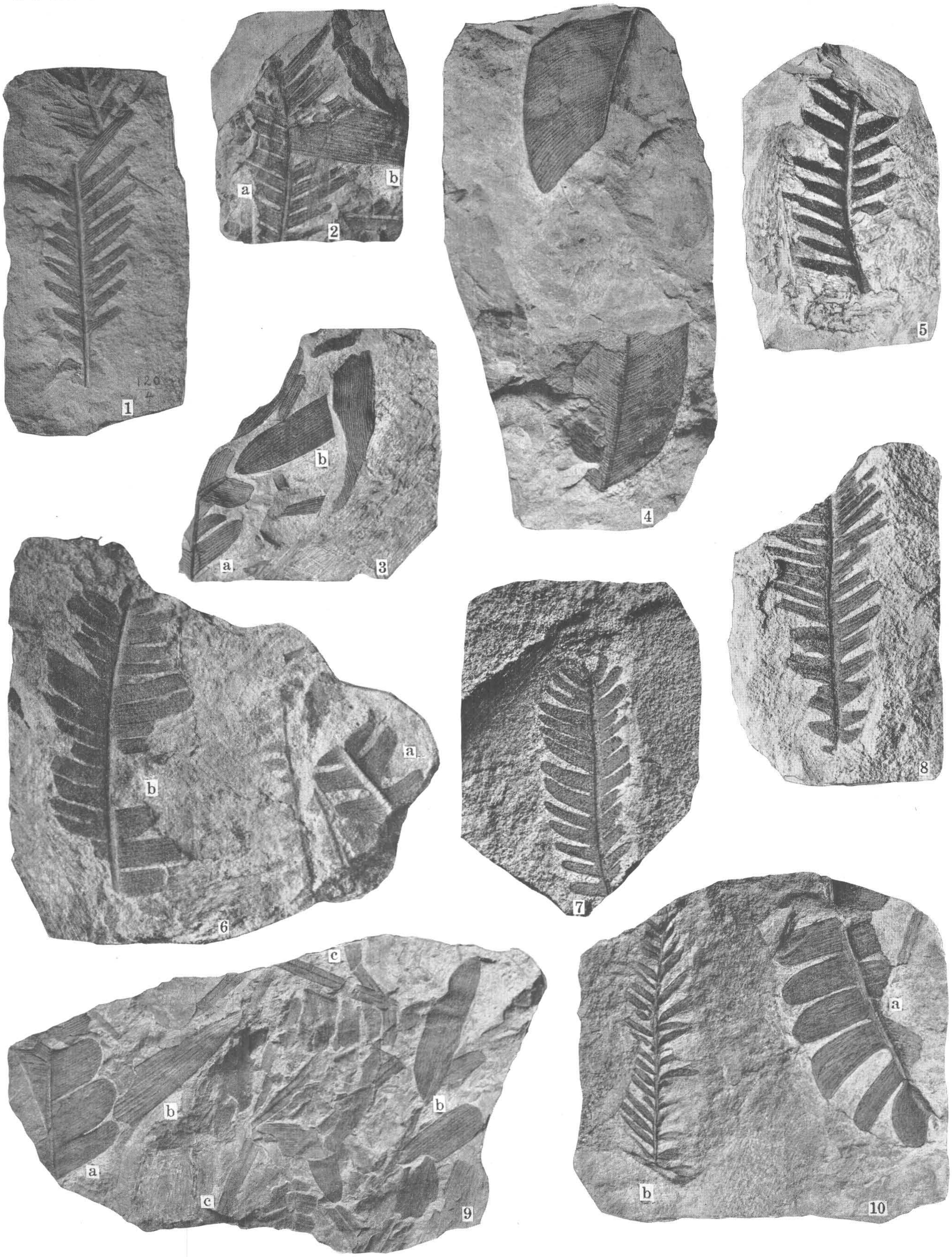
UPPER CRETACEOUS FLORAS OF ALASKA

1–5a. *Nilssonia serotina* Heer (U.S.N.M. 37341 (1–3), 37338 (4), 37337 (5a); p. 43).
5b. *Cephalotaxopsis microphylla laxa* Hollick, n. var. (U.S.N.M. 37342; p. 54).



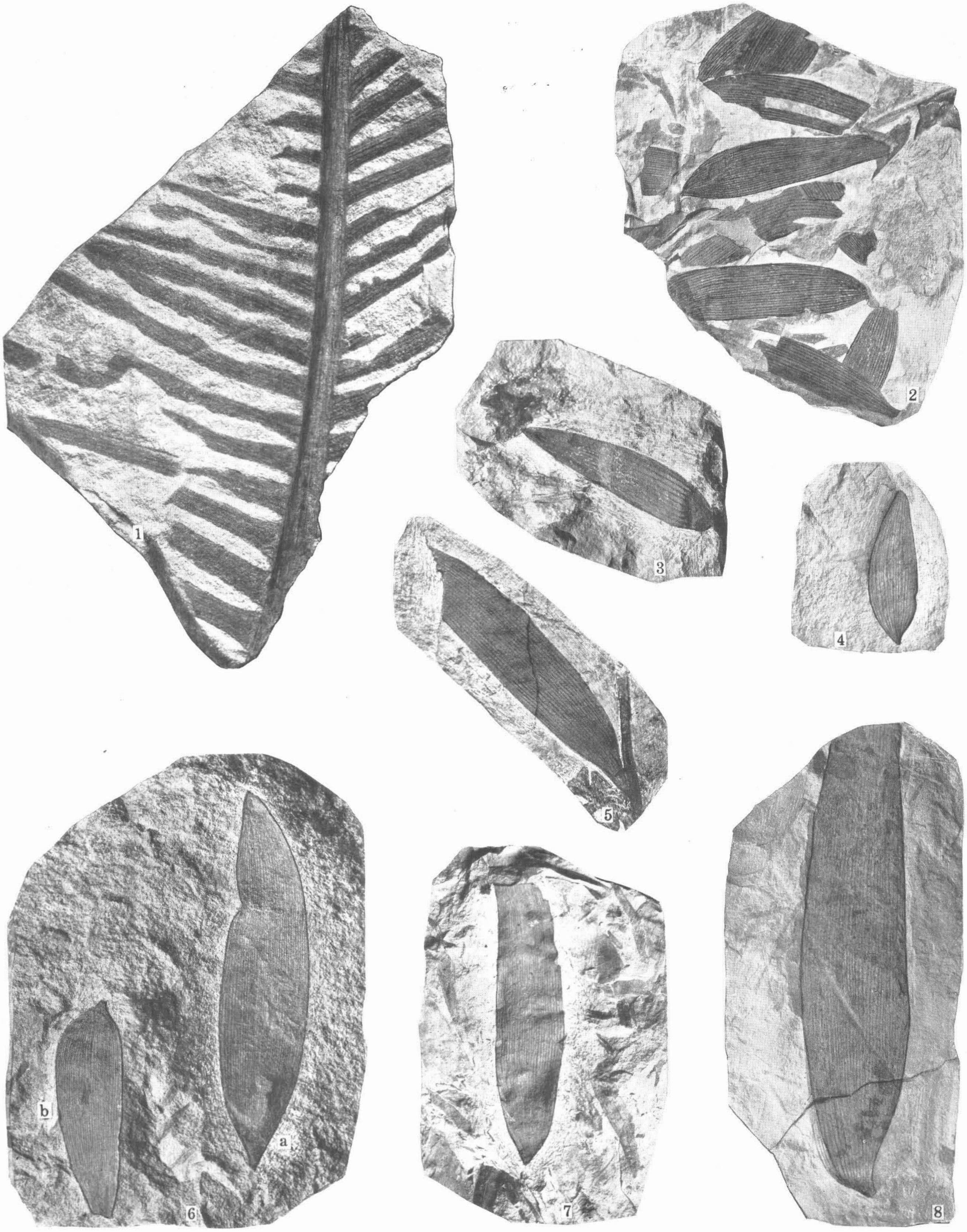
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Nilssonia comptula approximata* Hollick, n. var. (U.S.N.M. 37343; p. 44).
2. *Nilssonia pseudopterophylloides* Hollick, n. sp. (U.S.N.M. 37344; p. 44).
3–6a, 7, 8a, 9, 10. *Nilssonia alaskana* Hollick, n. sp. (U.S.N.M. 37345 (3), 37346 (4), 37347 (5, 6a, 7), 37350 (8a, 9), 37352 (10); p. 45).
6b, 8b. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37348, 37351; p. 46).
6c. *Phyllites* sp.? (U.S.N.M. 37349; p. 116).



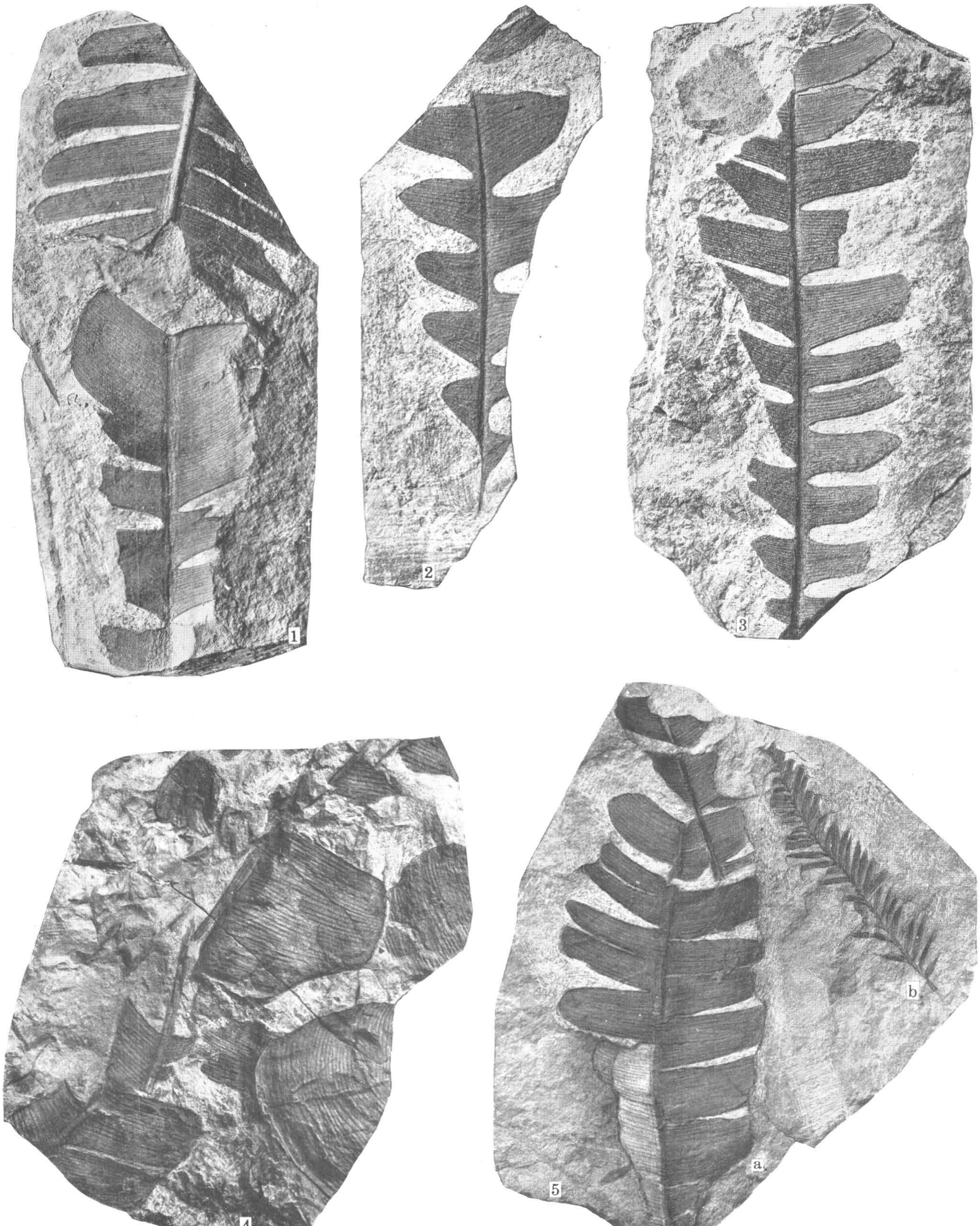
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2a, 3a, 5, 7–9a. *Nilssonia alaskana* Hollick, n. sp. (U.S.N.M. 37352 (1), 37346 (2a), 37350 (3a), 37347 (5), 37349 (7, 8), 37346 (9a); p. 45).
2b, 3b, 9b. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37353, 37351, 37353; p. 46).
4. *Nilssonia yukonensis* Hollick, n. sp. (U.S.N.M. 37354; p. 42).
6a, 6b, 10a. *Nilssonia serotina* Heer (U.S.N.M. 37348 (6a, 6b), 37337 (10a); p. 43).
9c. *Cephalotaxopsis magnifolia successiva* Hollick, n. var. (U.S.N.M. 37357; p. 53).
10b. *Cephalotaxopsis microphylla laxa* Hollick, n. var. (U.S.N.M. 37342; p. 54).



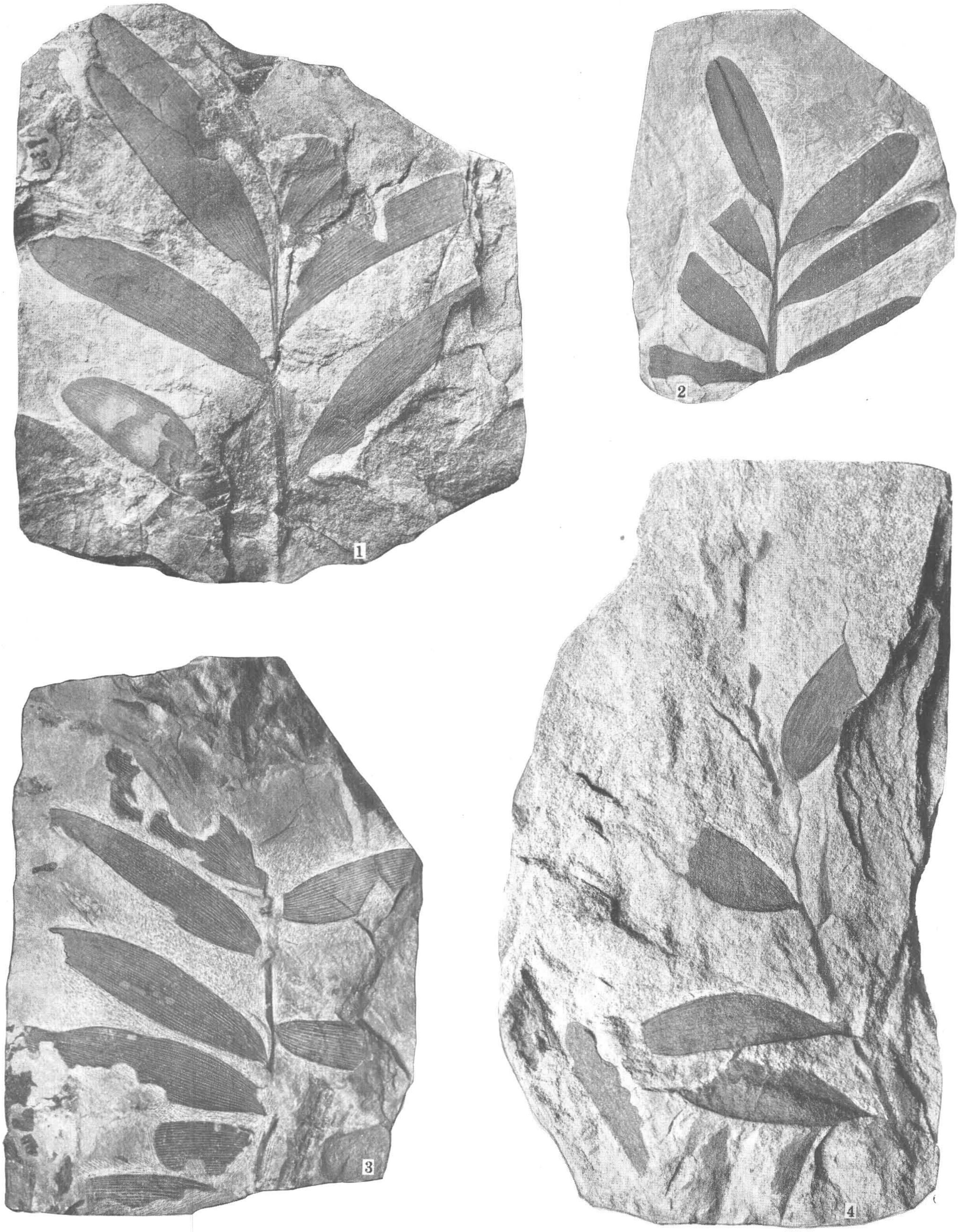
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Pterophyllum validum* Hollick, n. sp. (U.S.N.M. 37358; p. 45).
2, 4–8. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37351 (2), 37360 (4), 37361 (5, 6a, 6b), 37351 (7), 37348 (8); p. 48).
3. *Nageiopsis zamioides* Fontaine? (U.S.N.M. 37359; p. 51).



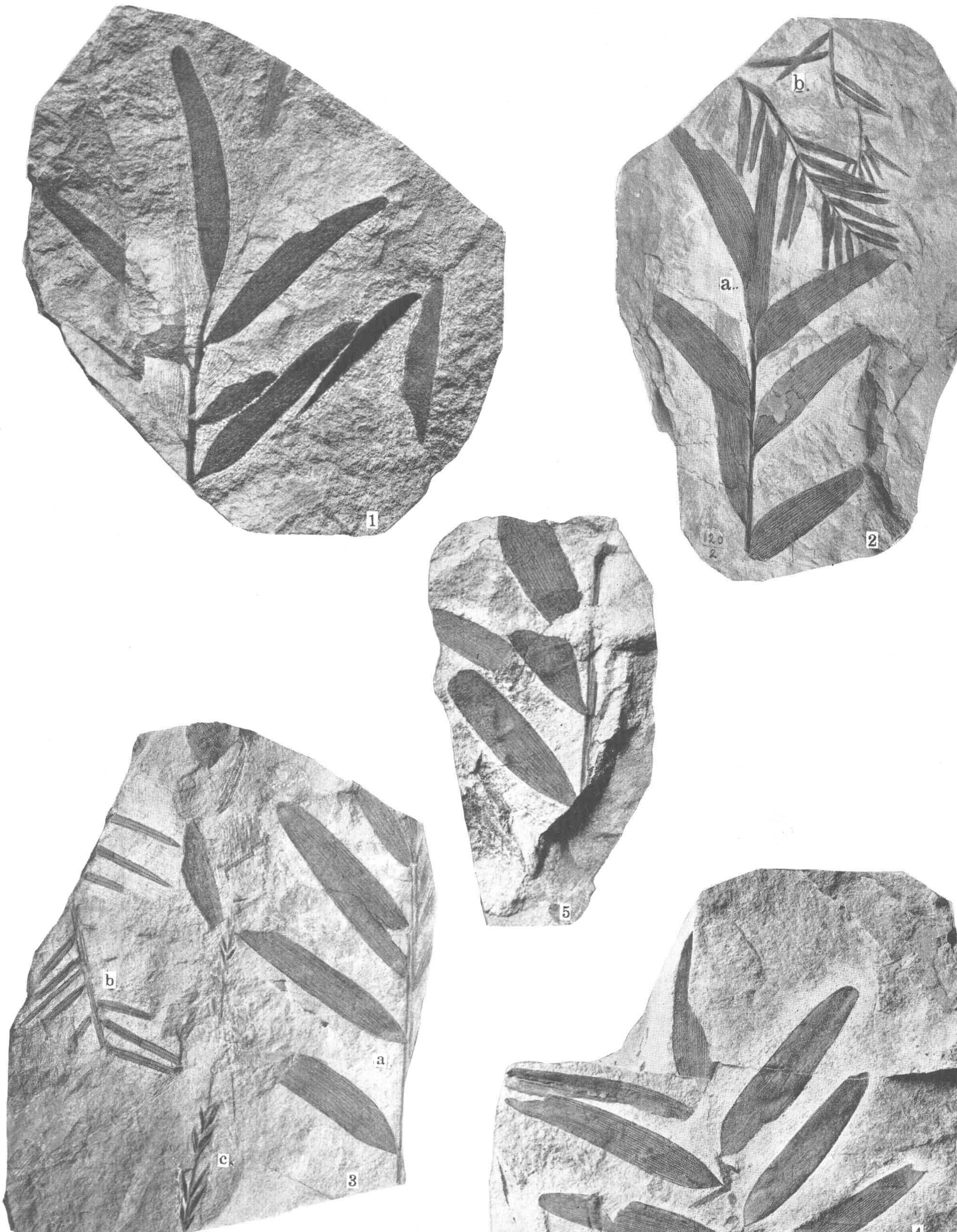
UPPER CRETACEOUS FLORAS OF ALASKA

1–5a. *Nilssonia serotina* Heer (U.S.N.M. 37341 (1–3), 37338 (4), 37337 (5a); p. 43).
5b. *Cephalotaxopsis microphylla laxa* Hollick, n. var. (U.S.N.M. 37342; p. 54).



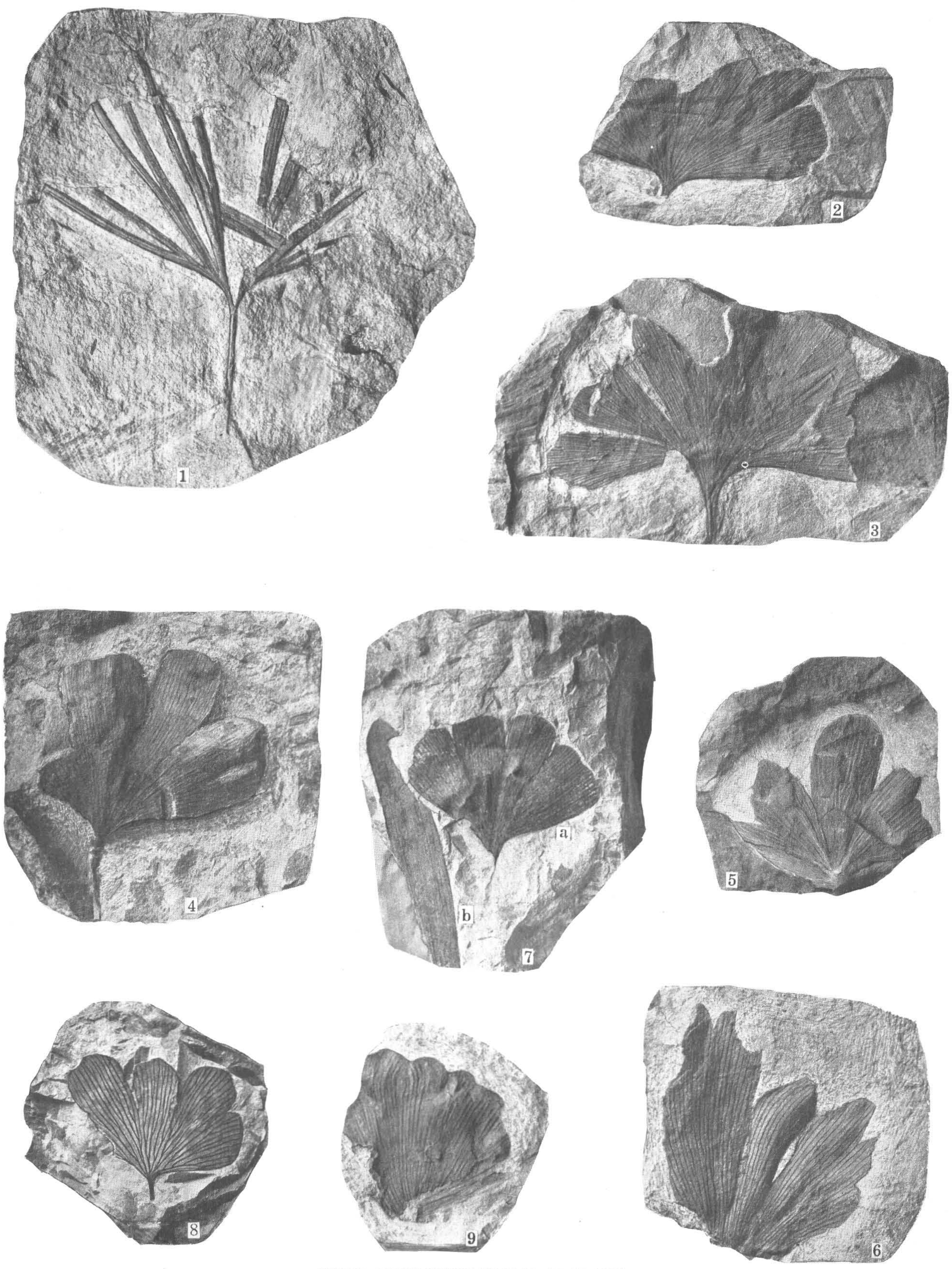
UPPER CRETACEOUS FLORAS OF ALASKA

1-4. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37362 (1), 37363 (2-4); p. 46).



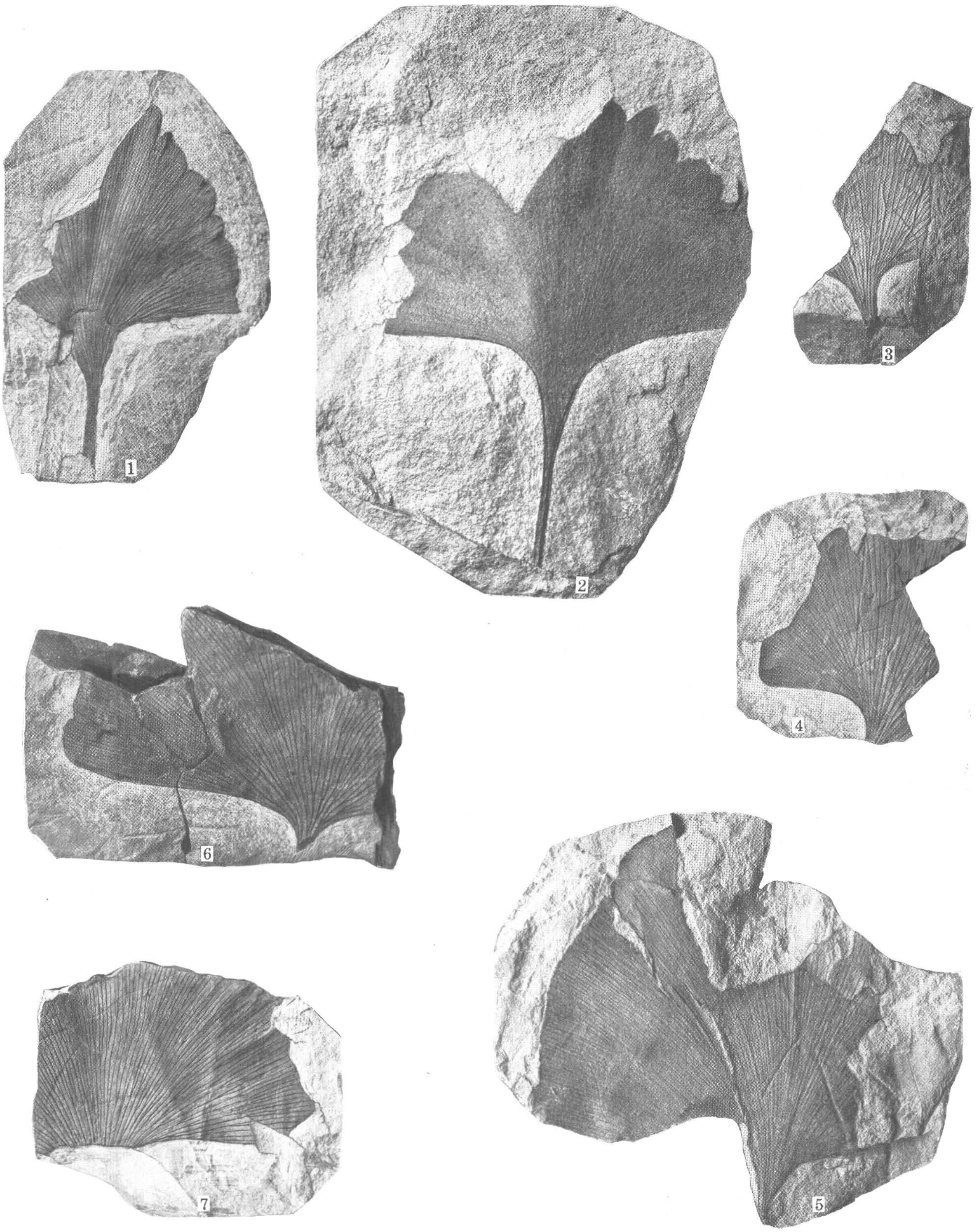
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2a, 3a, 4, 5. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37351, 37364, 37353, 37348, 37363; p. 46).
2b. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37365; p. 52).
3b. *Tumion gracillimum* Hollick, n. sp. (U.S.N.M. 37366; p. 55).
3c. *Glyptostrobus grönlandicus* Heer (U.S.N.M. 37367; p. 60).



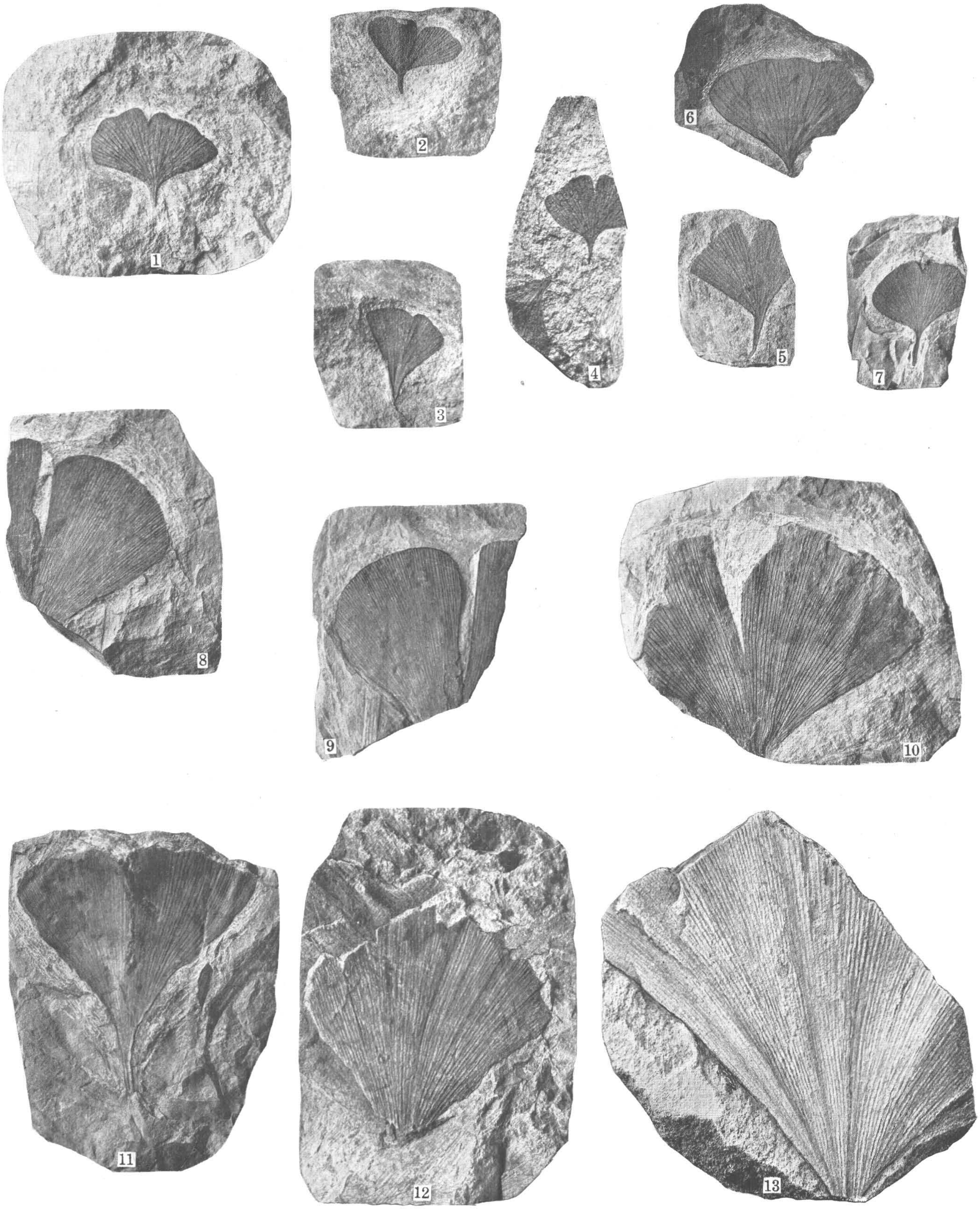
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Ginkgo concinna* Heer (U.S.N.M. 37368; p. 47).
2–7a, 8. *Ginkgo digitata* (Brongniart) Heer (U.S.N.M. 37369 (2, 3), 37370 (4–6), 37371 (7a, 8); p. 48).
7b. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37351; p. 46).
9. *Ginkgo* sp.? (U.S.N.M. 37372; p. 49).



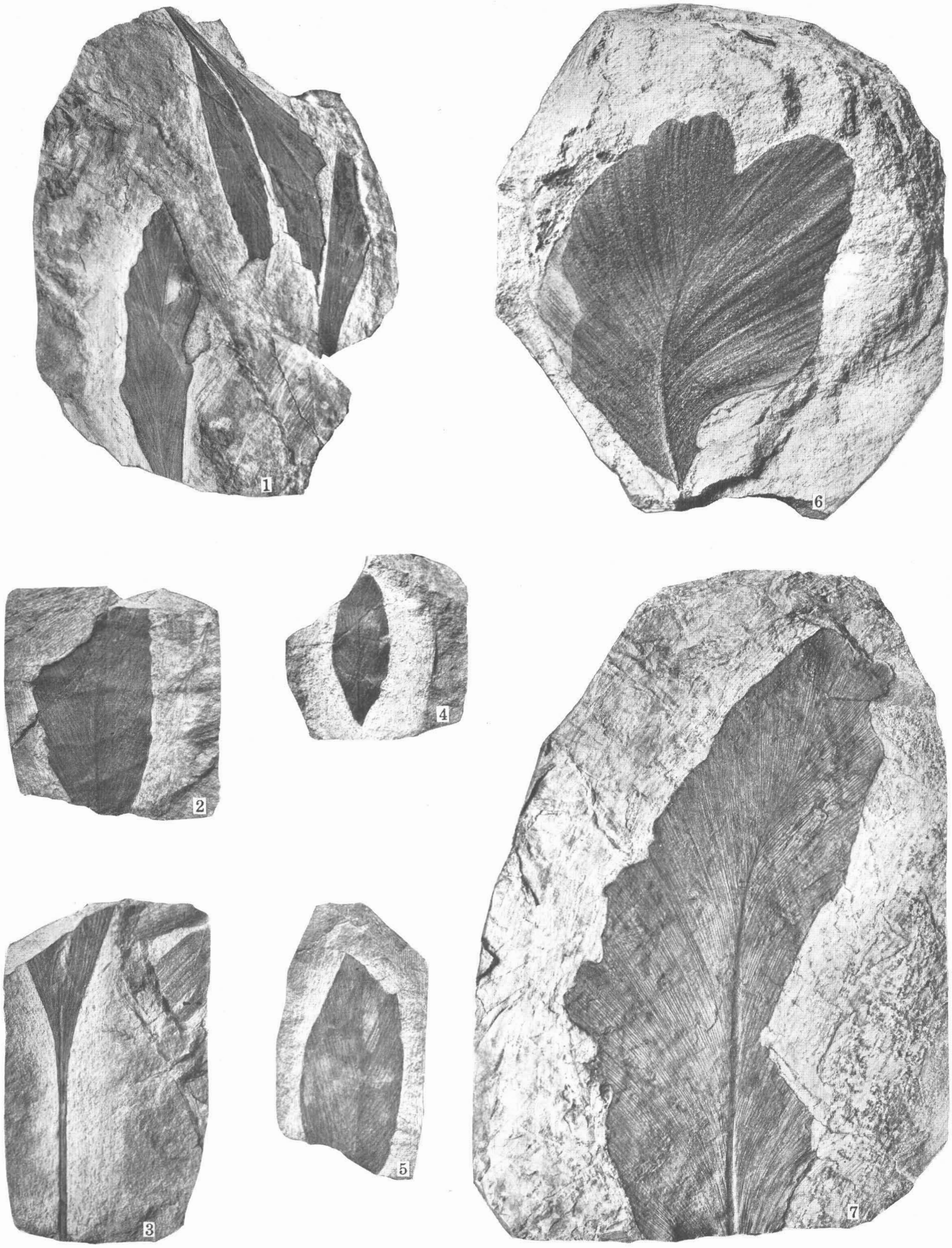
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Ginkgo crenulata* Hollick, n. sp. (U.S.N.M. 37373, 37374; p. 49).
3, 4. *Ginkgo laramiensis* Ward? (U.S.N.M. 37375; p. 49).
5–7. *Ginkgo reniformis* Hollick, n. sp. (U.S.N.M. 37376–37378; p. 49).



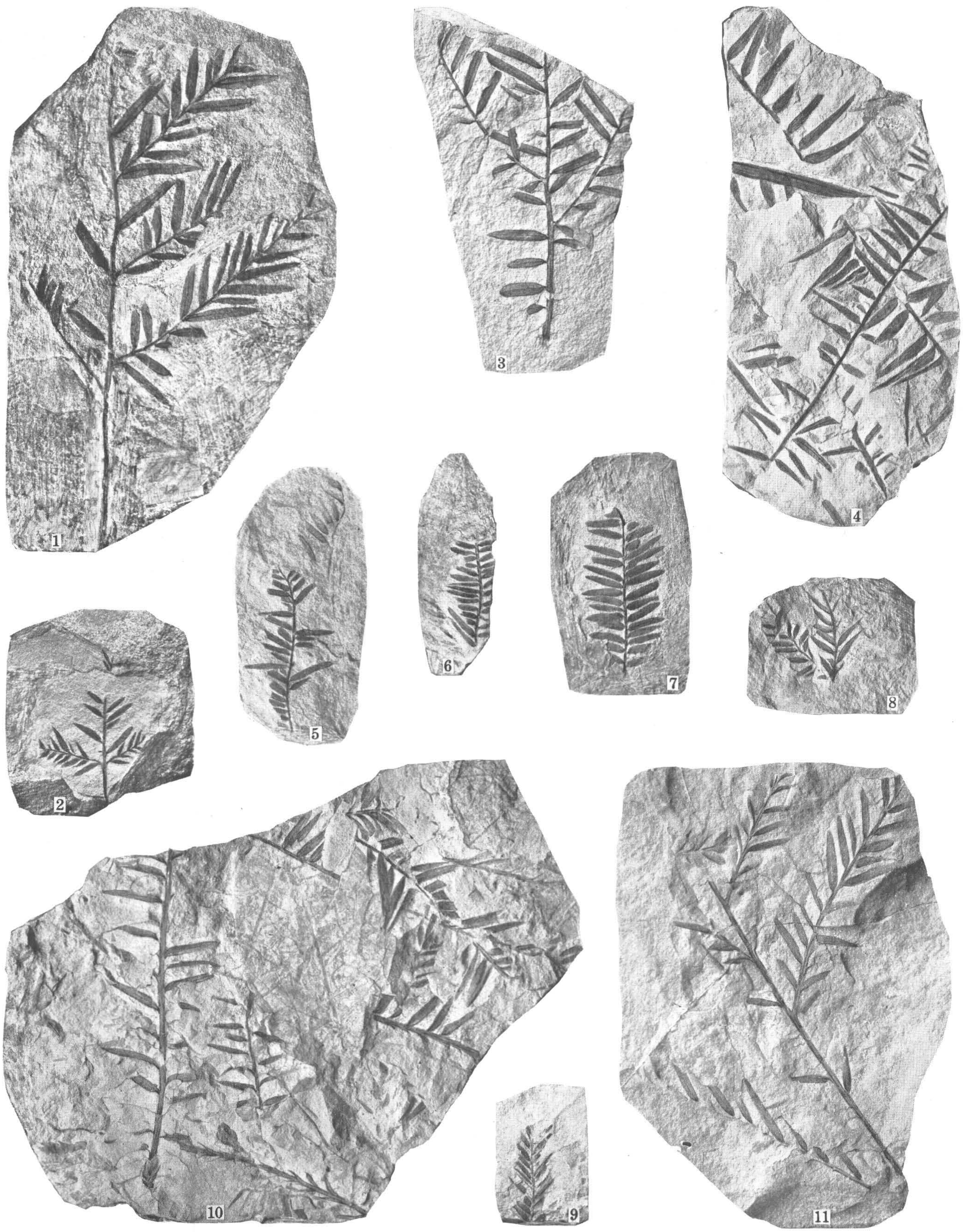
UPPER CRETACEOUS FLORAS OF ALASKA

1-7. *Ginkgo minor* Hollick, n. sp. (U.S.N.M. 37379 (1-5), 37380 (6, 7); p. 50).
8-12. *Ginkgo pseudoadiantoides* Hollick, n. sp. (U.S.N.M. 37381 (8-11), 37335 (12); p. 49).
13. *Ginkgo pseudoadiantoides major* Hollick, n. var. (U.S.N.M. 37386; p. 50).



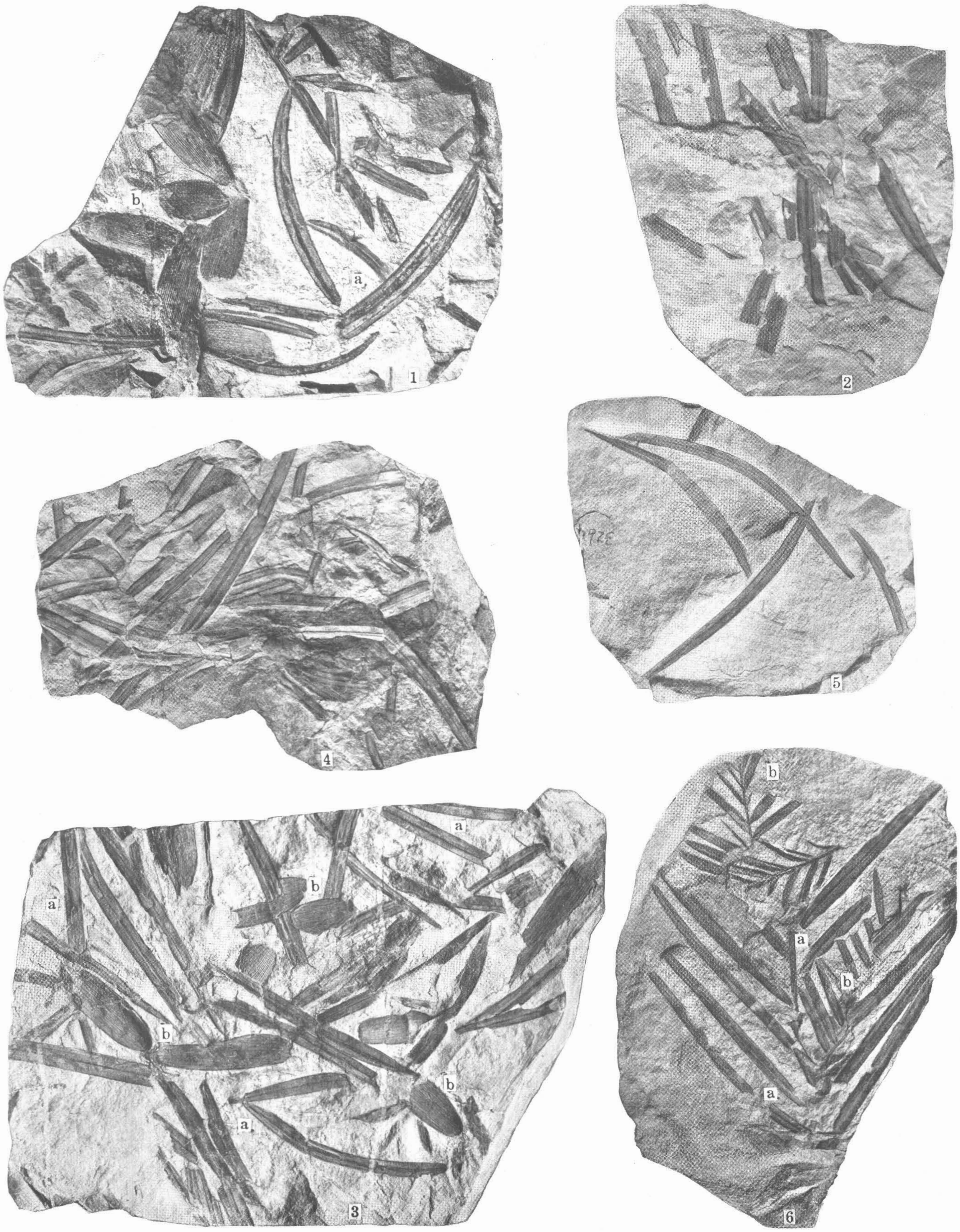
UPPER CRETACEOUS FLORAS OF ALASKA

1-3. *Protophyllocladus subintegrifolius* (Lesquereux) Berry (U.S.N.M. 37383 (1), 37384 (2, 3); p. 51).
4, 5. *Protophyllocladus simplex* Hollick, n. sp. (U.S.N.M. 37385; p. 52).
6. *Protophyllocladus obesus* (Hollick, n. sp. U.S.N.M. 37386; p. 51).
7. *Protophyllocladus polymorphus* (Lesquereux) Berry (U.S.N.M. 37387 p. 51).



UPPER CRETACEOUS FLORAS OF ALASKA

1-11. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37388 (1, 2), 37389 (3, 11), 37390 (4), 37391 (5-7), 37392 (8-9), 37393 (10); p. 52).



UPPER CRETACEOUS FLORAS OF ALASKA

1a, 2, 3a, 4–6a. *Cephalotaxopsis magnifolia successiva* Hollick, n. var. (U.S.N.M. 37394 (1a, 2, 3a), 37395 (4), 37396 (5), 37397 (6a); p. 53).
1b, 3b. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37348; p. 46).
6b. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37398; p. 52).

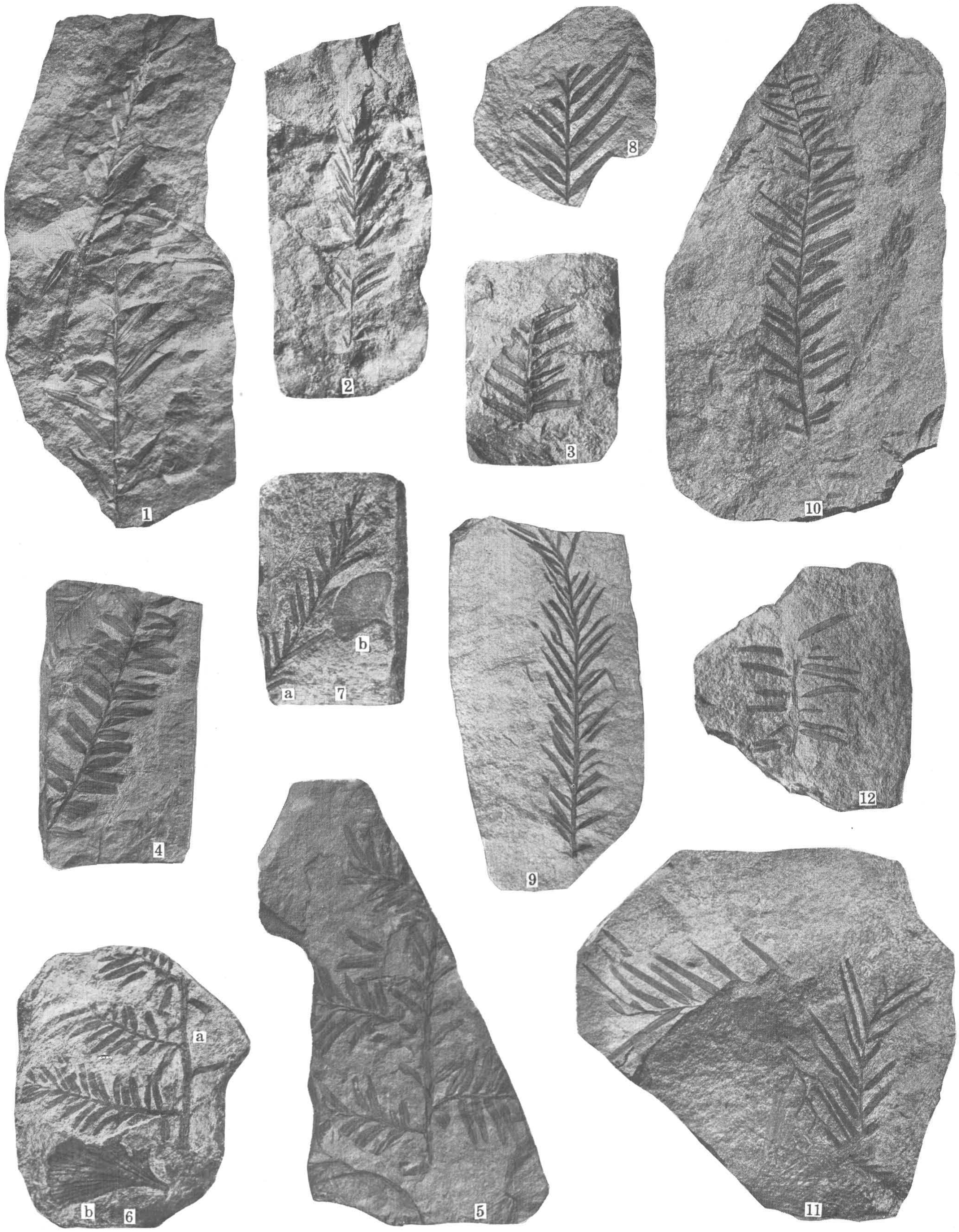
UPPER CRETACEOUS FLORAS OF ALASKA

1-3. *Cephalotaxopsis intermedia* Hollick, n. sp. (U.S.N.M. 37399, 37400, 37401; p. 54).
4. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37388; p. 52).
5. *Cephalotaxopsis microphylla laxa* Hollick, n. var. (U.S.N.M. 37402; p. 54).
6. *Tumion gracillimum* Hollick, n. sp. (U.S.N.M. 37403; p. 55).

85918—30——10

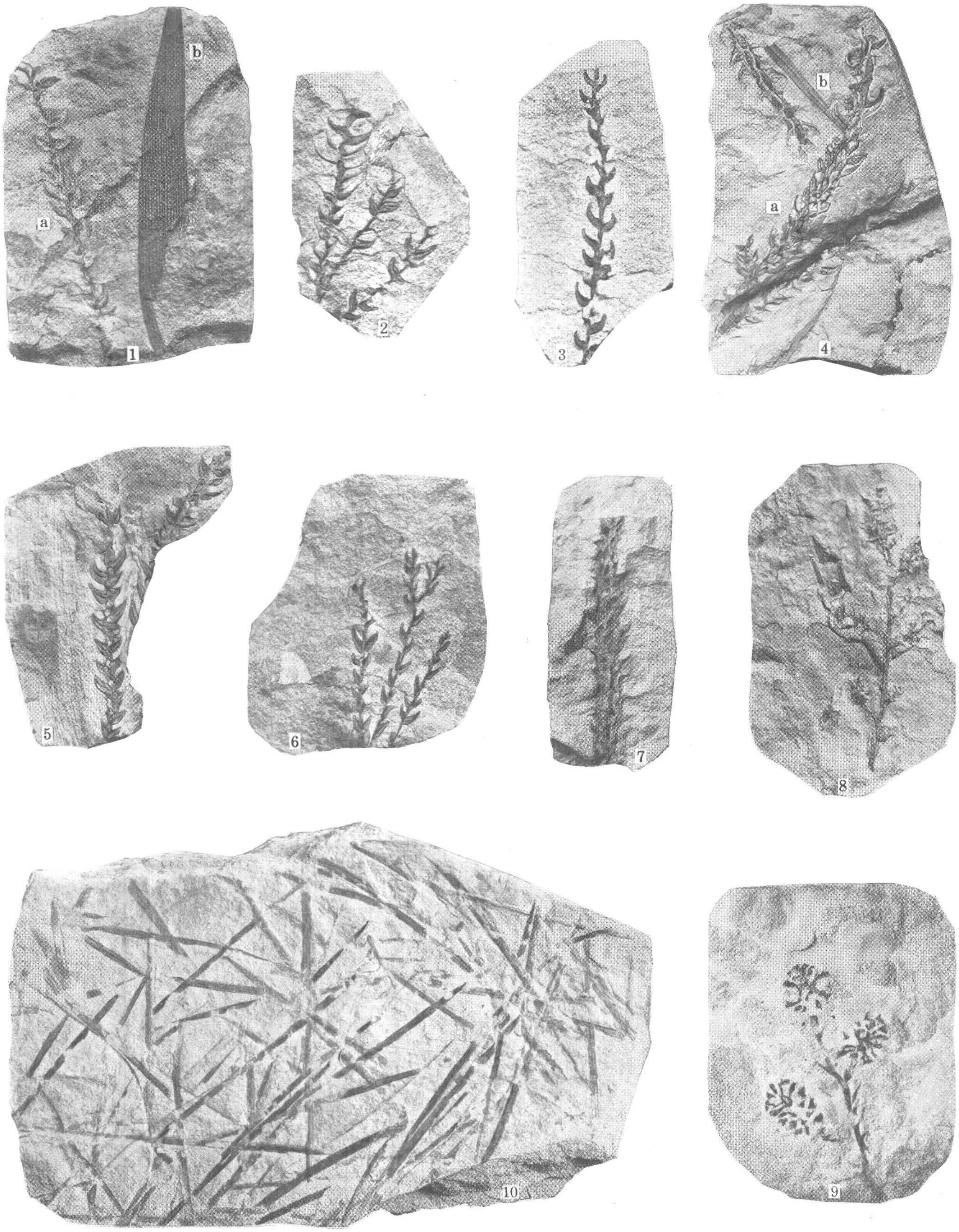
UPPER CRETACEOUS FLORAS OF ALASKA

1-11. *Tumion gracillimum* Hollick, n. sp. (U.S.N.M. 37404 (1-5 7) 37405 (6), 37406 (8) ,37407 (9) ,37408 (10), 37409 (11); p. 55).



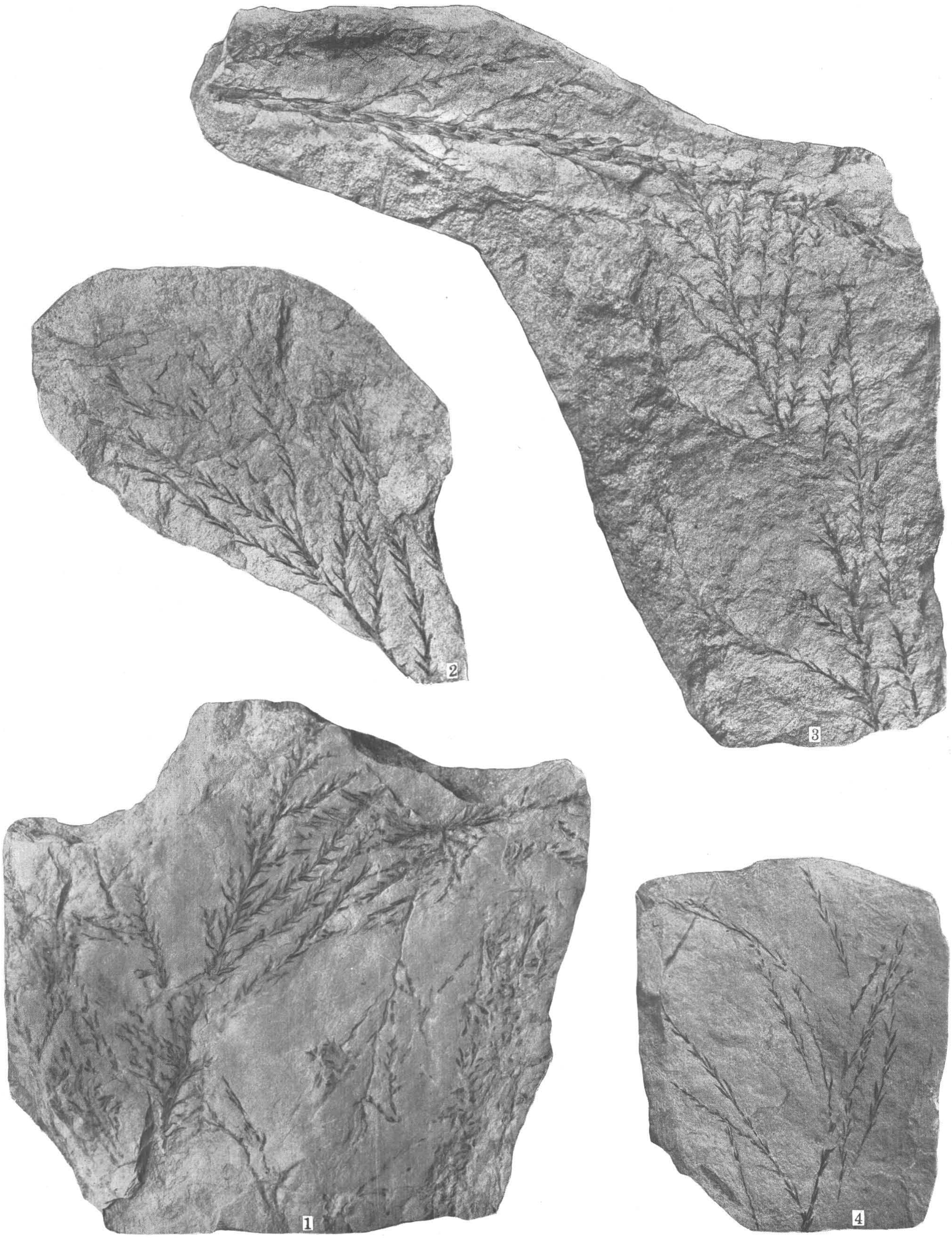
UPPER CRETACEOUS FLORAS OF ALASKA

1-3, 9, 10, 12. *Cephalotaxopsis microphylla laxa* Hollick, n. var. (U.S.N.M. 37410 (1), 37411 (2), 37412 (3), 37402 (9, 10), 37418 (12); p. 54).
4-6a. *Tumion? suspectum* Hollick, n. sp. (U.S.N.M. 37413 (4, 5), 37414 (6a); p. 55).
6b, 7b. *Ginkgo minor* Hollick, n. sp. (U.S.N.M. 37415; p. 50).
7a. *Sequoia rigida* Heer? (U.S.N.M. 37416; p. 58).
8, 11. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37390, 37388; p. 52).



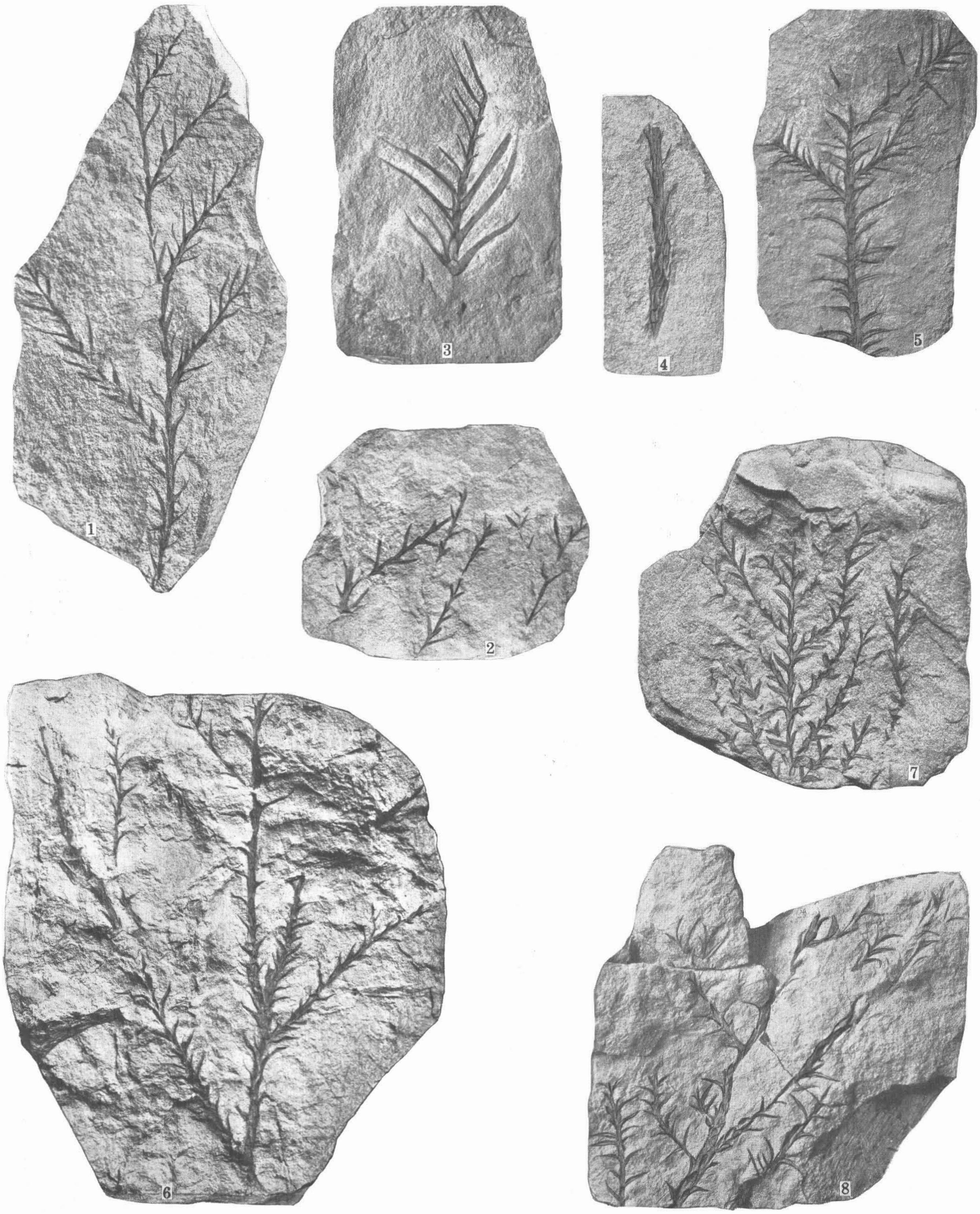
UPPER CRETACEOUS FLORAS OF ALASKA

1a, 2–4a, 5–7. *Sequoia ambigua* Heer (U.S.N.M. 37418 (1a, 2, 3, 6, 7), 37420 (4a, 5); p. 56).
1b. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37419; p. 46).
4b. *Cephalotaxopsis magnifolia successiva* Hollick, n. var. (U.S.N.M. 37396 p. 53).
8. *Sequoia?* sp. (immature cones) (U.S.N.M. 37421; p. 59).
9. *Sequoia* sp.? (disintegrated cones) (U.S.N.M. 37422; p. 59).
10. *Pinus?* sp. (U.S.N.M. 37423; p. 56).



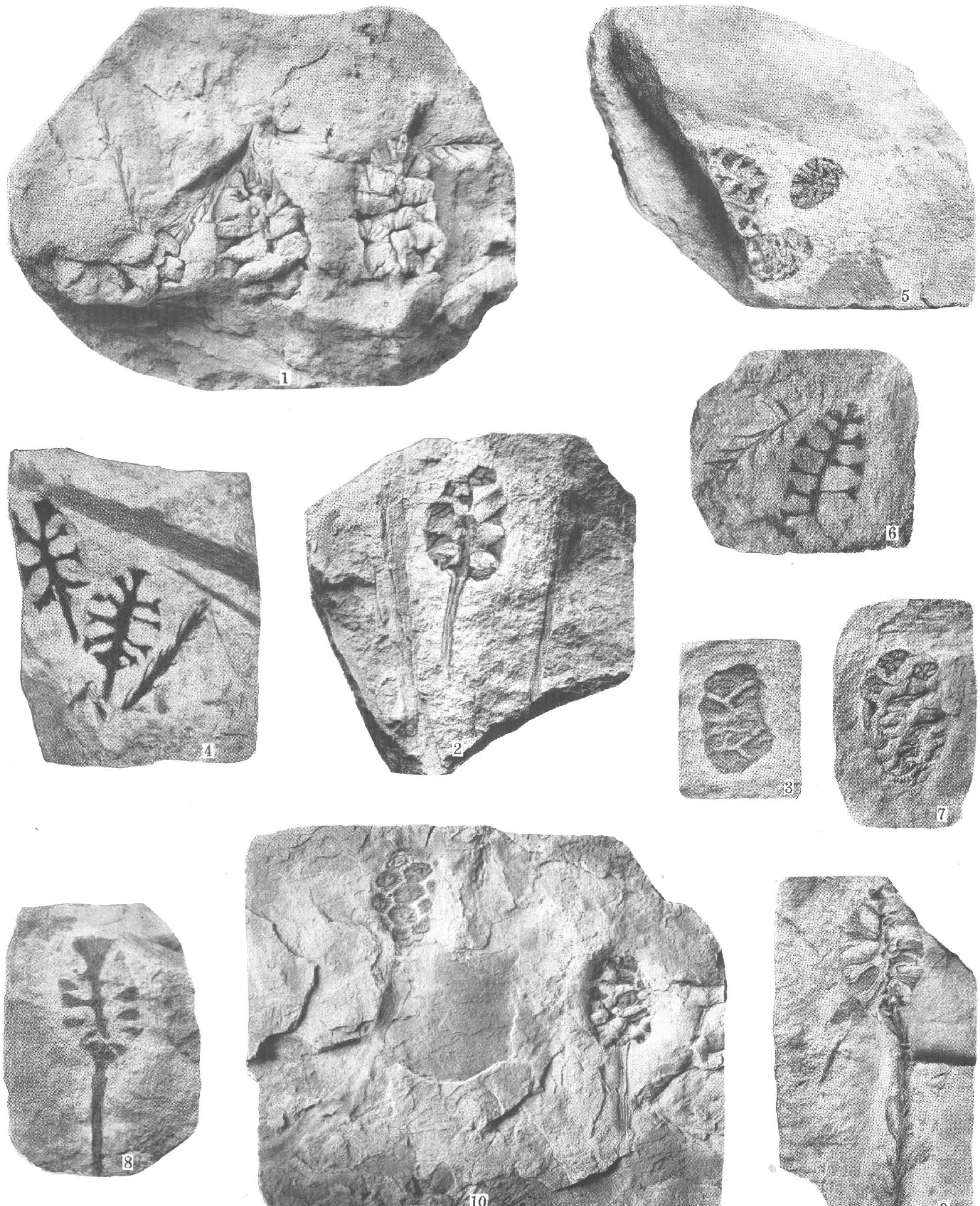
UPPER CRETACEOUS FLORAS OF ALASKA

1-4. *Sequoia fastigiata* (Sternberg) Heer (U.S.N.M. 37424 (1), 37425 (2-4); p. 57).



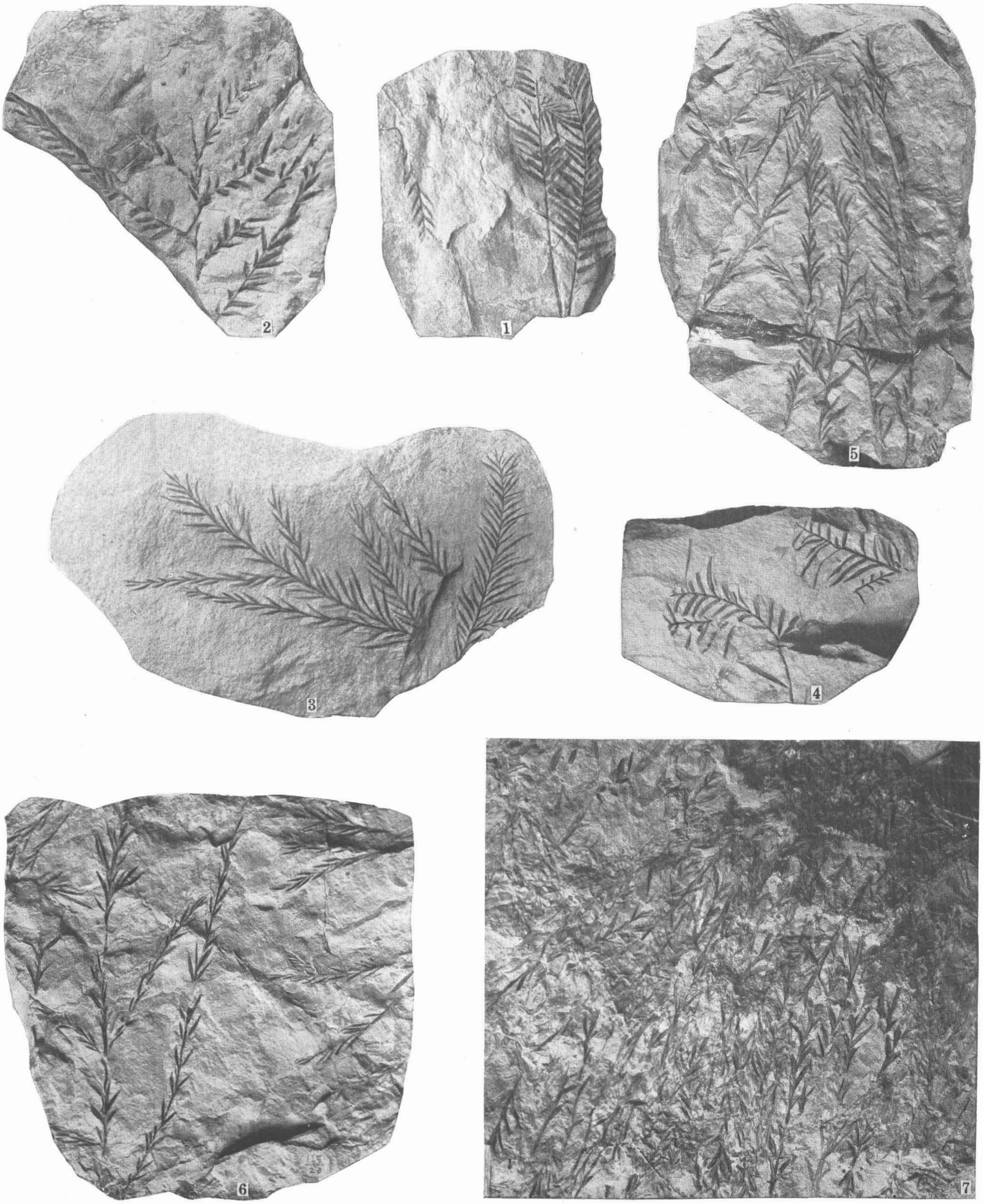
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Sequoia rigida spinifolia* Hollick, n. var. (U.S.N.M. 37426; p. 58).
3–5. *Sequoia reichenbachi* (Geinitz) Heer (U.S.N.M. 37427 (3, 4), 37428 (5); p. 57).
6–8. *Sequoia concinna* Heer (U.S.N.M. 37429 (6), 37430 (7, 8); p. 57).



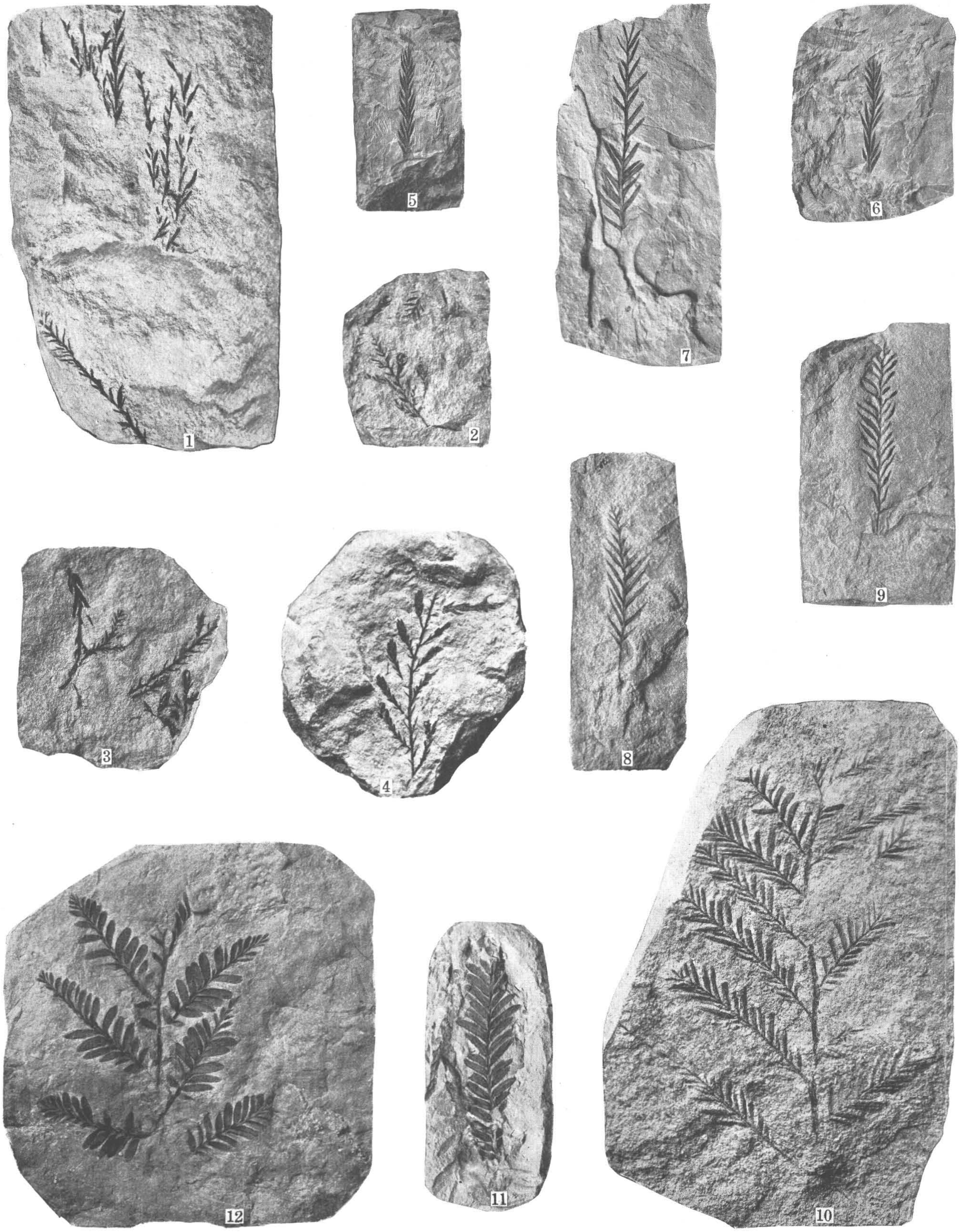
UPPER CRETACEOUS FLORAS OF ALASKA

1-10. Cones of *Sequoia* sp.? (U.S.N.M. 37431-37440; p. 59).



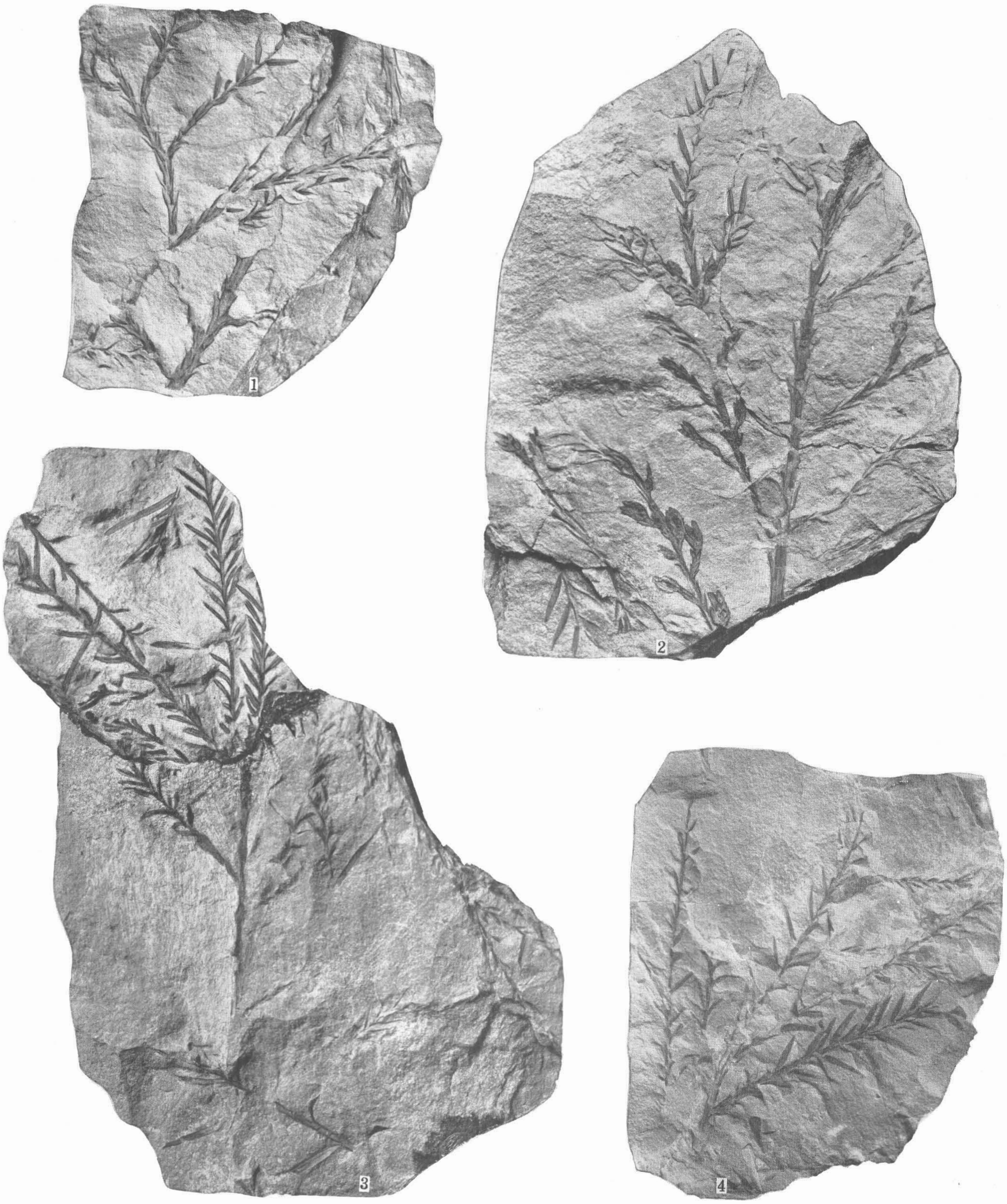
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Cephalotaxopsis electilis* Hollick, n. sp. (U.S.N.M. 37441; p. 55).
2. *Glyptostrobus grönlandicus* Heer (U.S.N.M. 37442; p. 60).
3-6. *Glyptostrobus specialis* Hollick, n. sp. (U.S.N.M. 37443 (3), 37444 (4-6); p. 61).
7. *Glyptostrobus?* sp. (U.S.N.M. 37445; p. 61).



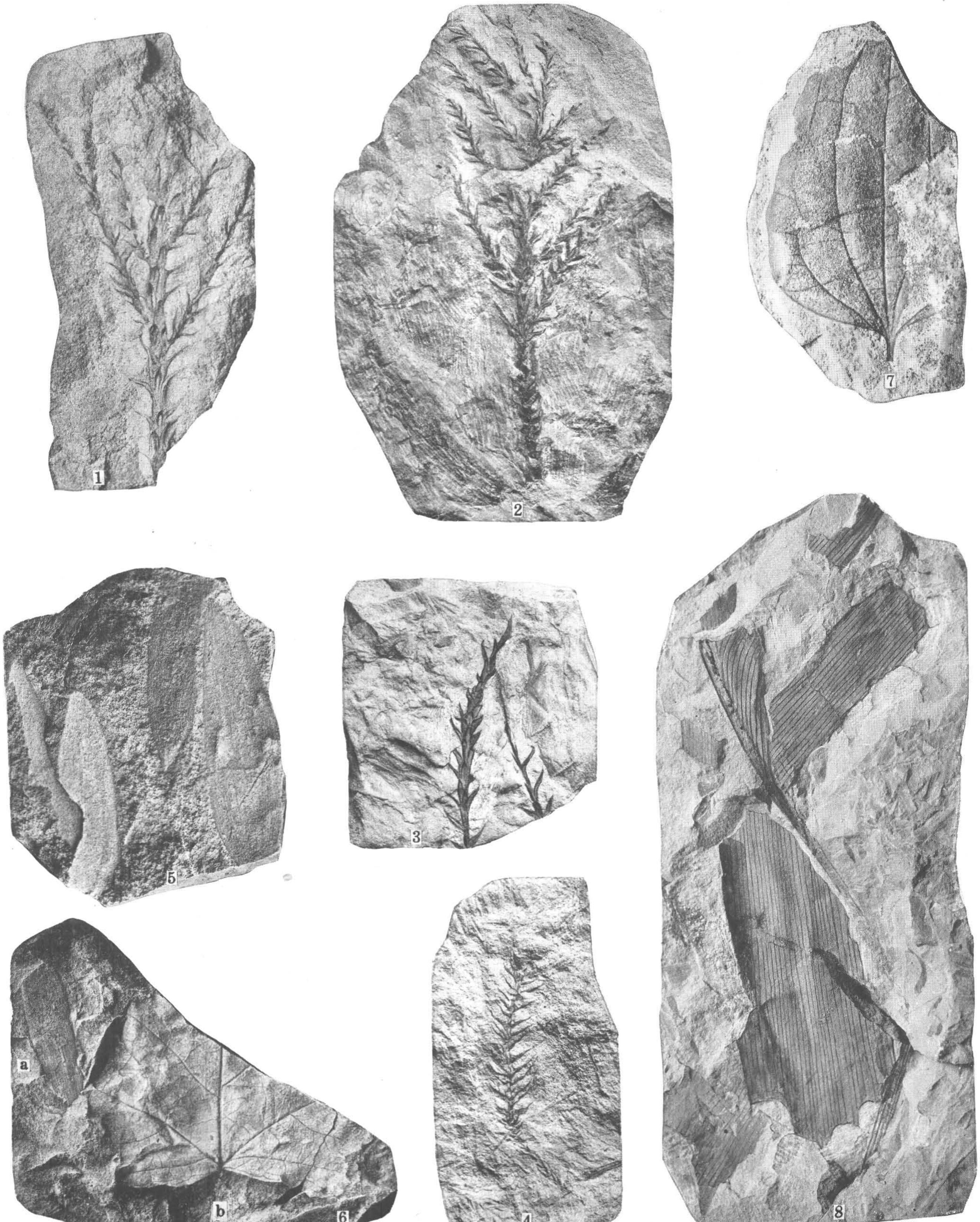
UPPER CRETACEOUS FLORAS OF ALASKA

1-6. *Sphenolepis sternbergiana* (Dunker) Schenk (U.S.N.M. 37446 (1-4), 37447 (5, 6); p. 60)
7. *Sequoia rigida* Heer? (U.S.N.M. 37448; p. 58).
8, 9. *Sequoia subulata* Heer? (U.S.N.M. 37449; p. 58).
10-12. *Sequoia obovata* Knowlton (U.S.N.M. 37450-37452; p. 58).



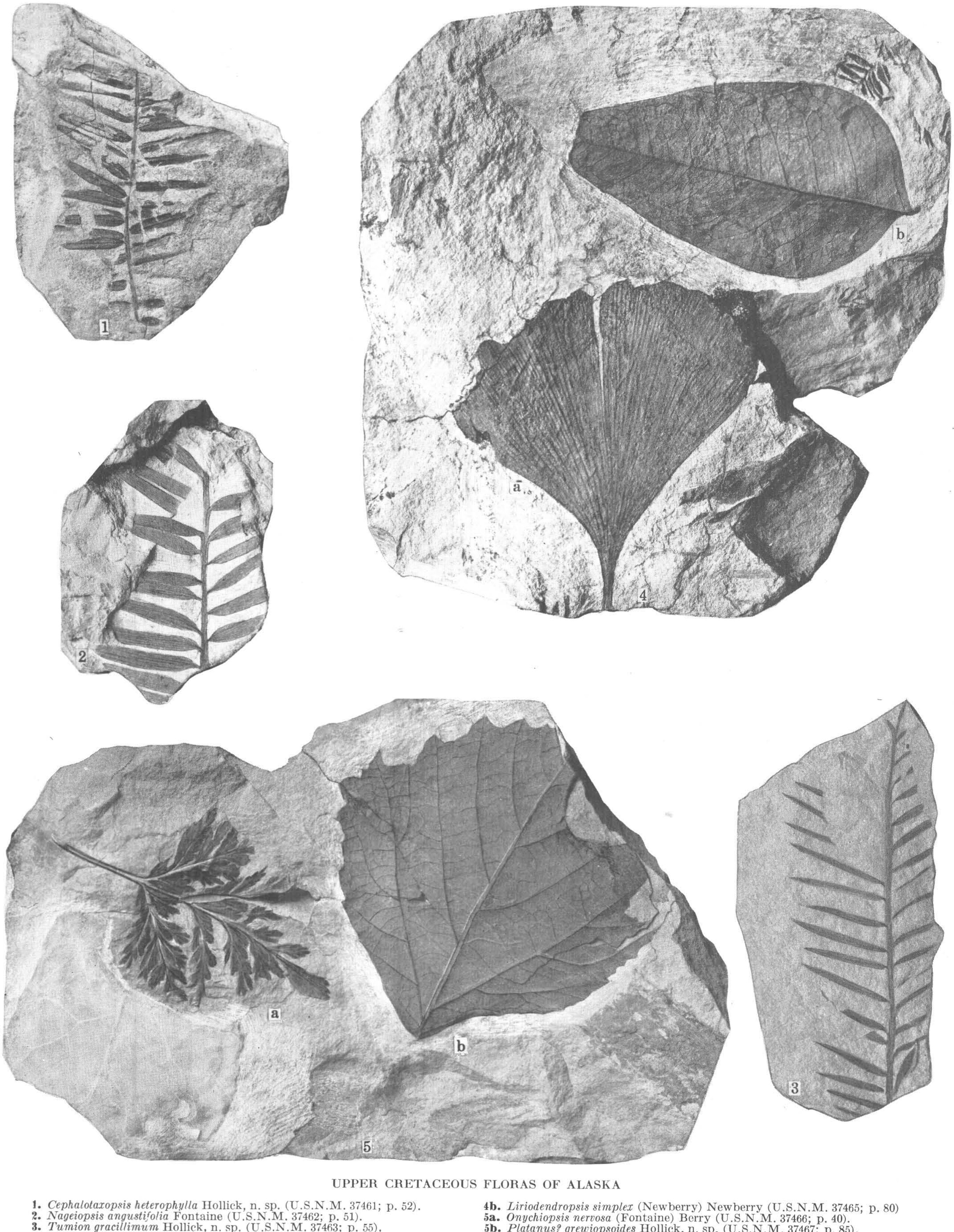
UPPER CRETACEOUS FLORAS OF ALASKA

1-4. *Glyptostrobus grönlandicus* Heer (U.S.N.M. 37453; p. 60).



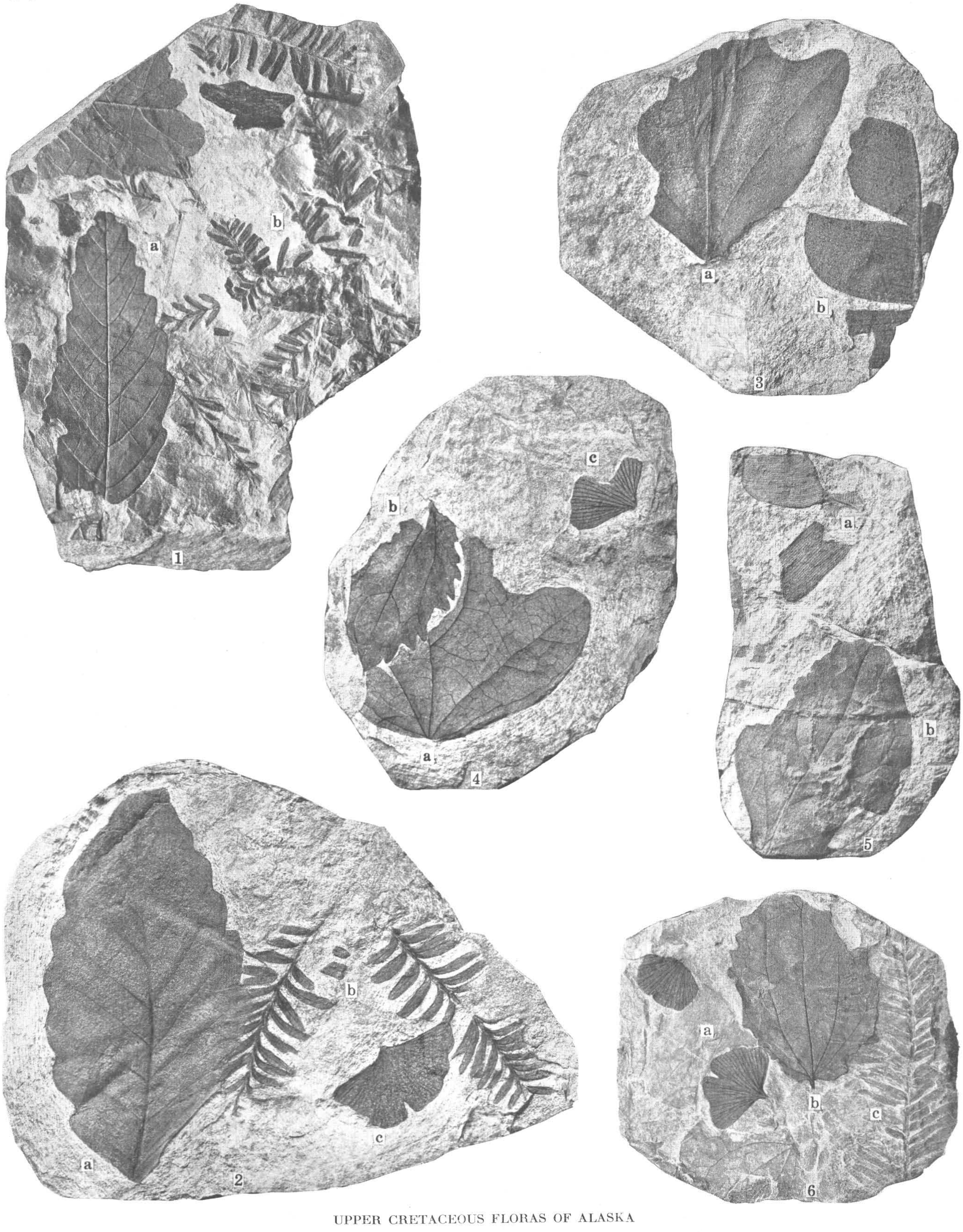
UPPER CRETACEOUS FLORAS OF ALASKA

1-3. *Sequoia concinna* Heer (U.S.N.M. 37454–37456; p. 57).
4. *Sequoia reichenbachi* (Geinitz) Heer (U.S.N.M. 37427; p. 57).
5, 6a. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37457; p. 46).
6b. *Hedera platanoidea* Lesquereux? (U.S.N.M. 37458; p. 111).
7. *Smilax herendeenensis* Hollick, n. sp. (U.S.N.M. 37459; p. 61).
8. *Zingiberites alaskensis* Hollick, n. sp. (U.S.N.M. 37460; p. 61).



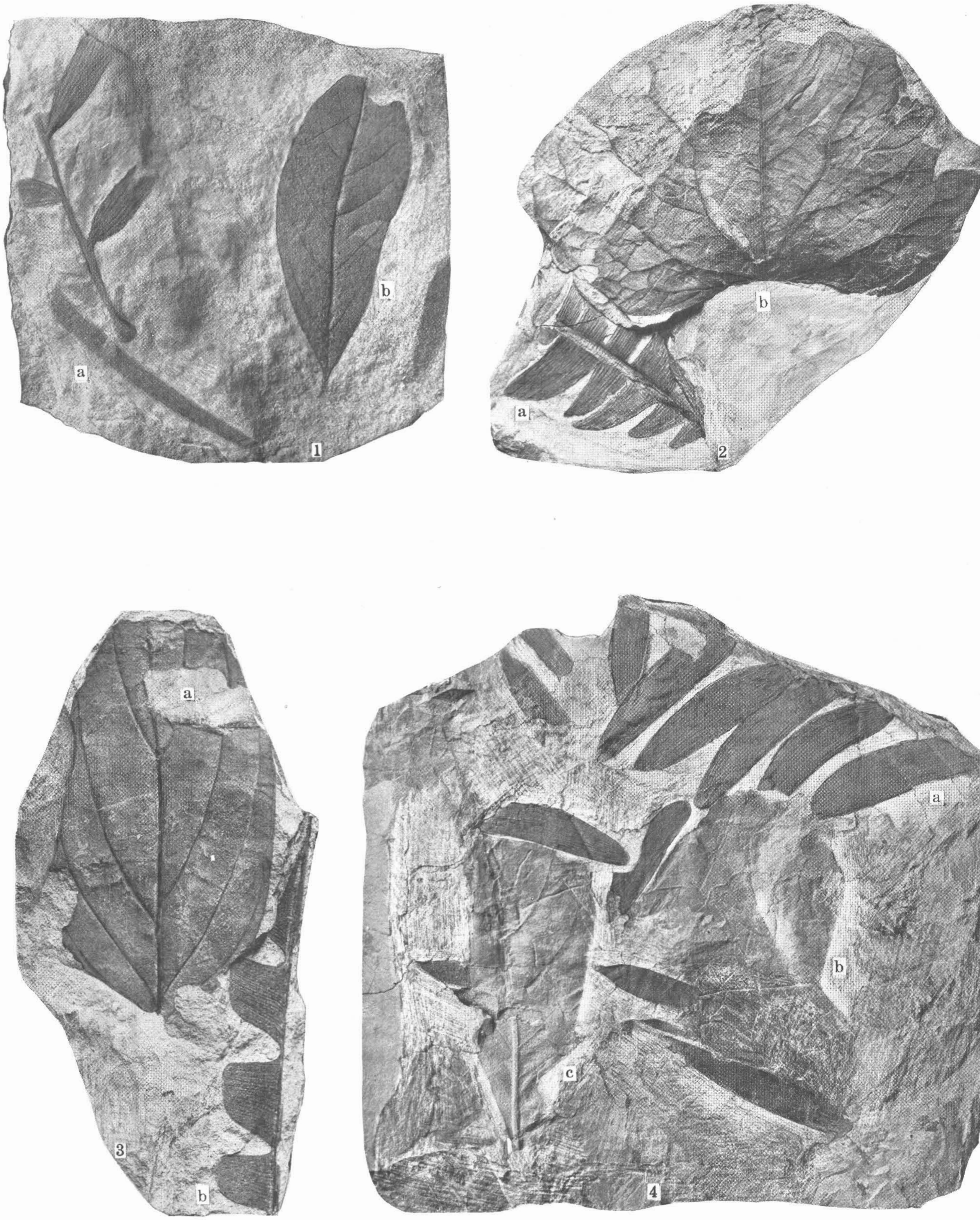
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Cephalotaxopsis heterophylla* Hollick, n. sp. (U.S.N.M. 37461; p. 52).
2. *Nageiopsis angustifolia* Fontaine (U.S.N.M. 37462; p. 51).
3. *Tumion gracillimum* Hollick, n. sp. (U.S.N.M. 37463; p. 55).
4a. *Ginkgo pseudoadiantoides* Hollick, n. sp. (U.S.N.M. 37464; p. 49).
4b. *Liriodendropsis simplex* (Newberry) Newberry (U.S.N.M. 37465; p. 80)
5a. *Onychiopsis nervosa* (Fontaine) Berry (U.S.N.M. 37466; p. 40).
5b. *Platanus? grewiopsoides* Hollick, n. sp. (U.S.N.M. 37467; p. 85).



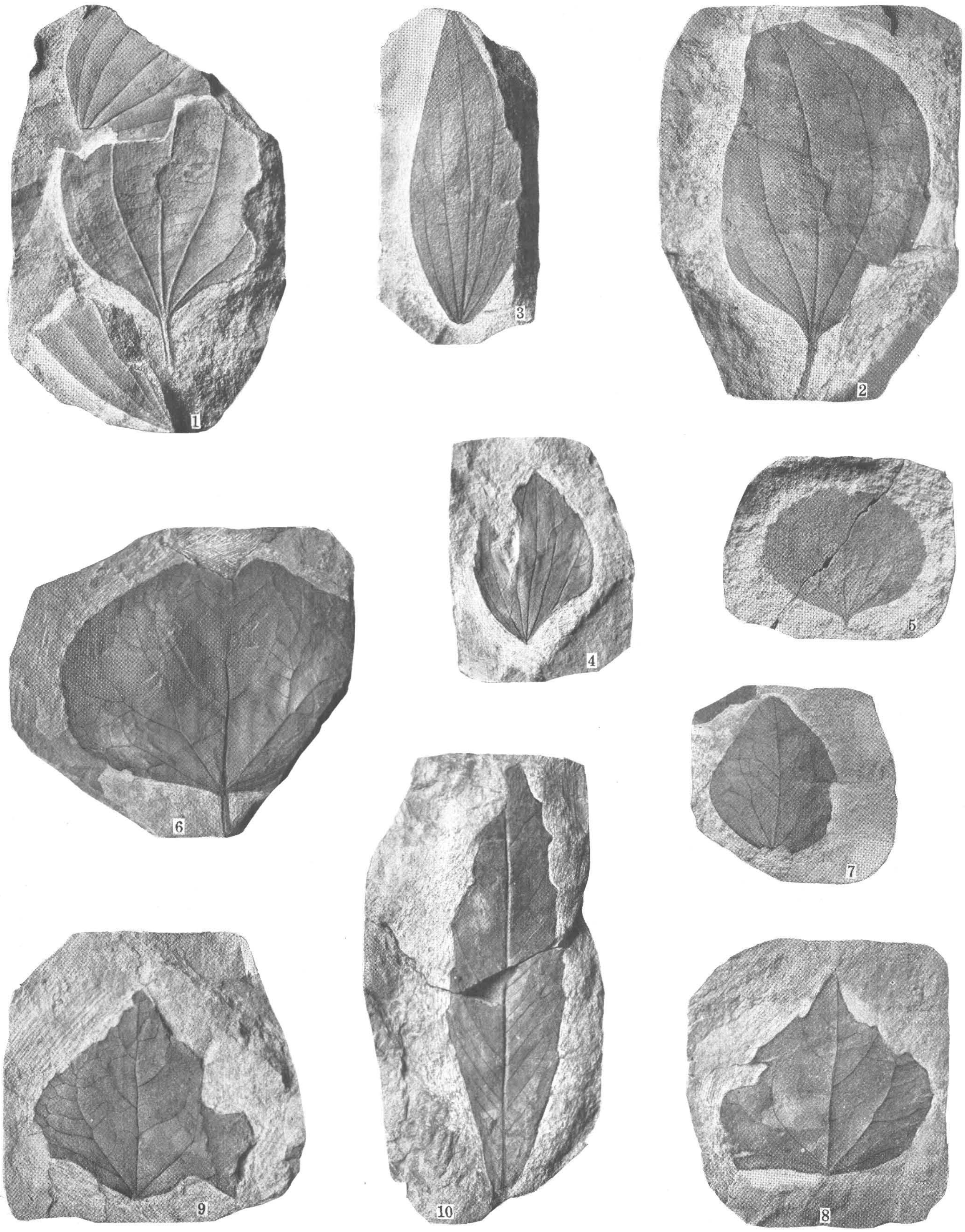
UPPER CRETACEOUS FLORAS OF ALASKA

1a. *Rulac quercifolium* Hollick, n. sp. (U.S.N.M. 37468; p. 100).
1b. *Tumion? suspectum* Hollick, n. sp. (U.S.N.M. 37413; p. 55).
2a. *Quercus pseudomarioni* Hollick, n. sp. (U.S.N.M. 37469; p. 69).
2b. *Sequoia obovata* Knowlton (U.S.N.M. 37452; p. 58).
2c, 4c, 6a. *Ginkgo minor* Hollick, n. sp. (U.S.N.M. 37470 (2c, 4c), 37380 (6a); p. 50).
3a, 4a. *Hedera curva* Hollick, n. sp. (U.S.N.M 37471; p. 112).
3b, 5a. *Nilssonia serotina* Heer (U.S.N.M. 37337, 37341; p. 43).
4b. *Urtica exemplaris* Hollick, n. sp. (U.S.N.M. 37472; p. 73).
5b. *Populus hyperborea* Heer? (U.S.N.M. 37473; p. 62).
6b. *Zizyphus pseudomeeki* Hollick, n. sp. (U.S.N.M. 37474; p. 103).
6c. *Cephalotaxopsis microphylla laxa* Hollick, n. var.? (U.S.N.M. 37475; p. 54).



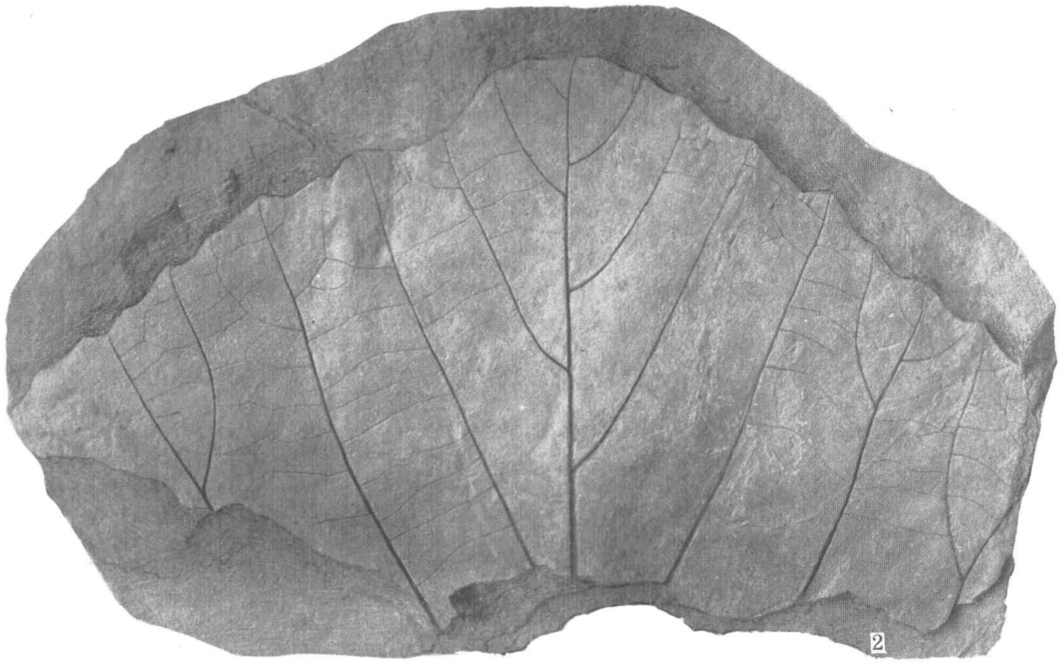
UPPER CRETACEOUS FLORAS OF ALASKA

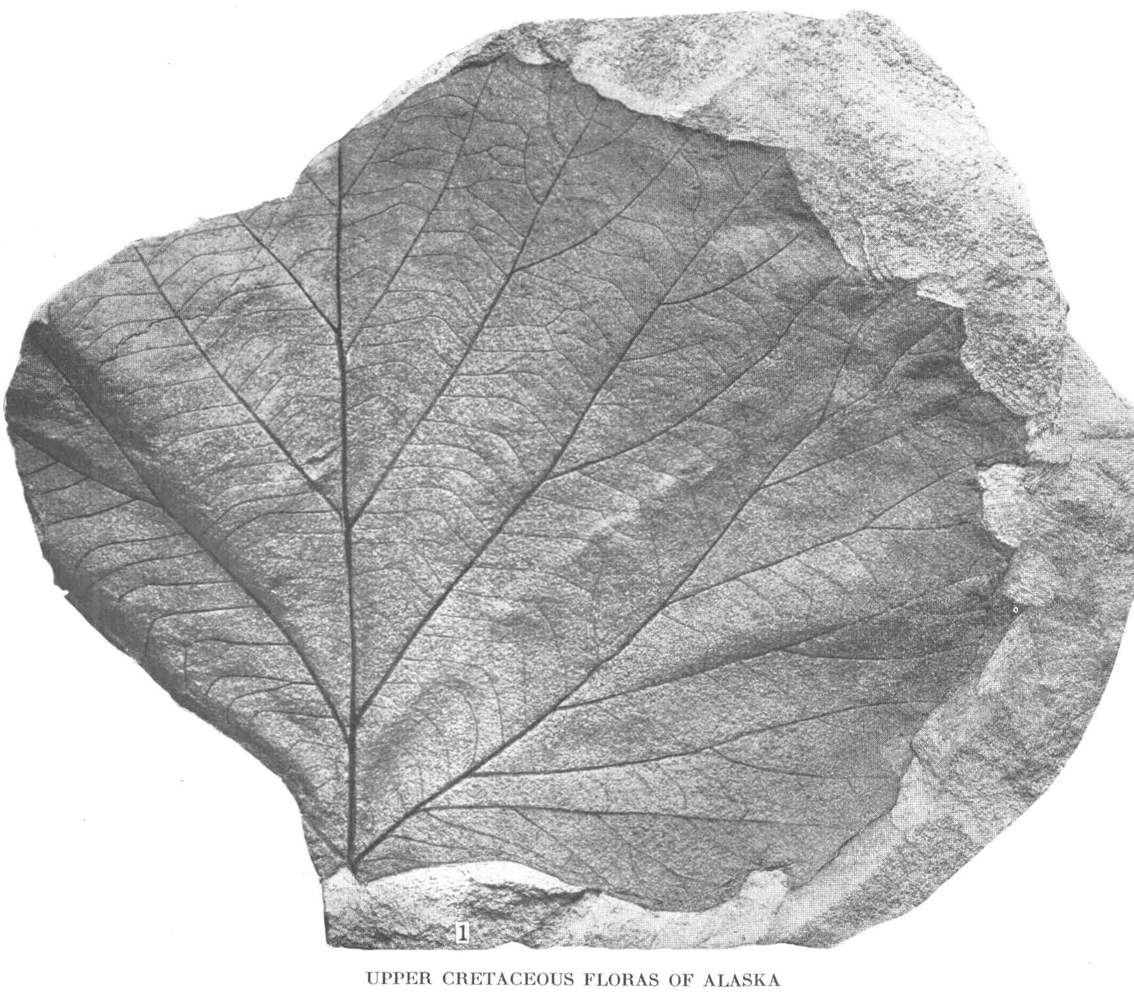
1a, 4a. *Podozamites lanceolatus* (Lindley and Hutton) C. F. W. Braun (U.S.N.M. 37476, 37363; p. 46).
1b. *Myrsine gaudini* (Lesquereux) Berry (U.S.N.M. 37477; p. 113).
2a, 3b. *Nilssonia serotina* Heer (U.S.N.M. 37337; p. 43).
2b. *Hedera macclurii* Heer? (U.S.N.M. 37478; p. 110).
3a. *Cornus forchhammeri* Heer (U.S.N.M. 37479; p. 112).
4b, 4c. *Phyllites* sp.? (U.S.N.M. 37480, 37481; p. 116).



UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Piper arcuatile* Hollick, n. sp. (U.S.N.M. 37482, 37483; p. 62).
3. *Macclintockia alaskana* Hollick, n. sp. (U.S.N.M. 37484; p. 74).
4. *Macclintockia electilis* Hollick, n. sp. (U.S.N.M. 37485; p. 74).
5. *Populus elliptica* Newberry (U.S.N.M. 37486; p. 63).
6. *Populus pseudoelliptica* Hollick, n. sp. (U.S.N.M. 37487; p. 63).
7. *Populus pseudostygia* Hollick, n. sp. (U.S.N.M. 37488; p. 63).
8, 9. *Populus praelatior* Hollick, n. sp. (U.S.N.M. 37489; p. 64).
10. *Myrica? trifoliata* Newberry? (U.S.N.M. 37490; p. 67).





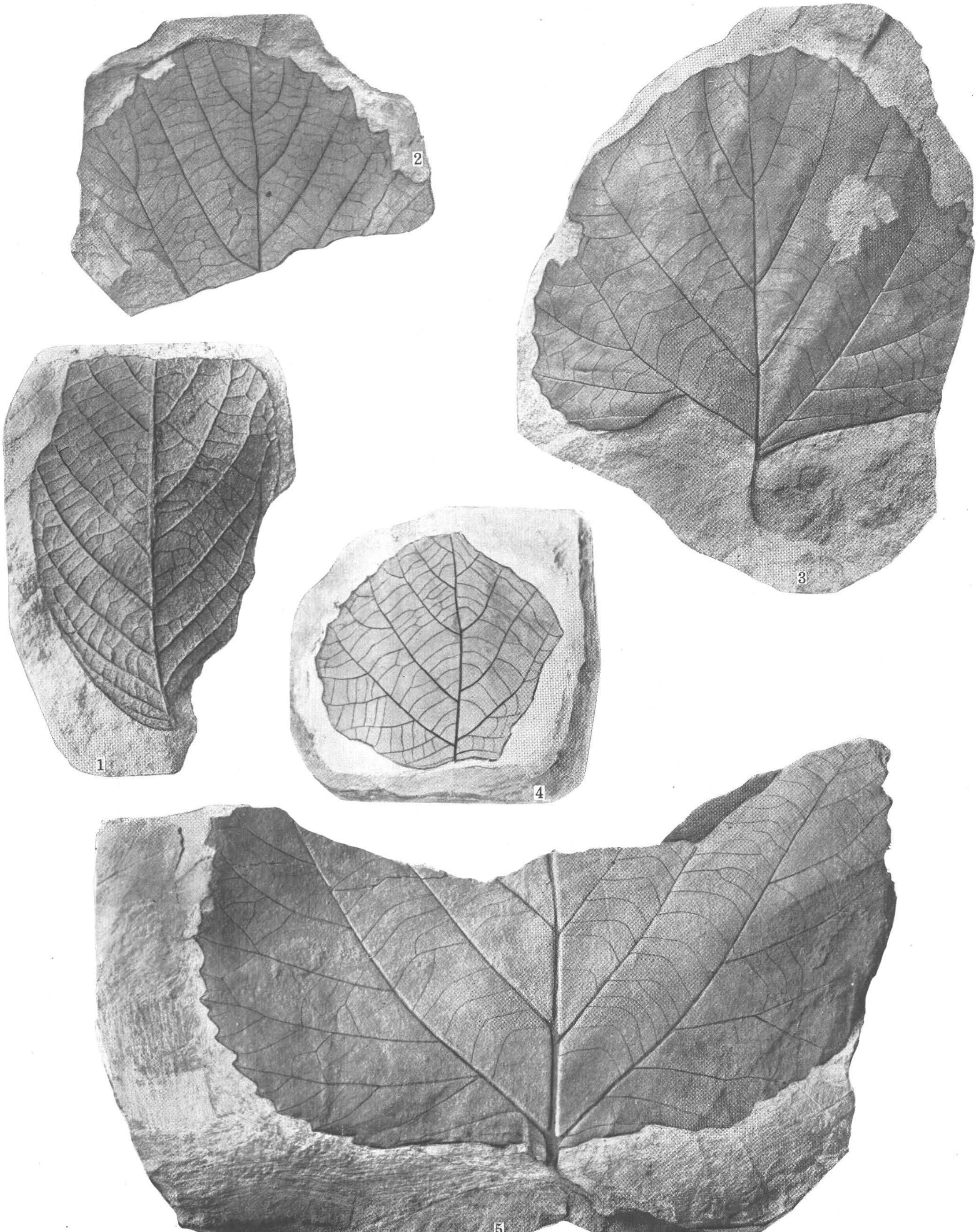
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Populites spatiosus* Hollick, n. sp. (U.S.N.M. 37491, 37492; p. 66).

UPPER CRETACEOUS FLORAS OF ALASKA

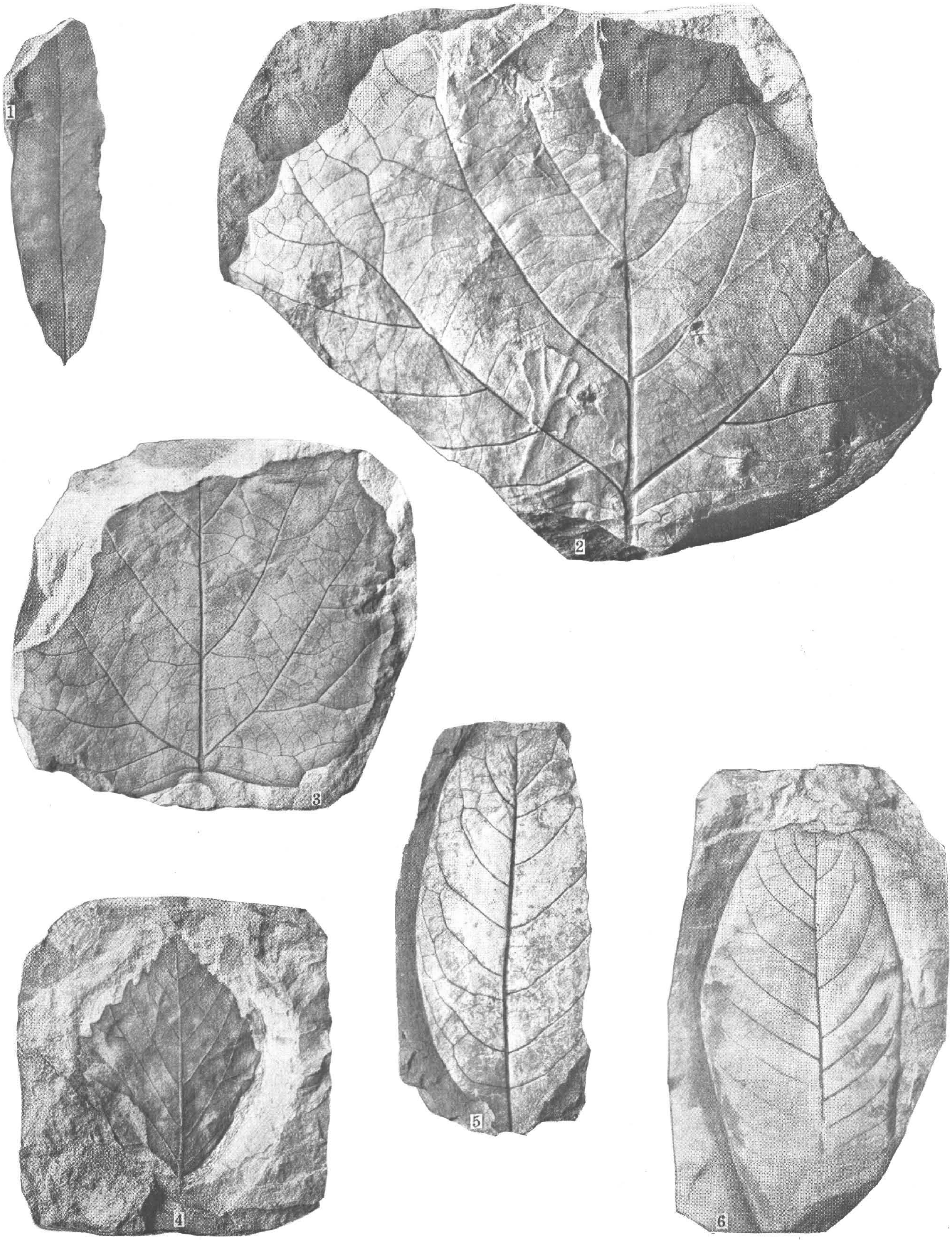
Populites mirabilis Hollick, n. sp. (U.S.N.M. 37493; p. 67).

85918—30——11



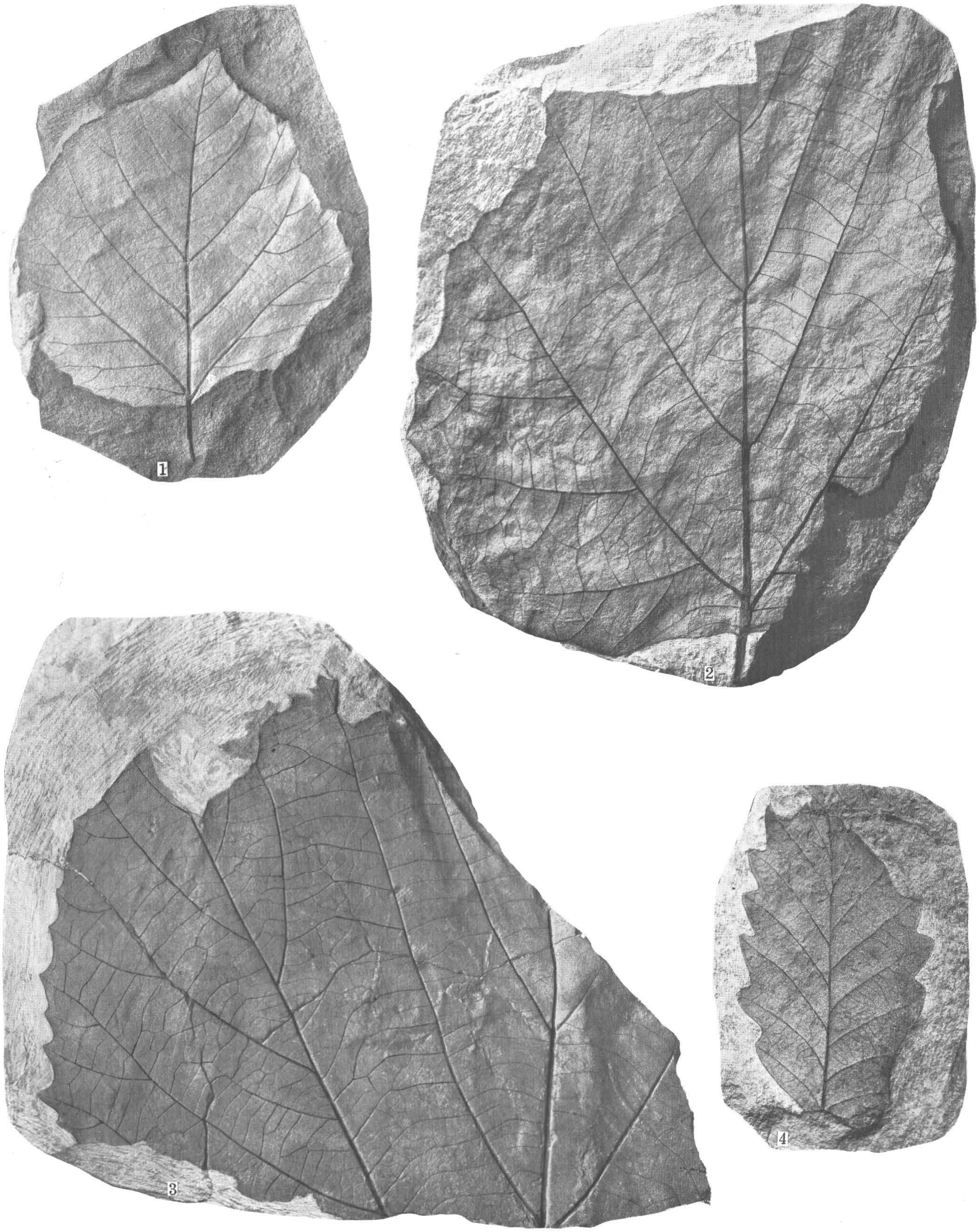
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Hicoria duriuscula* Hollick, n. sp. (U.S.N.M. 37494; p. 68).
2-4. *Populites vitiformis* Hollick, n. sp. (U.S.N.M. 37495-37497; p. 65).
5. *Populites platanoides* Hollick, n. sp. (U.S.N.M. 37498; p. 65).



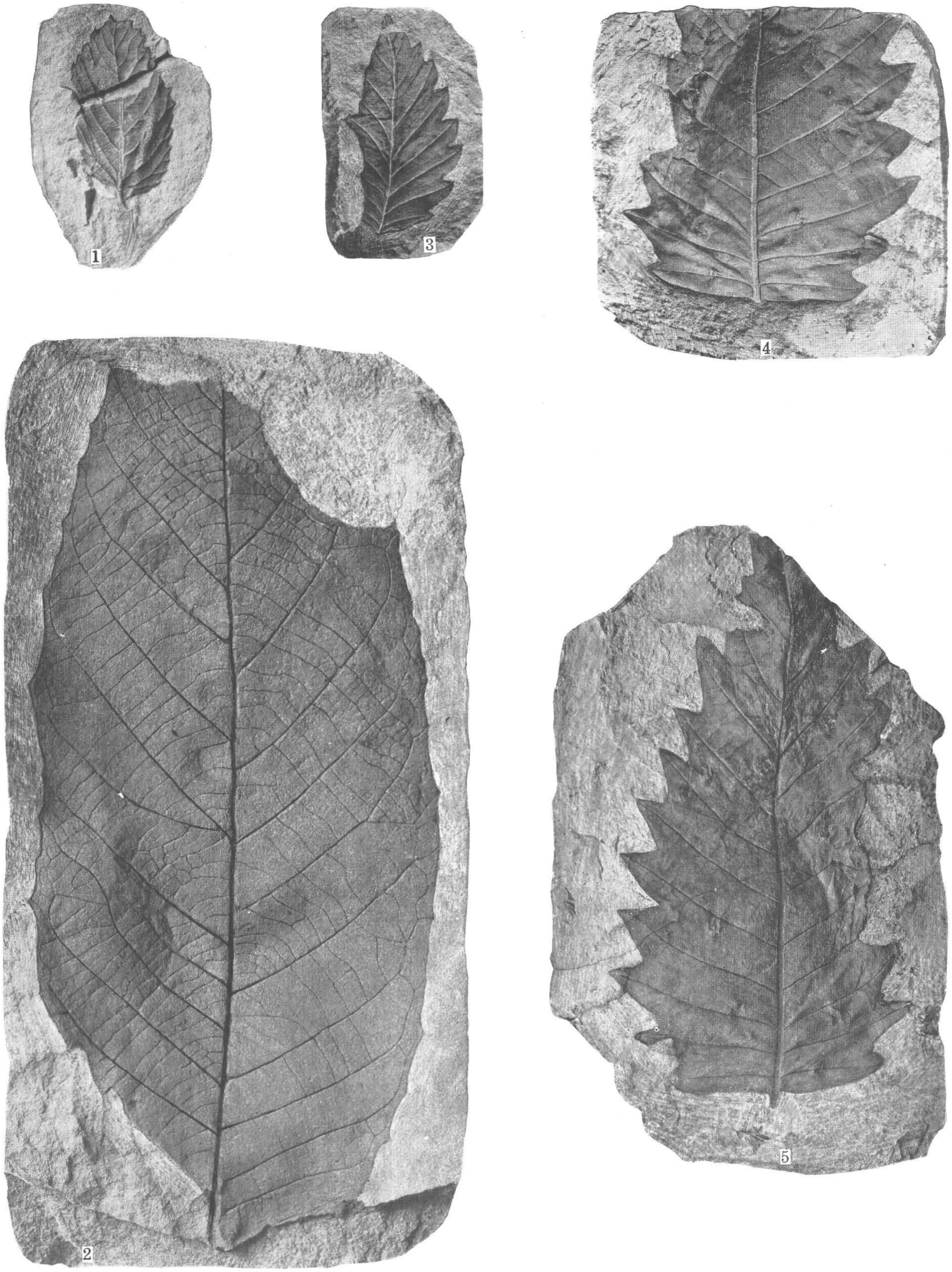
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Quercus eamesi* Trelease? (U.S.N.M. 37499; p. 70).
2. *Populites pseudoelegans* Hollick, n. sp. (U.S.N.M. 37500; p. 64).
3. *Populites pseudolancastriensis* Hollick, n. sp. (U.S.N.M. 37501; p. 65).
4. *Betula beatricina conformis* Hollick, n. var. (U.S.N.M. 37502; p. 68).
5, 6. *Juglans arctica* Heer (U.S.N.M. 37503, 37504; p. 67).



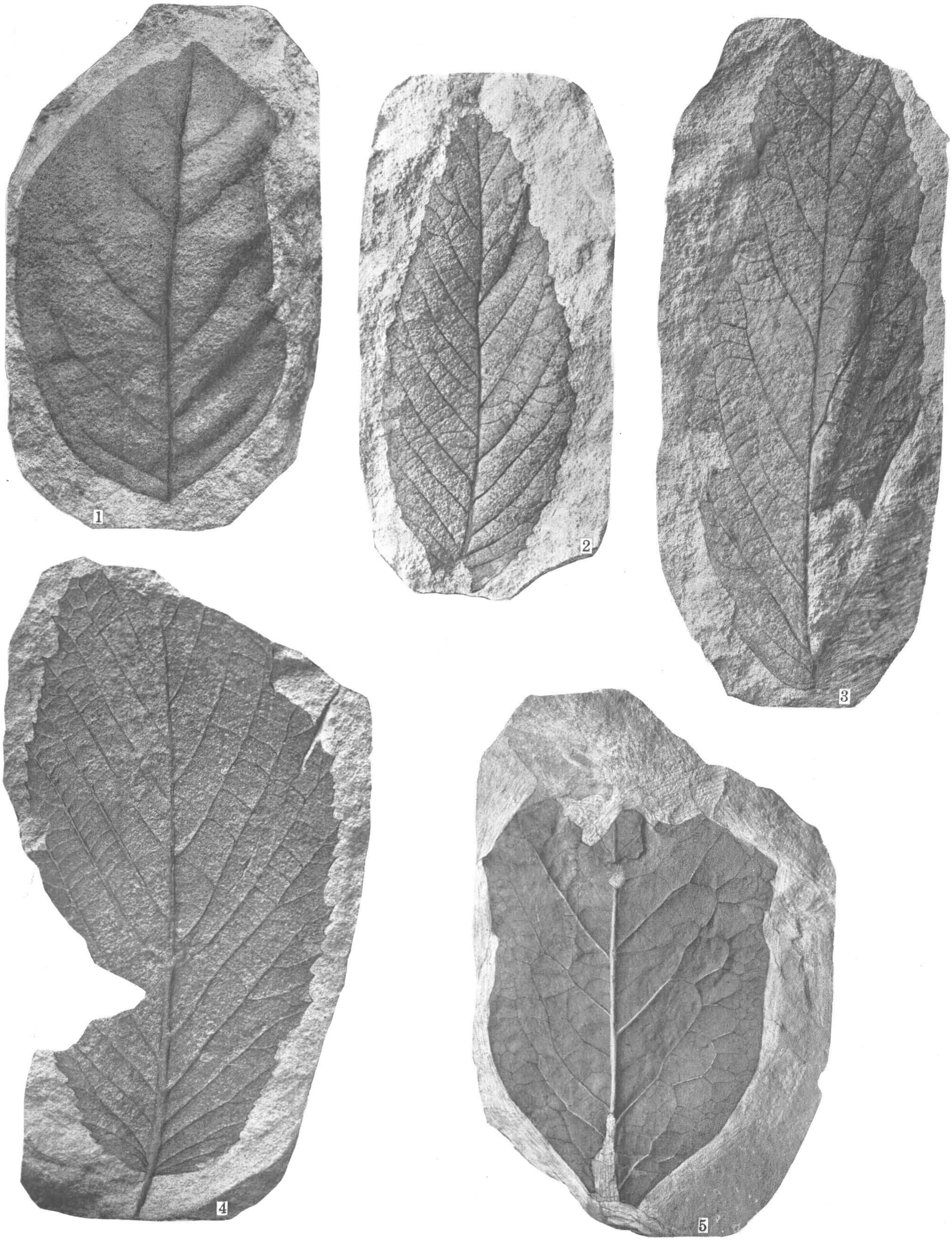
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Betulites rugosus apiculatus* Hollick, n. var. (U.S.N.M. 37505; p. 68).
2. *Populites? captiosus* Hollick, n. sp. (U.S.N.M. 37506; p. 66).
3. *Populites platanoides* Hollick, n. sp. (U.S.N.M. 37507; p. 65).
4. *Quercus pseudomarioni* Hollick, n. sp. (U.S.N.M. 37469; p. 69).



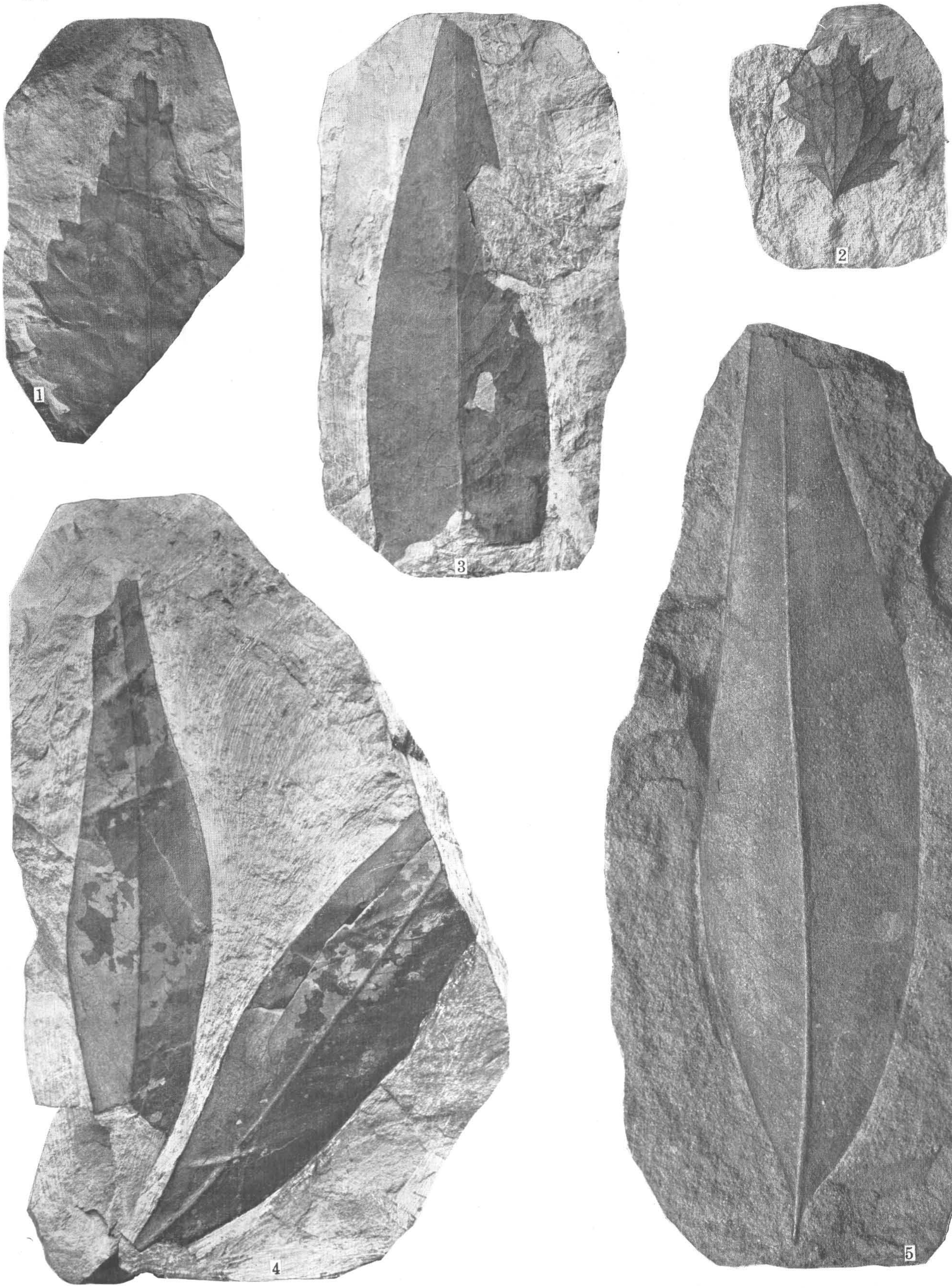
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Ulmus oblongifolia* Hollick, n. sp. (U.S.N.M. 37508; p. 70).
2. *Paullinia minutidenticulata* Hollick, n. sp. (U.S.N.M. 37509; p. 101).
3. *Quercus chignikensis* Hollick, n. sp. (U.S.N.M. 37510 p. 69).
4, 5. *Quercus paleoilicoides* Hollick, n. sp. (U.S.N.M. 37511; p. 69).



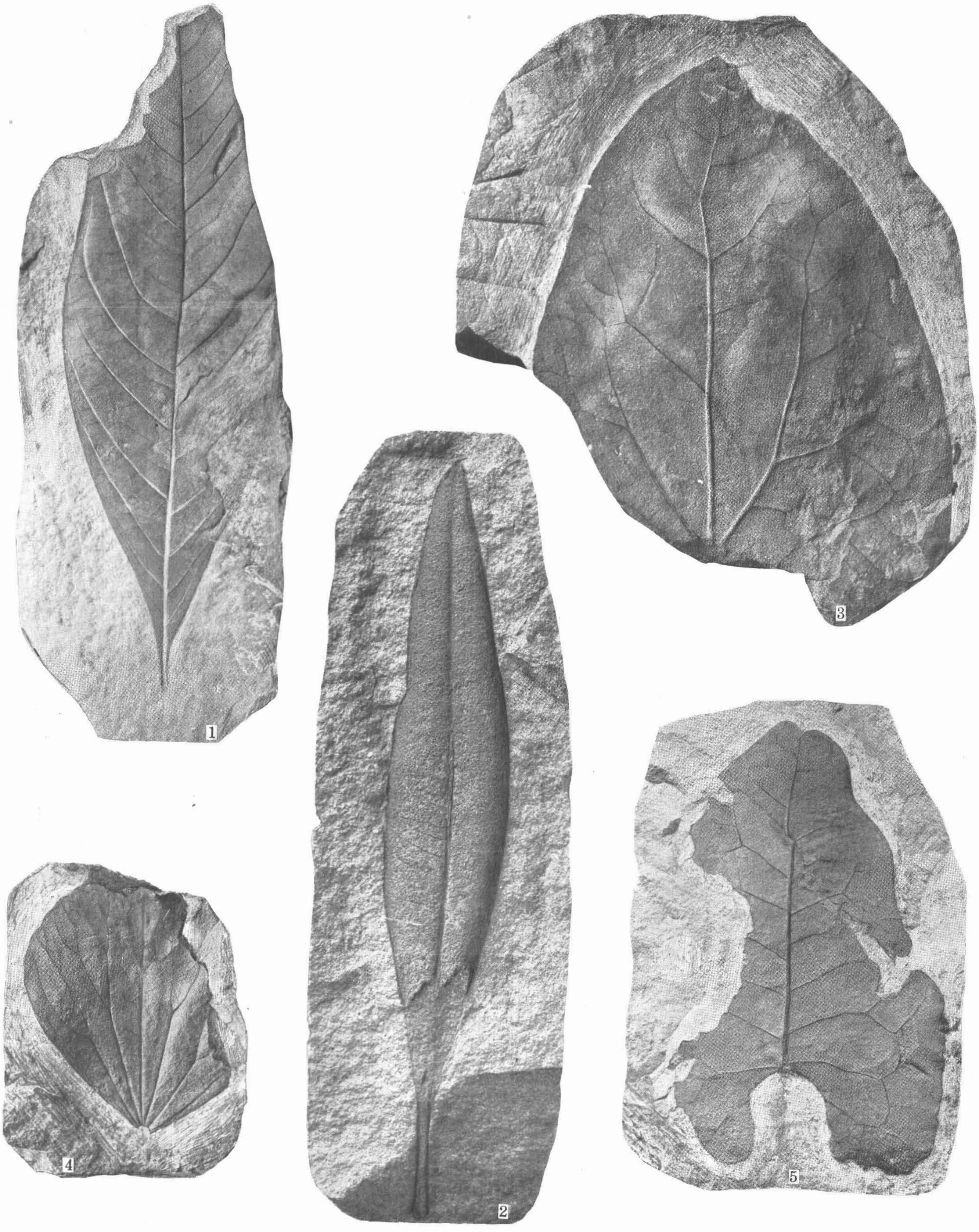
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Ficus? juglandifolia* Hollick, n. sp. (U.S.N.M. 37512; p. 72).
2. *Dryophyllum bruneri* Ward (U.S.N.M. 37513; p. 70).
3. *Quercus turbulenta* Hollick, n. sp. (U.S.N.M. 37514; p. 70).
4. *Ulmus alnoides* Hollick, n. sp. (U.S.N.M. 37515; p. 71).
5. *Ficus dictyodroma* Hollick, n. sp. (U.S.N.M. 37516; p. 72).



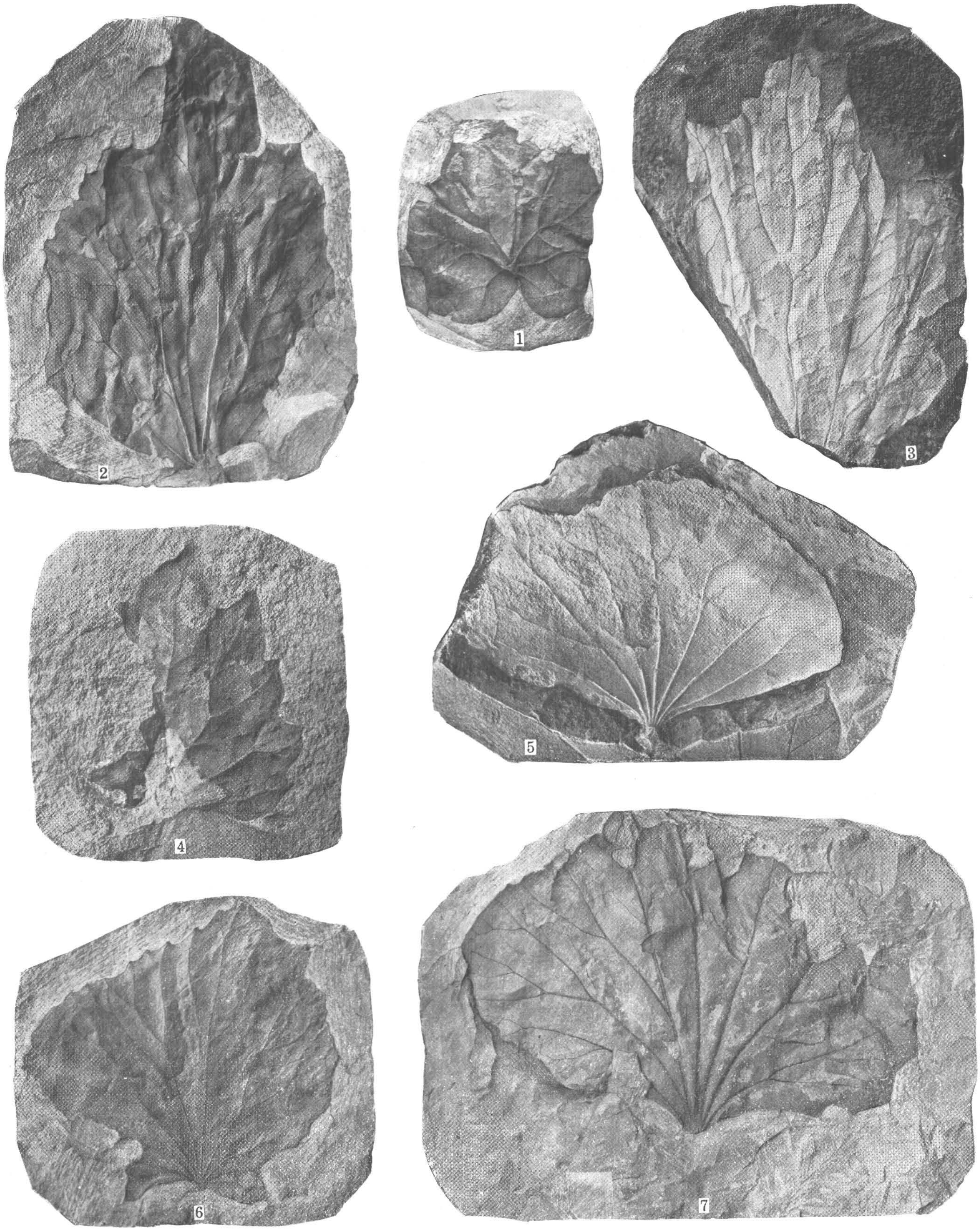
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Urtica alaskana* Hollick, n. sp. (U.S.N.M. 37517; p. 73).
2. *Urtica exemplaris* Hollick, n. sp. (U.S.N.M. 37518; p. 73).
3–5. *Ficus daphnogenoides* (Heer) Berry (U.S.N.M. 37519 (3, 4), 37520 (5); p. 71).



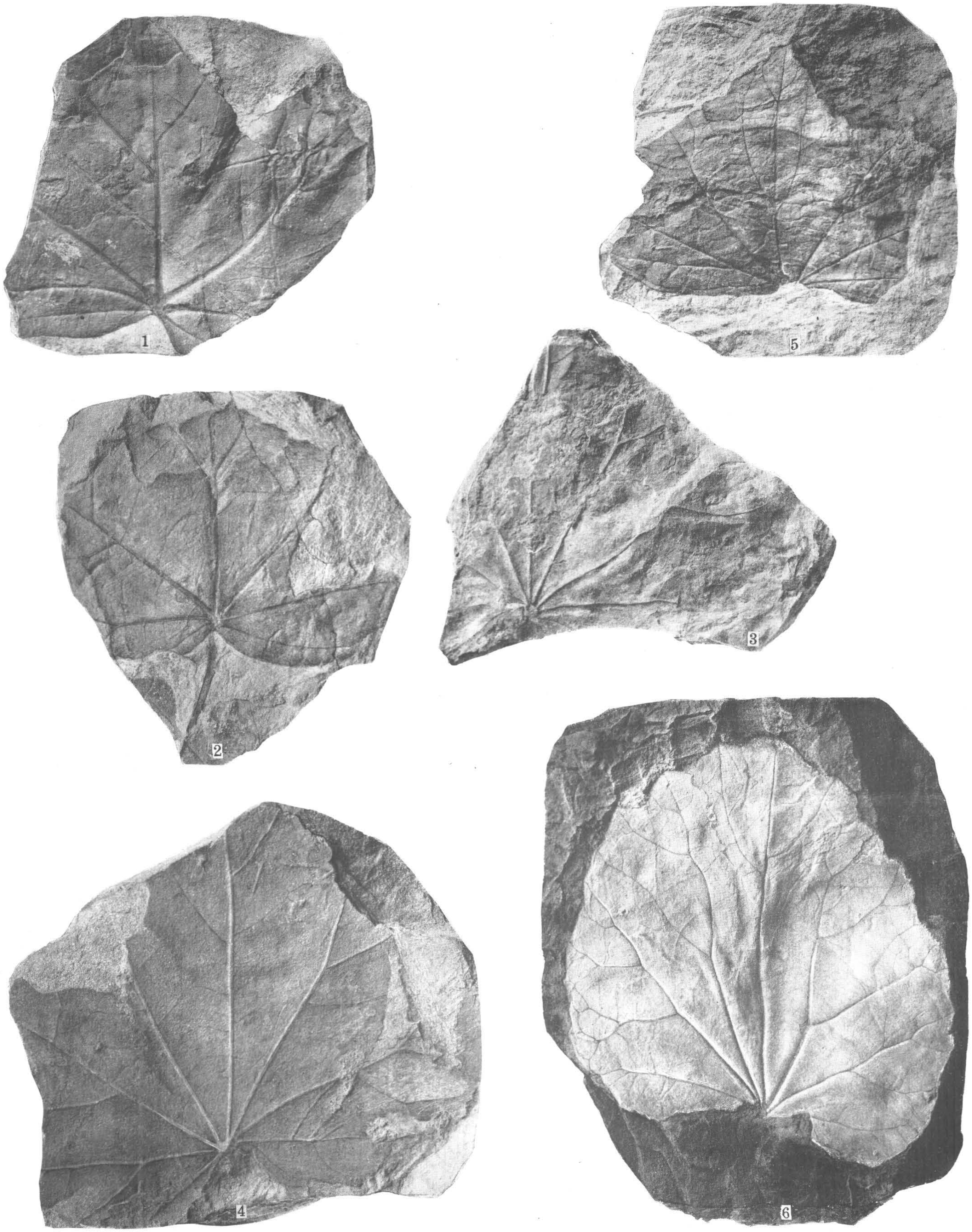
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Ficus lesquereuxii lata* Hollick, n. var. (U.S.N.M. 37521; p. 71).
2. *Ficus laurophylla* Lesquereux (U.S.N.M. 37522; p. 72).
3. *Aristolochia paigei* Hollick, n. sp. (U.S.N.M. 37523; p. 74).
4. *Nymphaeites exemplaris* Hollick, n. sp. (U.S.N.M. 37524; p. 75).
5. *Paleonuphar inopina* Hollick, n. sp. (U.S.N.M. 37525; p. 75).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Menispermites cordifolius* Hollick, n. sp. (U.S.N.M. 37526; p. 79).
2. *Castaliites inordinatus* Hollick, n. sp. (U.S.N.M. 37527; p. 77).
3. *Castaliites acutidentatus* Hollick, n. sp. (U.S.N.M. 37528; p. 77).
4. *Castaliites crenatidentatus* Hollick, n. sp. (U.S.N.M. 37529; p. 77).
5. *Castaliites flabelliformis* Hollick, n. sp. (U.S.N.M. 37530; p. 76).
6. *Castaliites cordatus* Hollick, n. sp. (U.S.N.M. 37531; p. 76).
7. *Castaliites ordinarius* Hollick, n. sp. (U.S.N.M. 37532; p. 76).

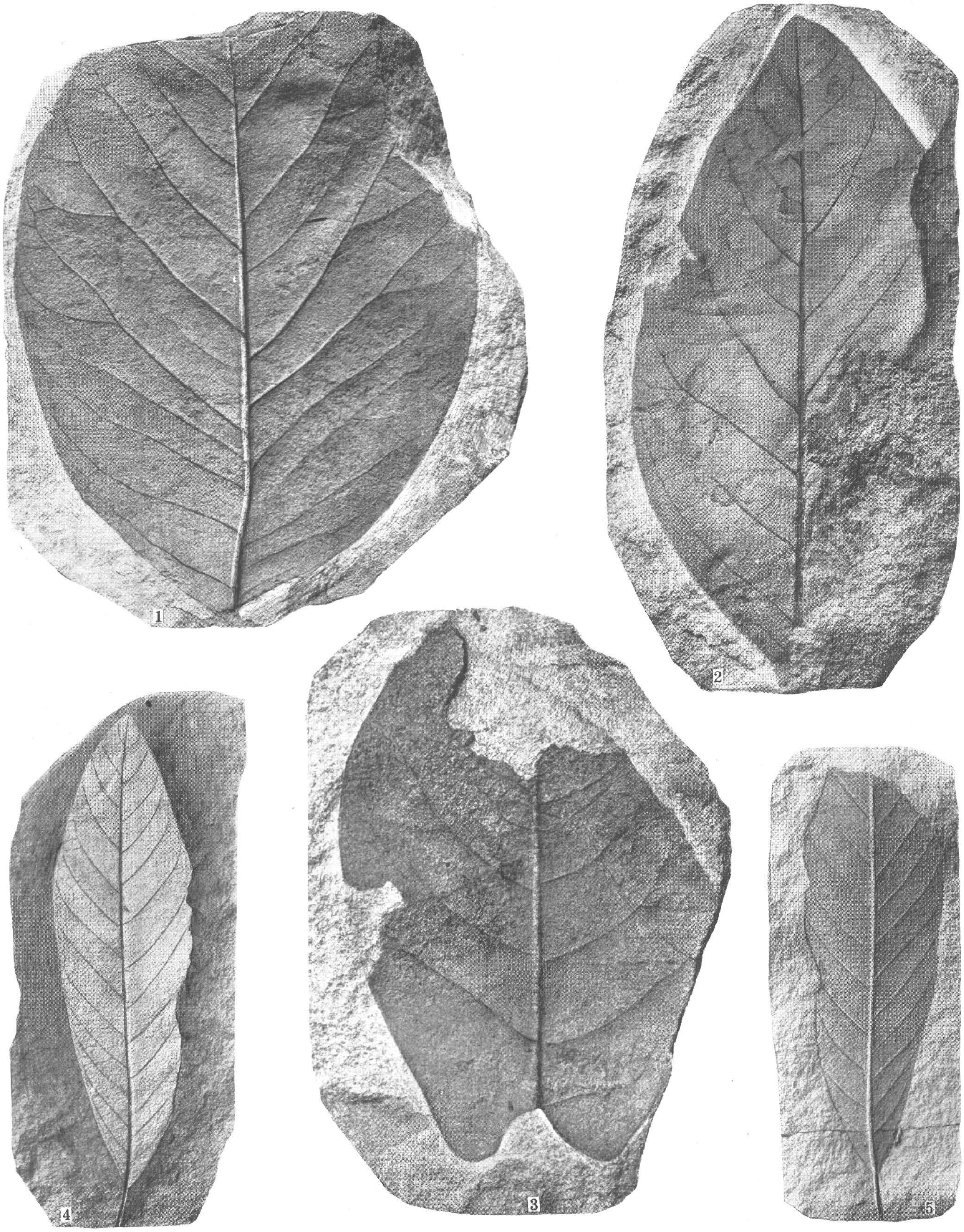


UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Menispermites communis* Hollick, n. sp. (U.S.N.M. 37533; p. 78).
3, 4. *Menispermites septentrionalis* Hollick, n. sp. (U.S.N.M. 37534, 37535; p. 79).
5. *Menispermites hederaeoides* Hollick, n. sp. (U.S.N.M. 37536; p. 78).
6. *Menispermites reniformis* Dawson (U.S.N.M. 37537; p. 78).

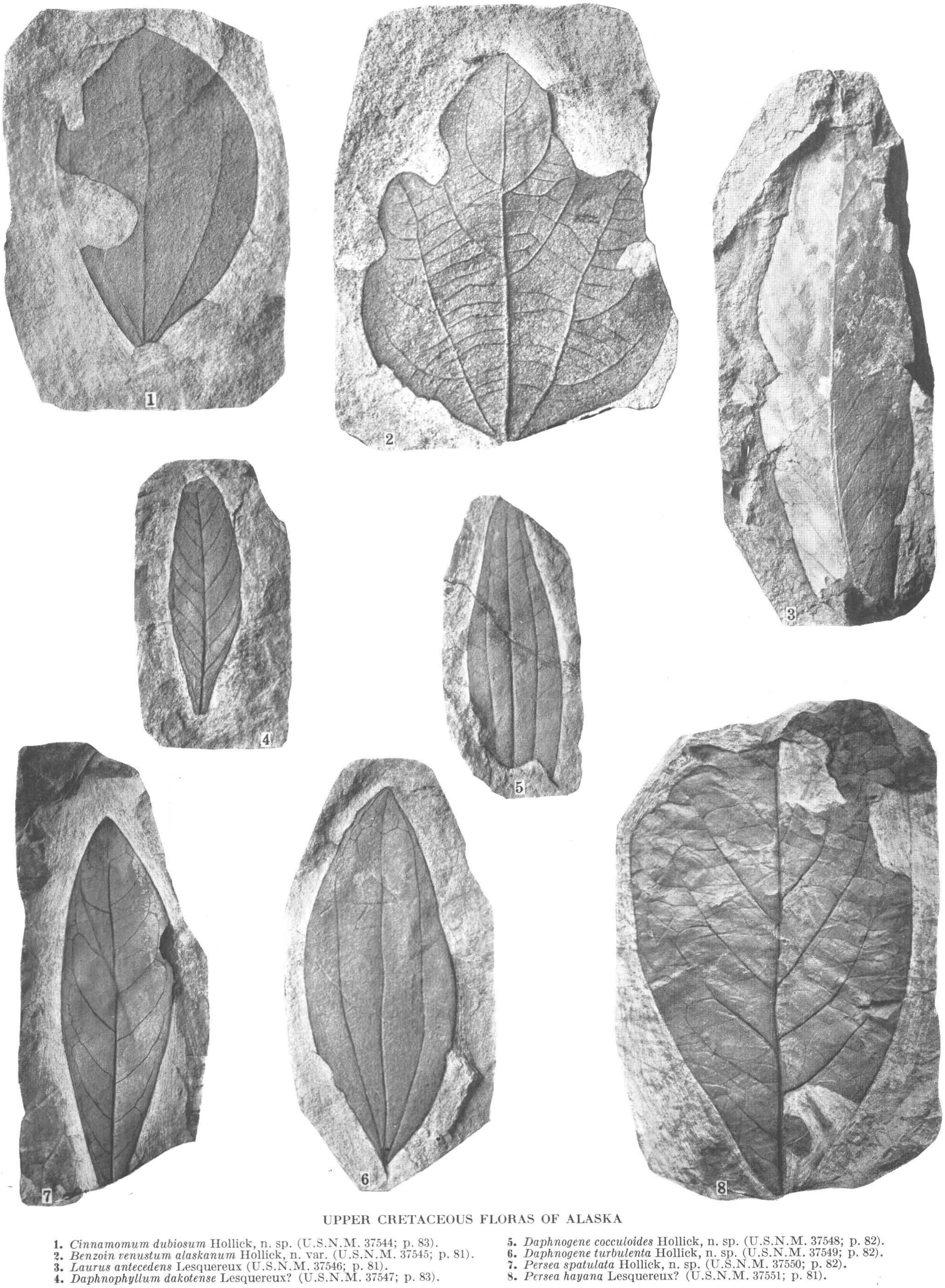
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Menispermites reniformis* Dawson (U.S.N.M. 37538; p. 78).
2. *Platanus heerii* Lesquereux (U.S.N.M. 37539; p. 84).



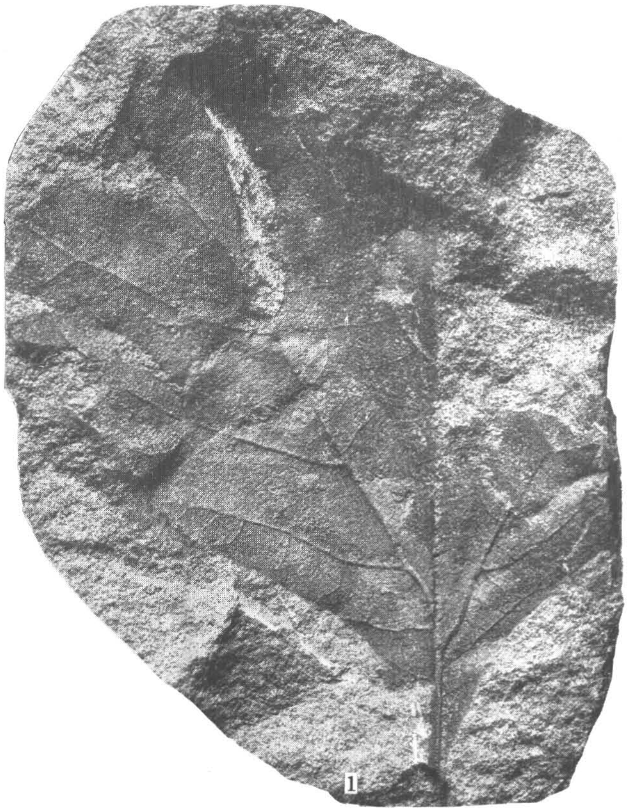
UPPER CRETACEOUS FLORAS OF ALASKA

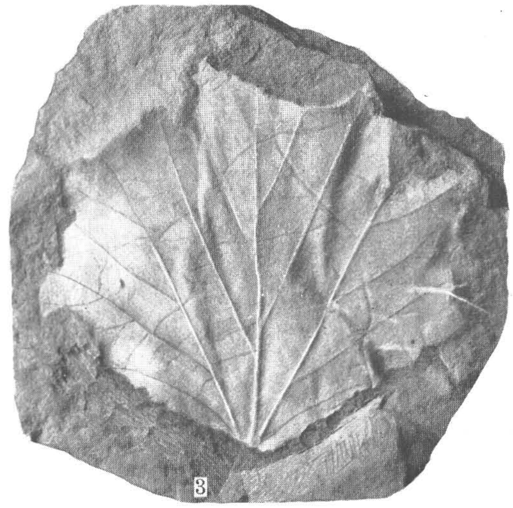
1. *Magnolia lacoeana* Lesquereux (U.S.N.M. 37540; p. 79).
2. *Magnolia amplifolia* Heer (U.S.N.M. 37541; p. 79).
3. *Magnolia palaeauriculata* Hollick, n. sp. (U.S.N.M. 37542; p. 80).
4, 5. *Asimina knowltoniana* Hollick, n. sp. (U.S.N.M. 37543; p. 80).

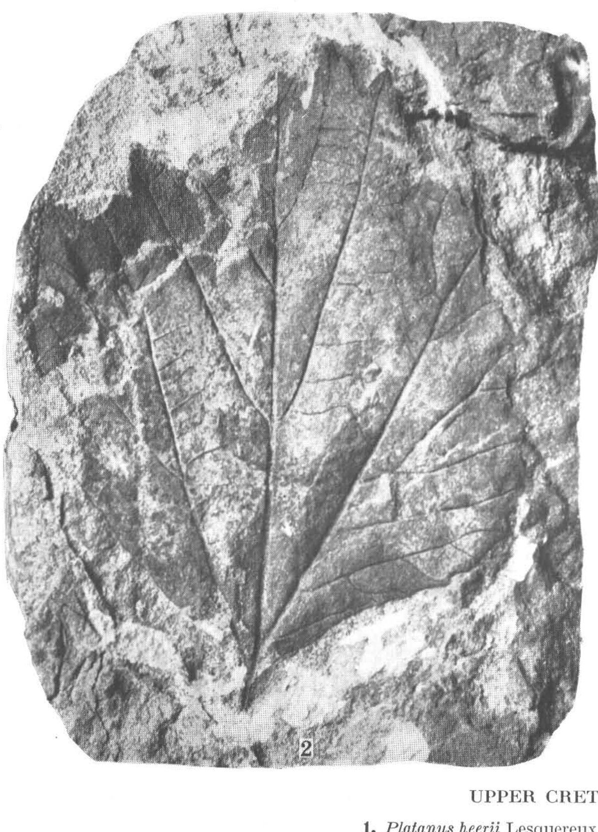


UPPER CRETACEOUS FLORAS OF ALASKA

1. *Cinnamomum dubiosum* Hollick, n. sp. (U.S.N.M. 37544; p. 83).
2. *Benzoin venustum alaskanum* Hollick, n. var. (U.S.N.M. 37545; p. 81).
3. *Laurus antecedens* Lesquereux (U.S.N.M. 37546; p. 81).
4. *Daphnophyllum dakotense* Lesquereux? (U.S.N.M. 37547; p. 83).
5. *Daphnogene cocculoides* Hollick, n. sp. (U.S.N.M. 37548; p. 82).
6. *Daphnogene turbulenta* Hollick, n. sp. (U.S.N.M. 37549; p. 82).
7. *Persea spatulata* Hollick, n. sp. (U.S.N.M. 37550; p. 82).
8. *Persea hayana* Lesquereux? (U.S.N.M. 37551; p. 81).

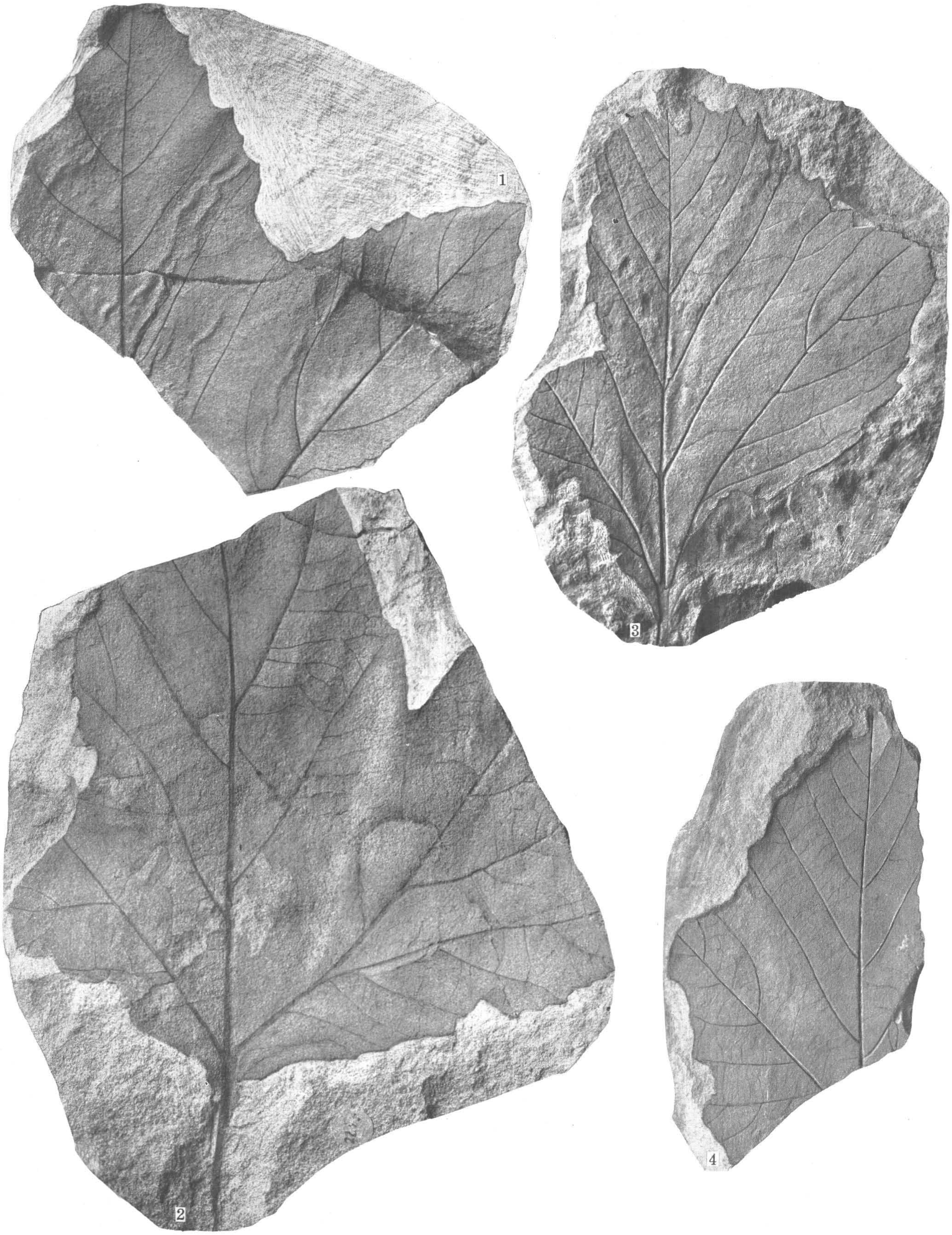






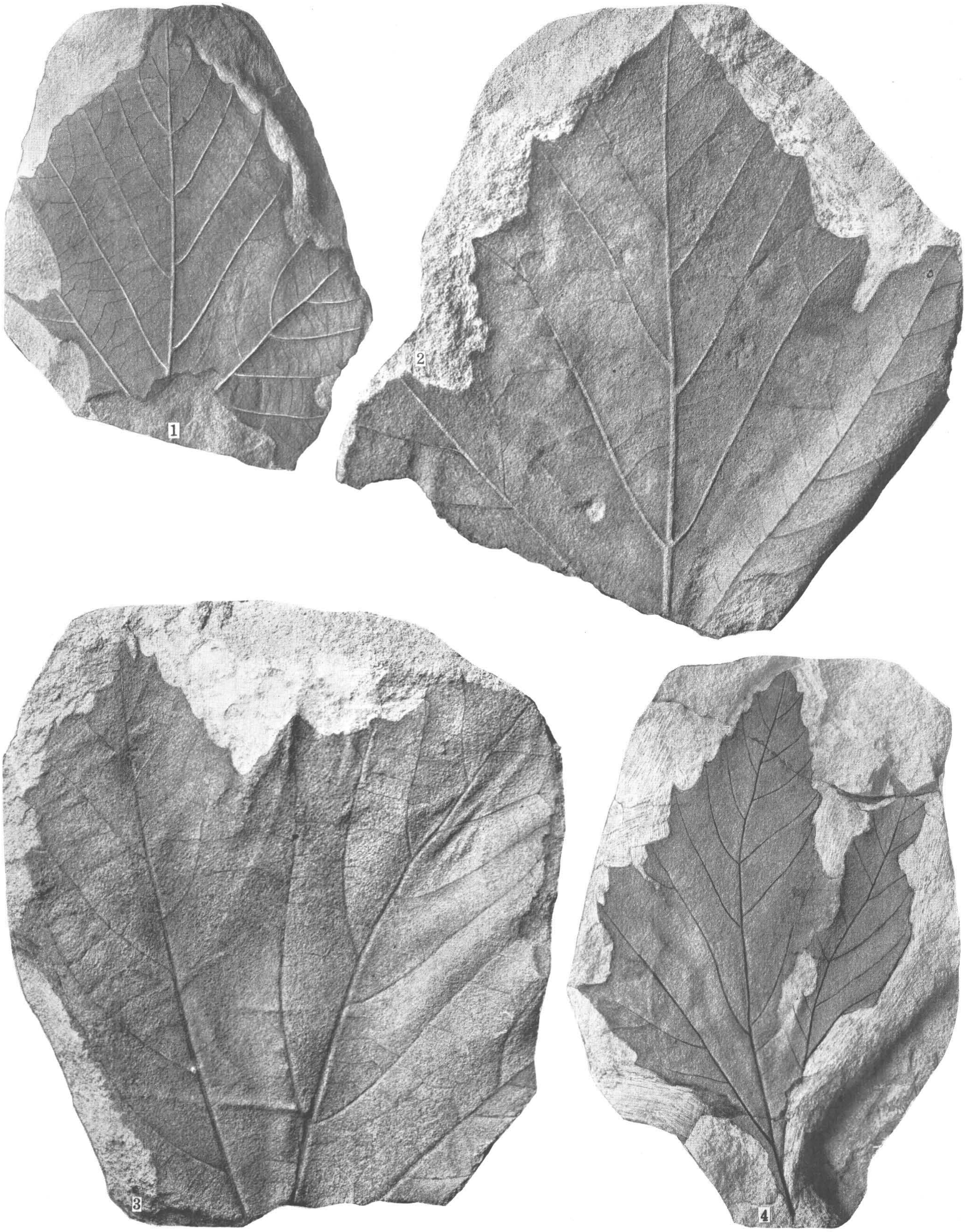
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Platanus heerii* Lesquereux (U.S.N.M. 37552; p. 84).
2, 3. *Platanus? newberryana* Heer (U.S.N.M. 37553, 37554; p. 83).
4. *Platanus? newberryana conditionalis* Hollick, n. var. (U.S.N.M. 37555; p. 83).



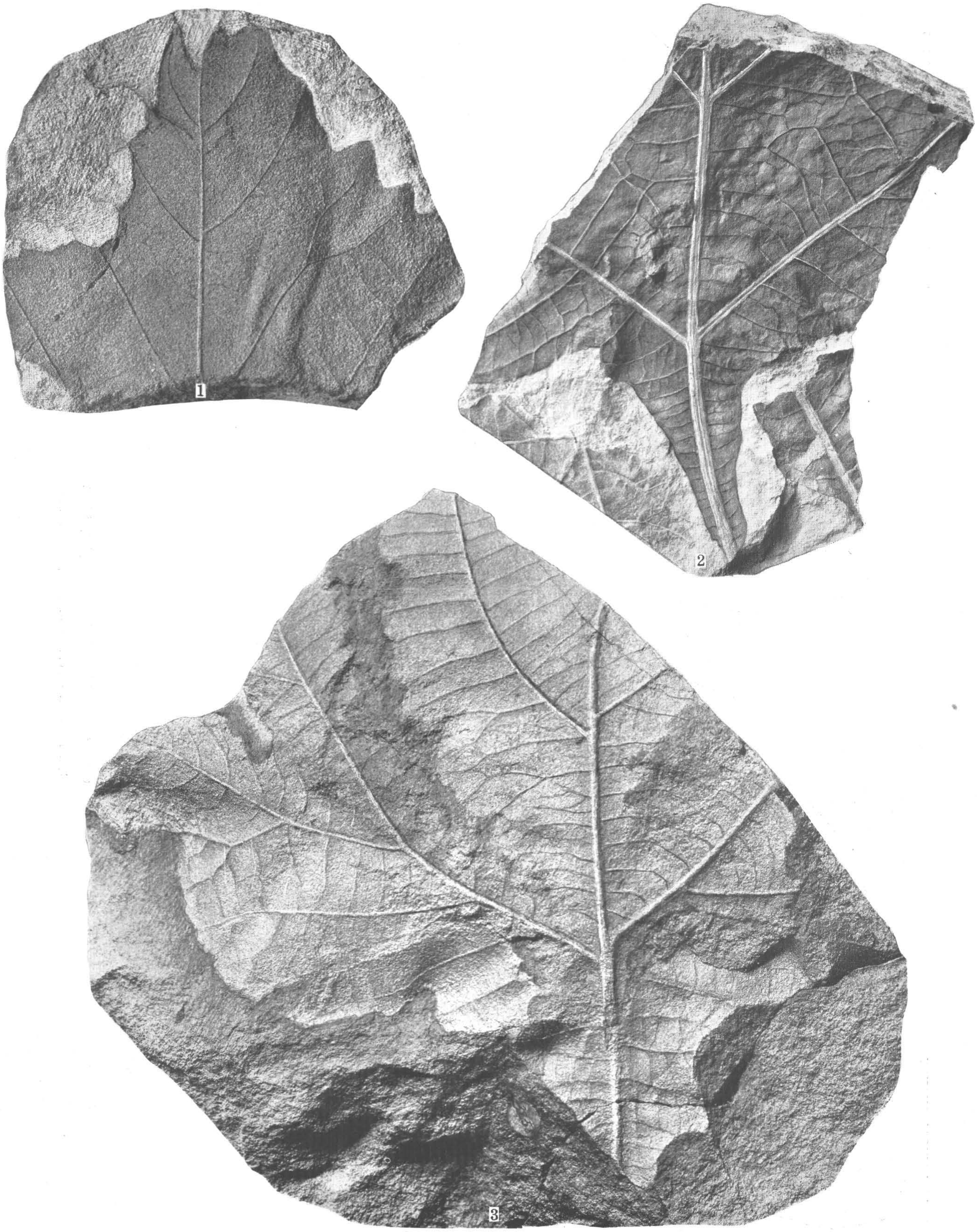
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Platanus septentrionalis* Hollick, n. sp. (U.S.N.M. 37556; p. 84).
3. *Platanus? newberryana* Heer (U.S.N.M. 37557; p. 83).
4. *Platanus? newberryana conditionalis* Hollick, n. var. (U.S.N.M. 37558; p. 83).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Platanus? newberryana conditionalis* Hollick, n. var. (U.S.N.M. 37558; p. 83)
2–4. *Platanus septentrionalis* Hollick, n. sp. (U.S.N.M. 37556; p. 84).



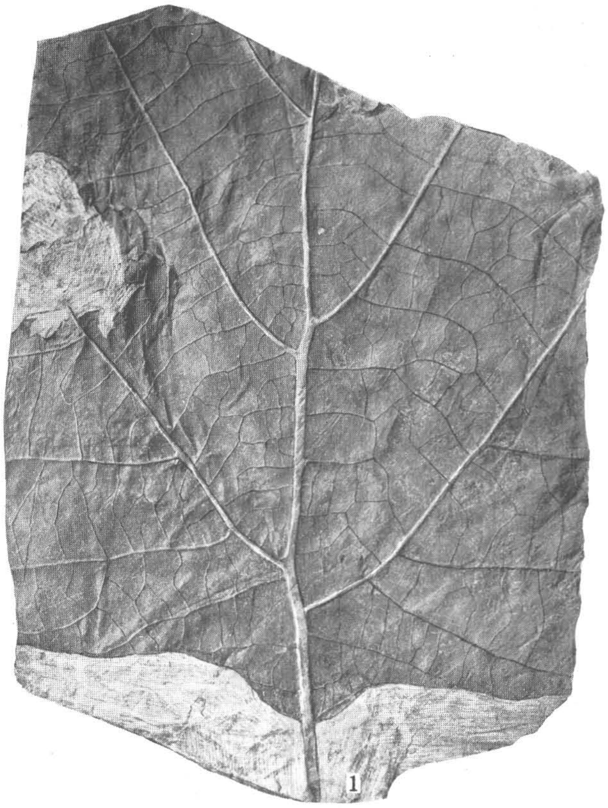
UPPER CRETACEOUS FLORAS OF ALASKA

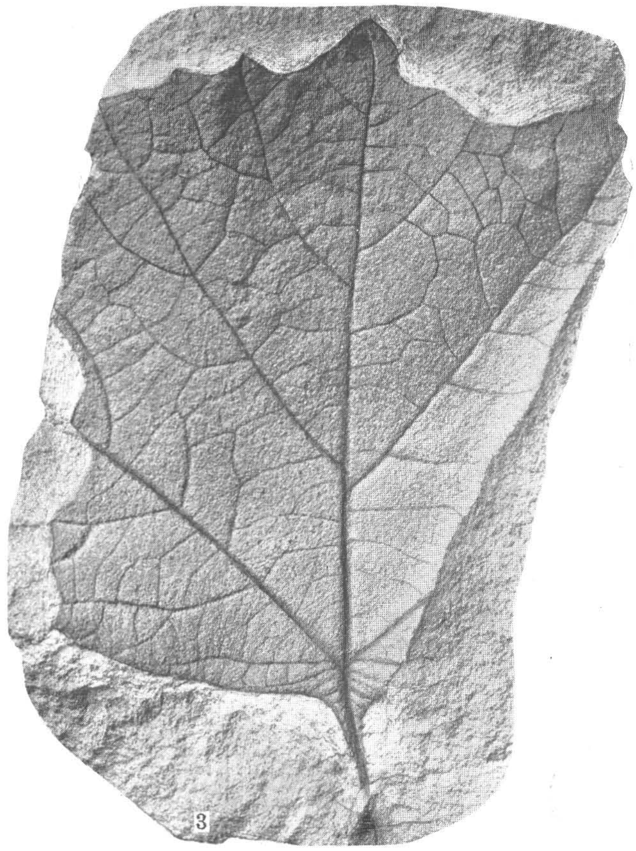
1. *Platanus septentrionalis* Hollick, n. sp. (U.S.N.M. 37556; p. 84).
2, 3. *Platanus alata* Hollick, n. sp. (U.S.N.M. 37559, 37560; p. 85).

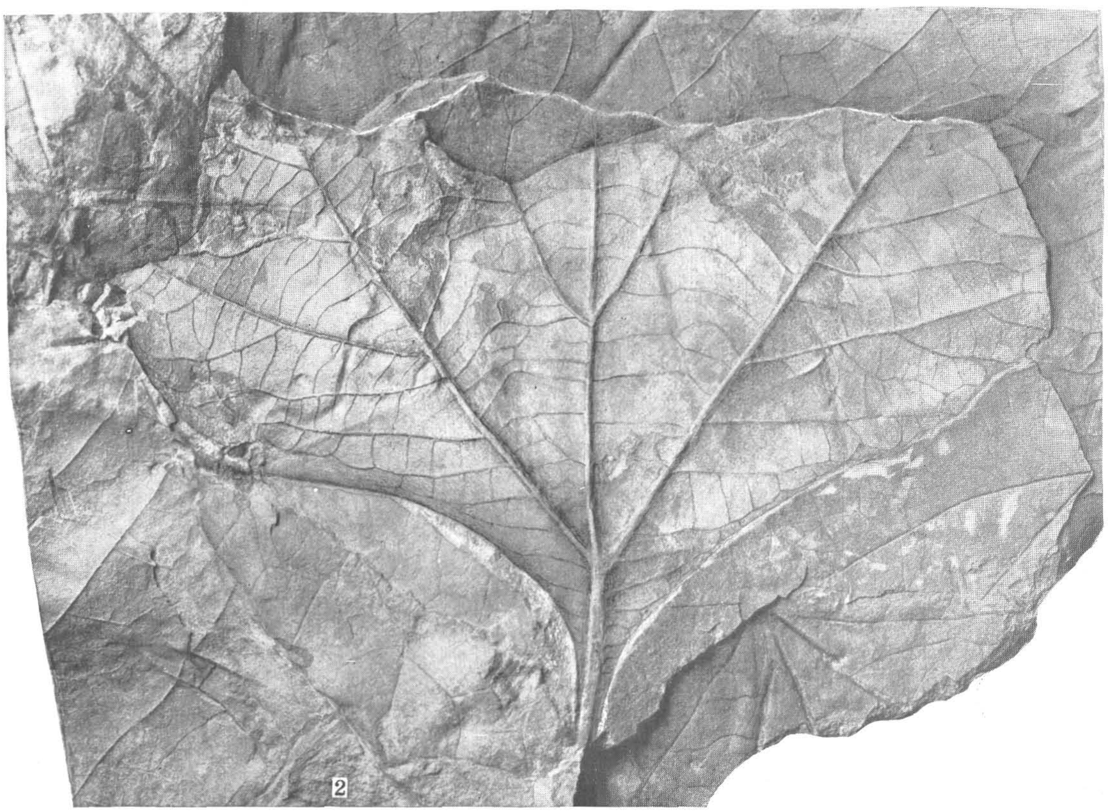
85918—30——12

UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Platanus?* sp. (U.S.N.M. 37561, 37562; p. 85).

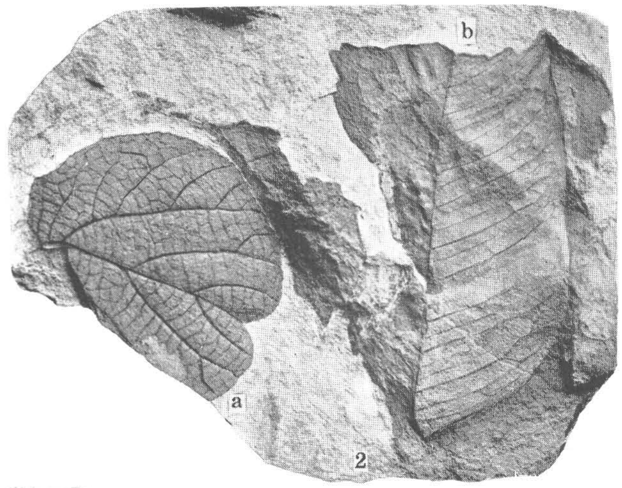






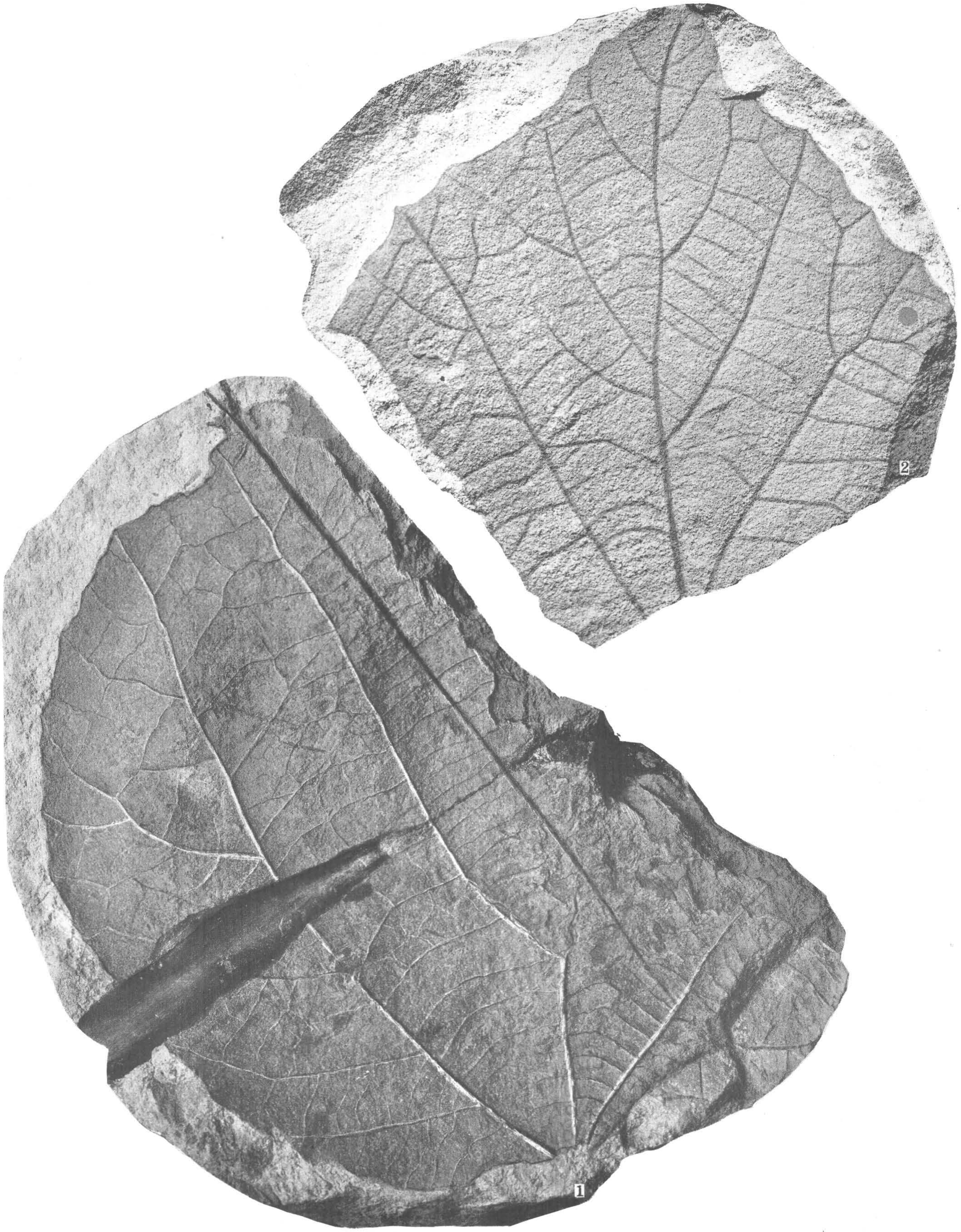
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Platanus latibasalis* Hollick, n. sp. (U.S.N.M. 37563; p. 85).
2. *Platanus latior* (Lesquereux) Knowlton (U.S.N.M. 37564; p. 84).
3. *Paracredneria? platanoidea* Hollick, n. sp. (U.S.N.M. 37565; p. 90).



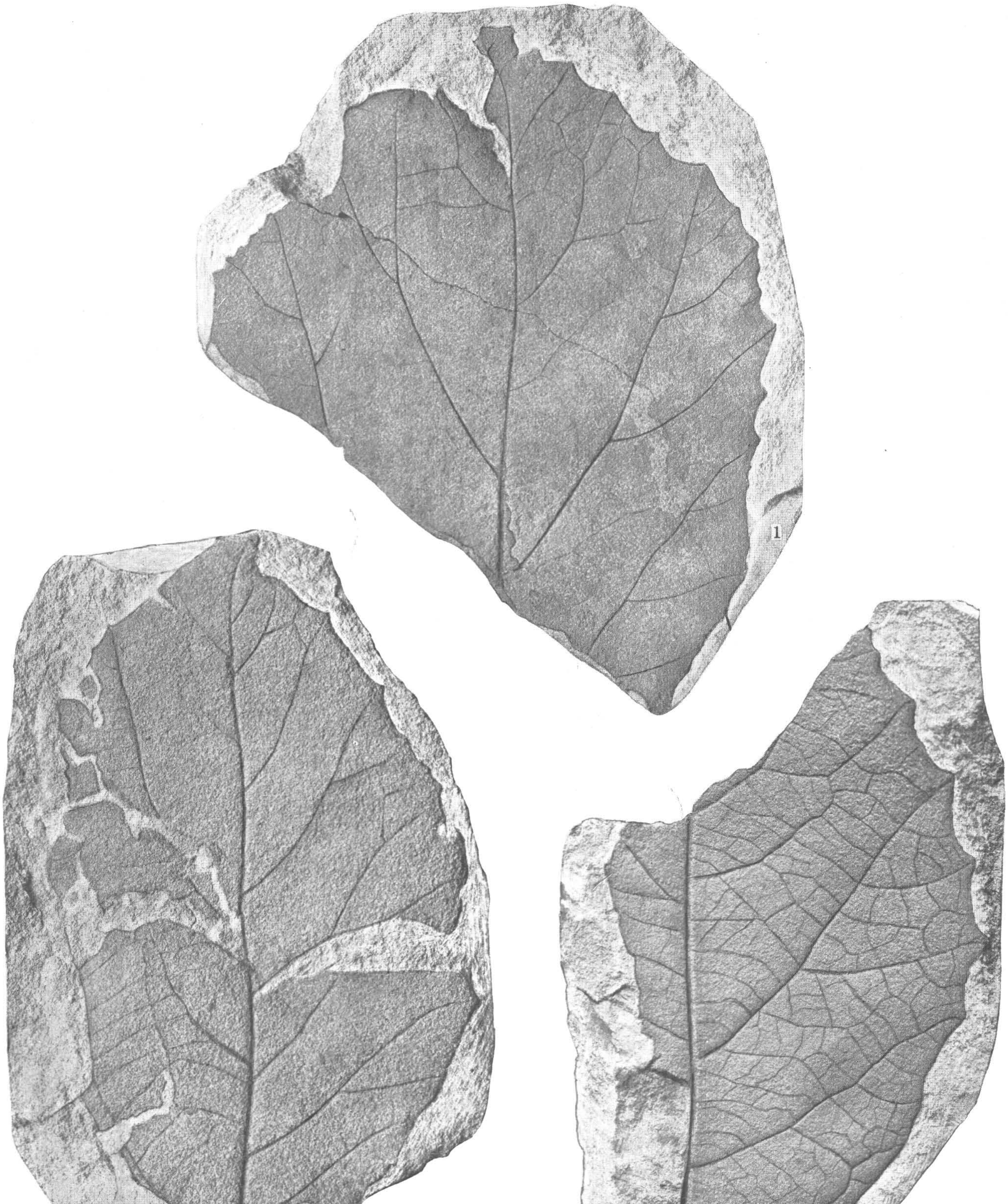
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Platanus? grewiopsoides* Hollick, n. sp. (U.S.N.M. 37566; p. 85).
2a. *Pseudoprotophyllum emarginatum* Hollick, n. sp. (U.S.N.M. 37567; p. 92).
2b. *Ficus melanophylla* Lesquereux? (U.S.N.M. 37568; p. 72).
3. *Credneria grewiopsoides* Hollick, n. sp. (U.S.N.M. 37569; p. 87).



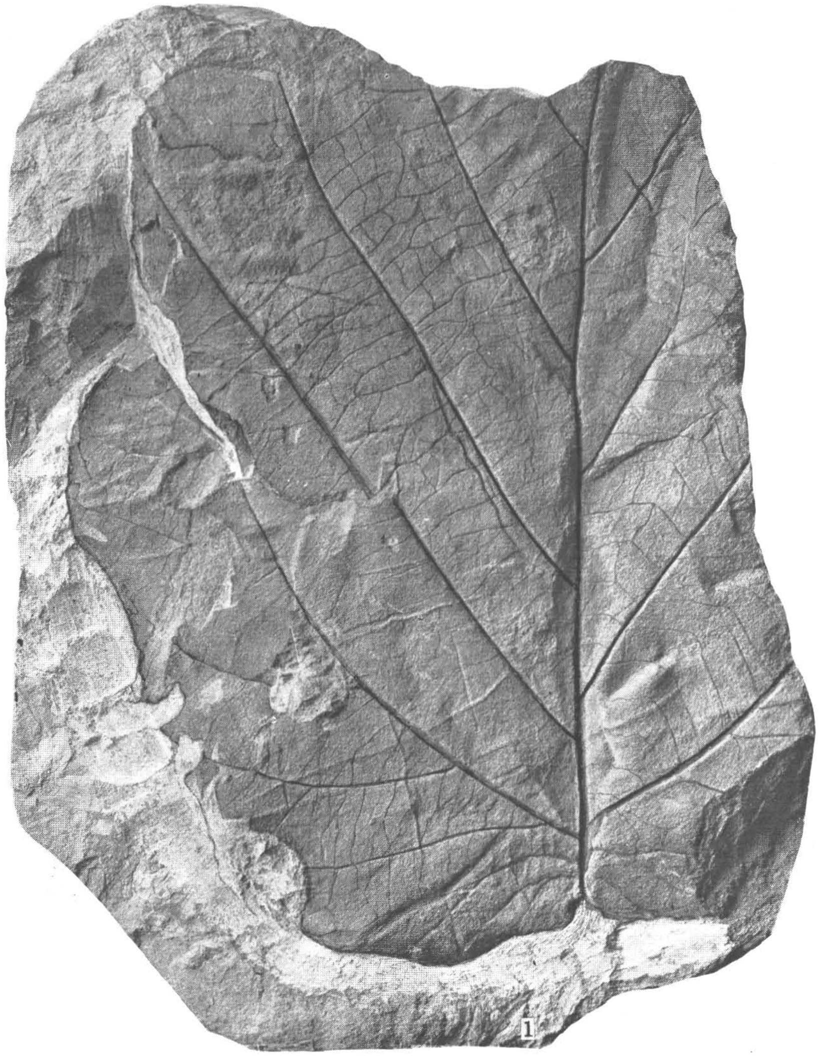
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Credneria grewiopsoides* Hollick, n. sp. (U.S.N.M. 37570; p. 87).
2. *Paracredneria?* sp. (U.S.N.M. 37571; p. 91).



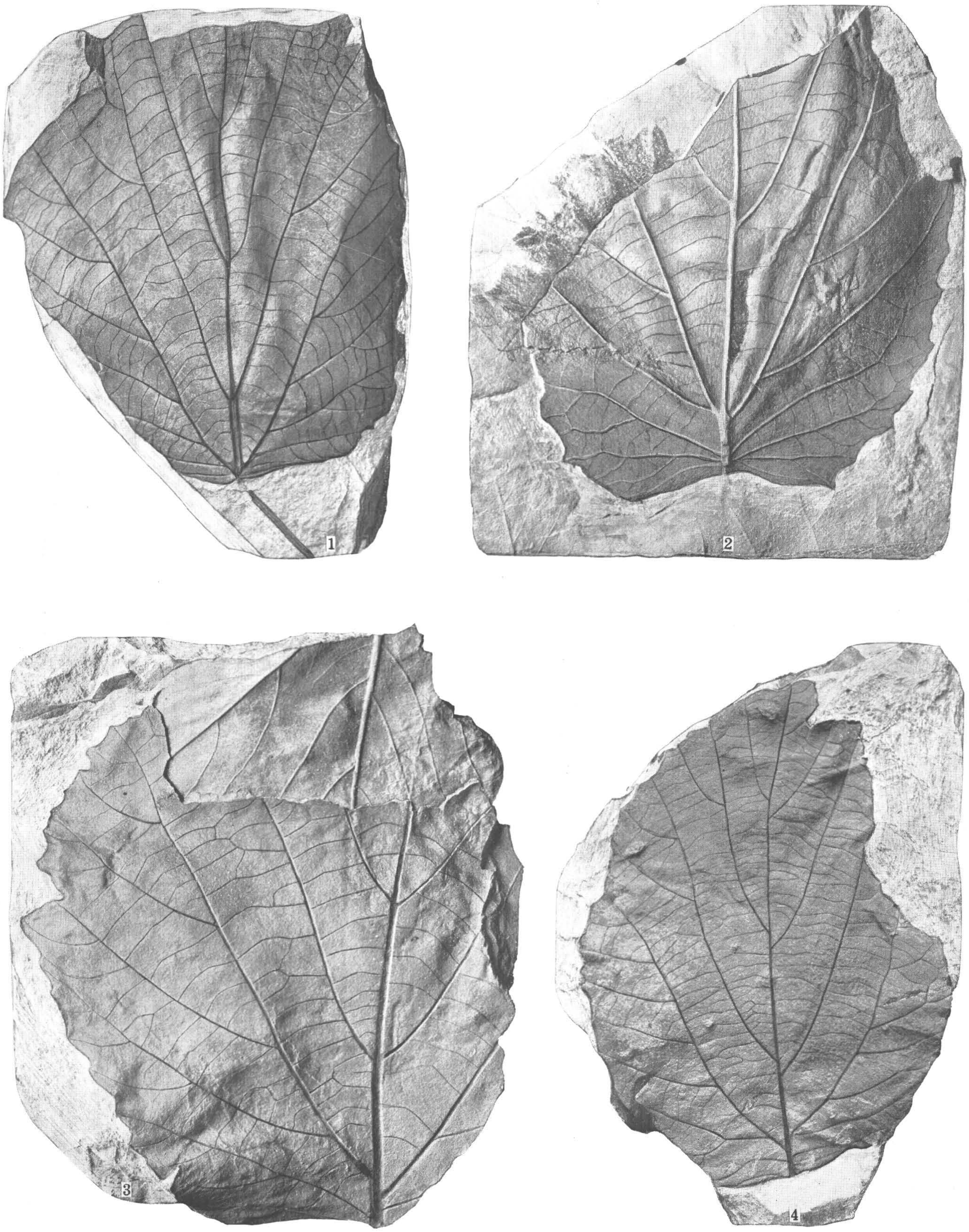
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Paracredneria crednerioides* Hollick, n. sp. (U.S.N.M. 37572; p. 90).
2, 3. *Paracredneria alaskana* Hollick, n. sp. (U.S.N.M. 37573; p. 90).



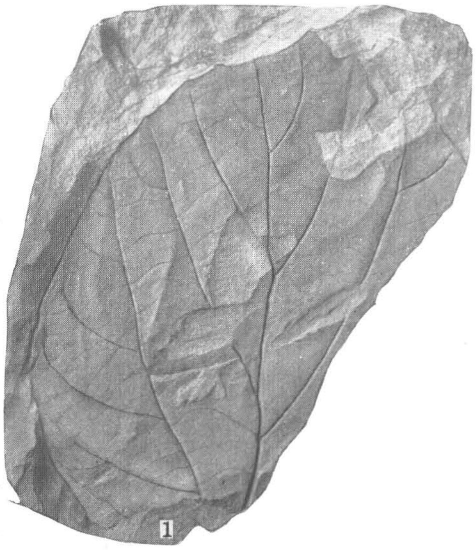
UPPER CRETACEOUS FLORAS OF ALASKA

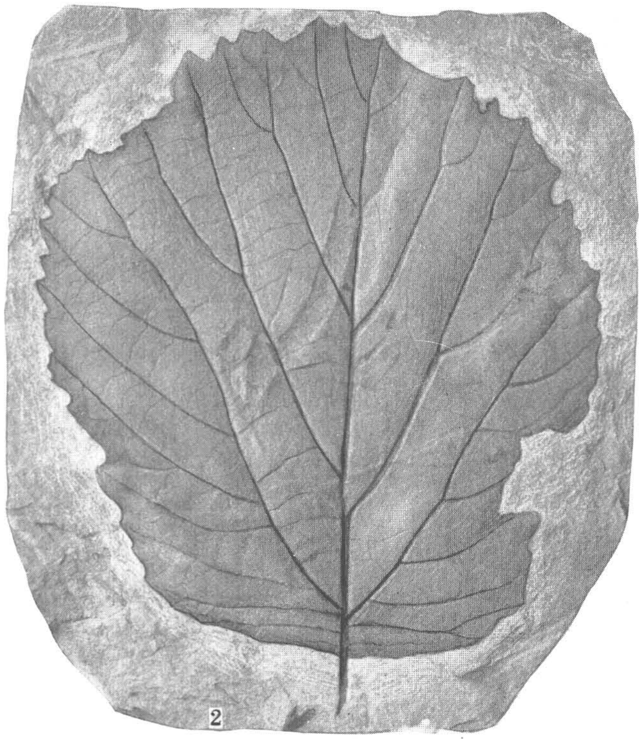
1. *Credneria intermedia* Hollick, n. sp. (U.S.N.M. 37574; p. 89).
2. *Platanus heerii* Lesquereux (U.S.N.M. 37575; p. 84).

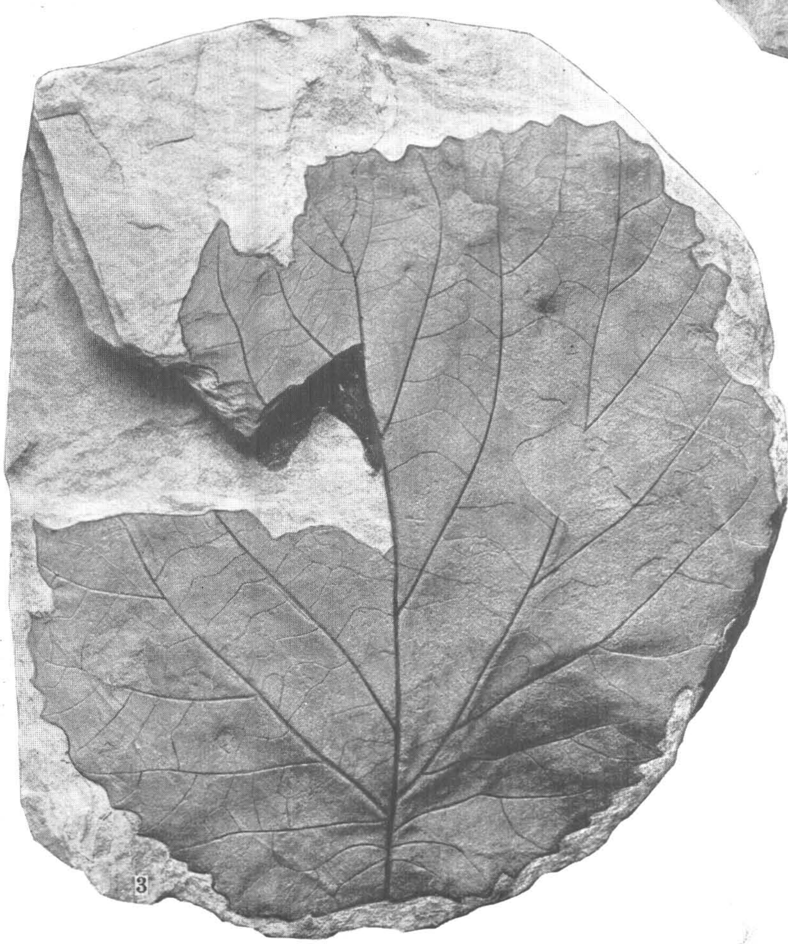


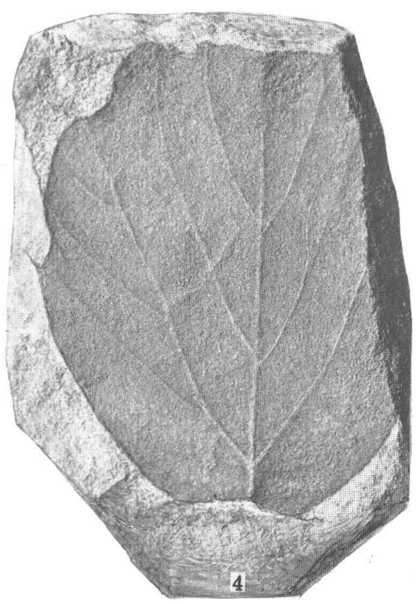
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Credneria basinervosa* Hollick, n. sp. (U.S.N.M. 37576; p. 89)
2. *Credneria elegans* Hollick, n. sp. (U.S.N.M. 37577; p. 88)
3. *Credneria inordinata* Hollick, n. sp. (U.S.N.M. 37578; p. 86).
4. *Credneria mixta* Hollick, n. sp. (U.S.N.M. 37579: p. 88).



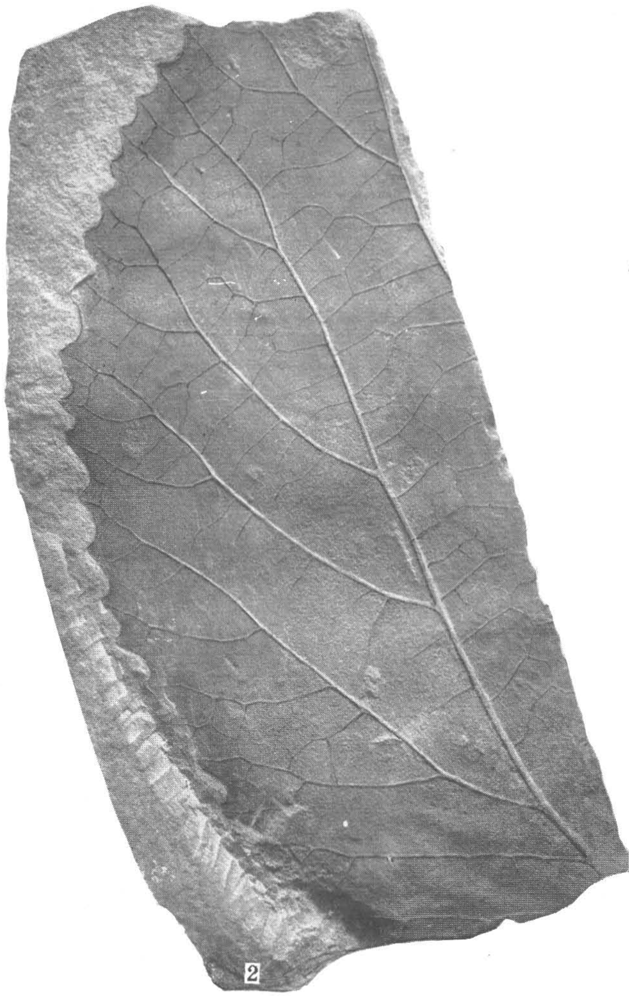


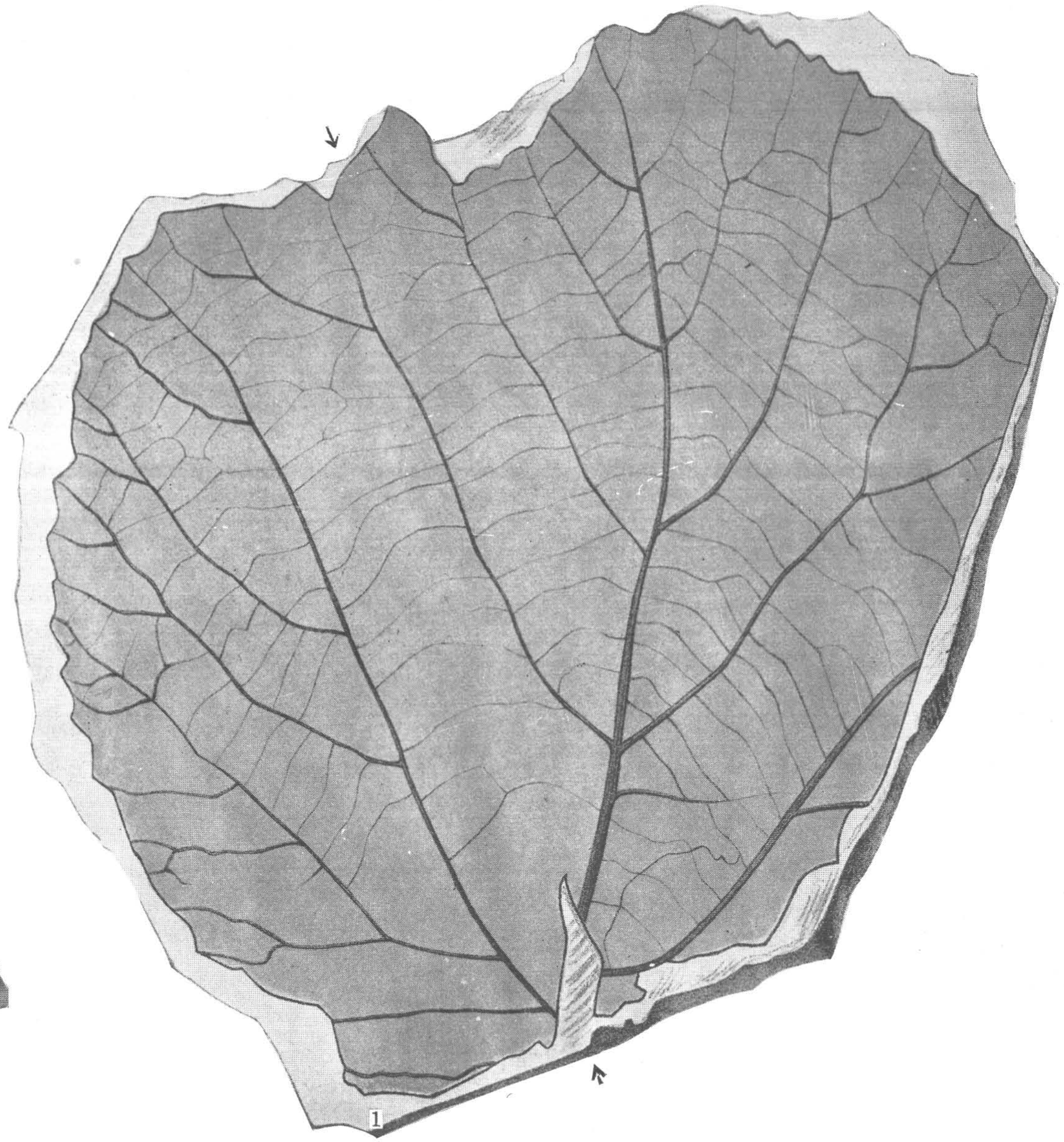




UPPER CRETACEOUS FLORAS OF ALASKA

1. *Credneria mixta* Hollick, n. sp. (U.S.N.M. 37580; p. 88).
2, 3. *Credneria inordinata* Hollick, n. sp. (U.S.N.M. 37581; p. 86).
4. *Credneria comparabilis* Hollick, n. sp. (U.S.N.M. 37582; p. 89).



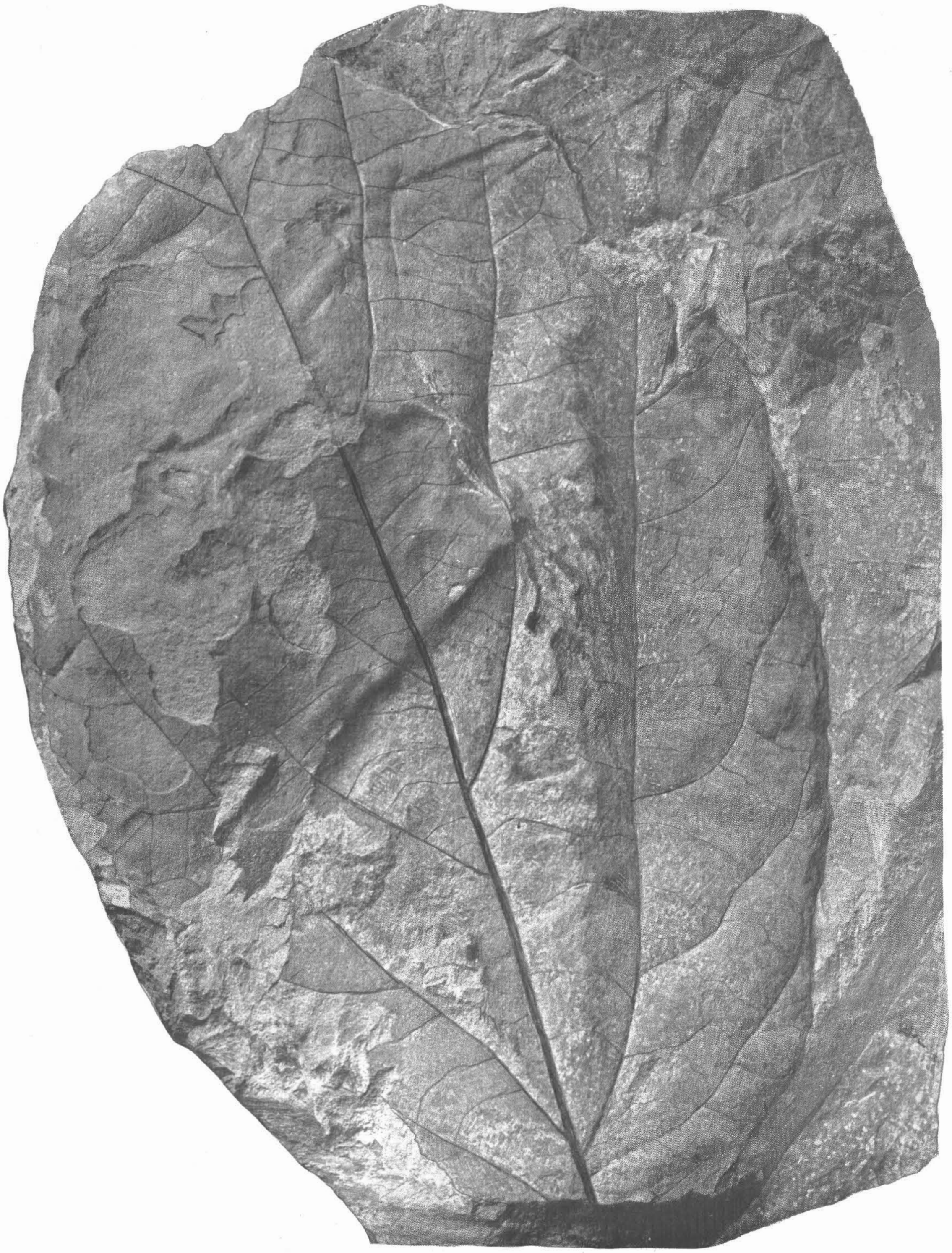


UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Credneria inordinata maxima* Hollick, n. var. (p. 86), = *Pterospermites dentatus* Heer, fide Newberry, U. S. Geol. Survey Mon. 35, pl. 53, fig. 1, 1898. 1, Photographic reproduction of Newberry's figure; 2, photograph of left side of specimen from which the drawing for Newberry's figure was made (U.S.N.M. 7122)

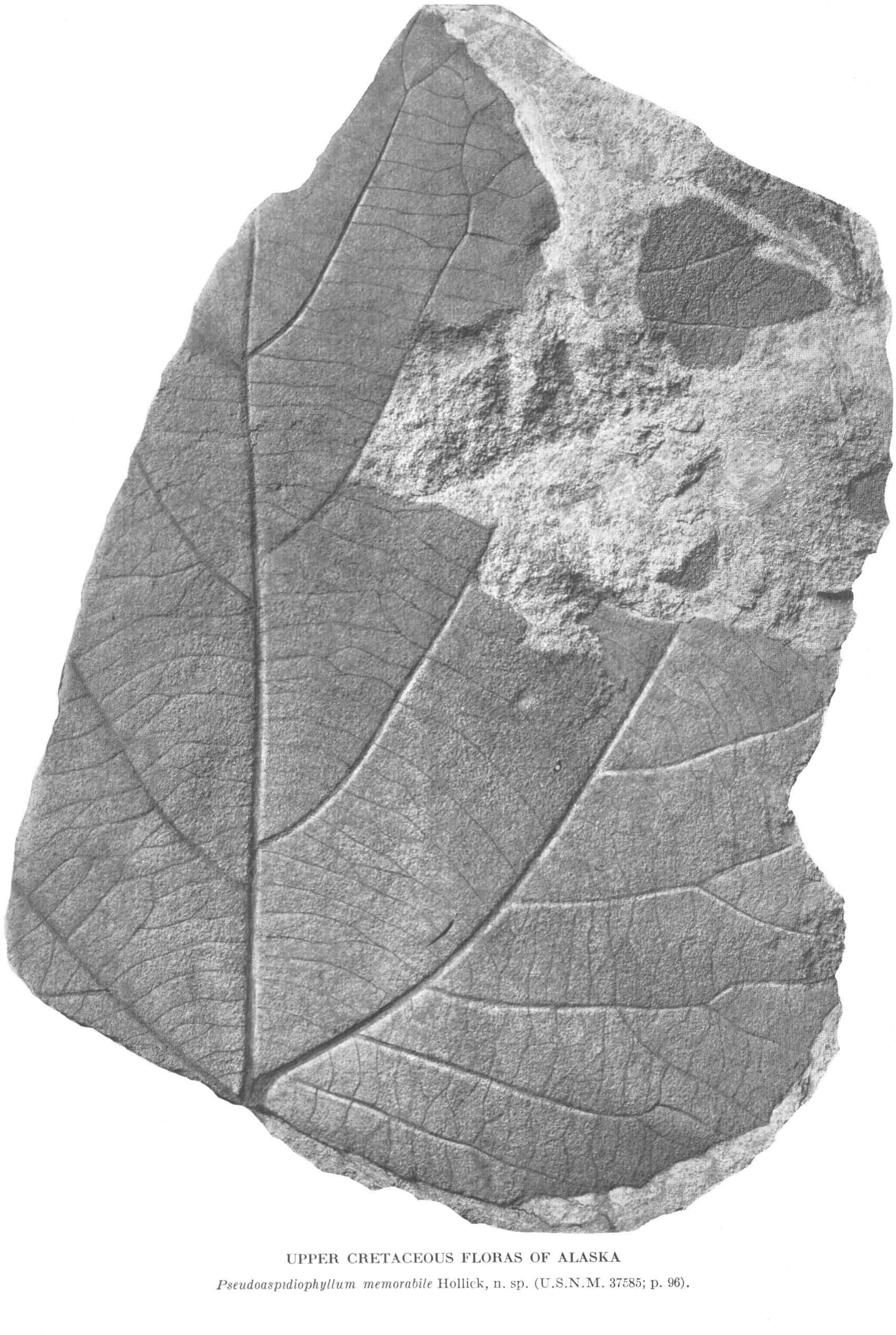
UPPER CRETACEOUS FLORAS OF ALASKA

Credneria spatiosa Hollick, n. sp. (U.S.N.M. 37583; p. 87).



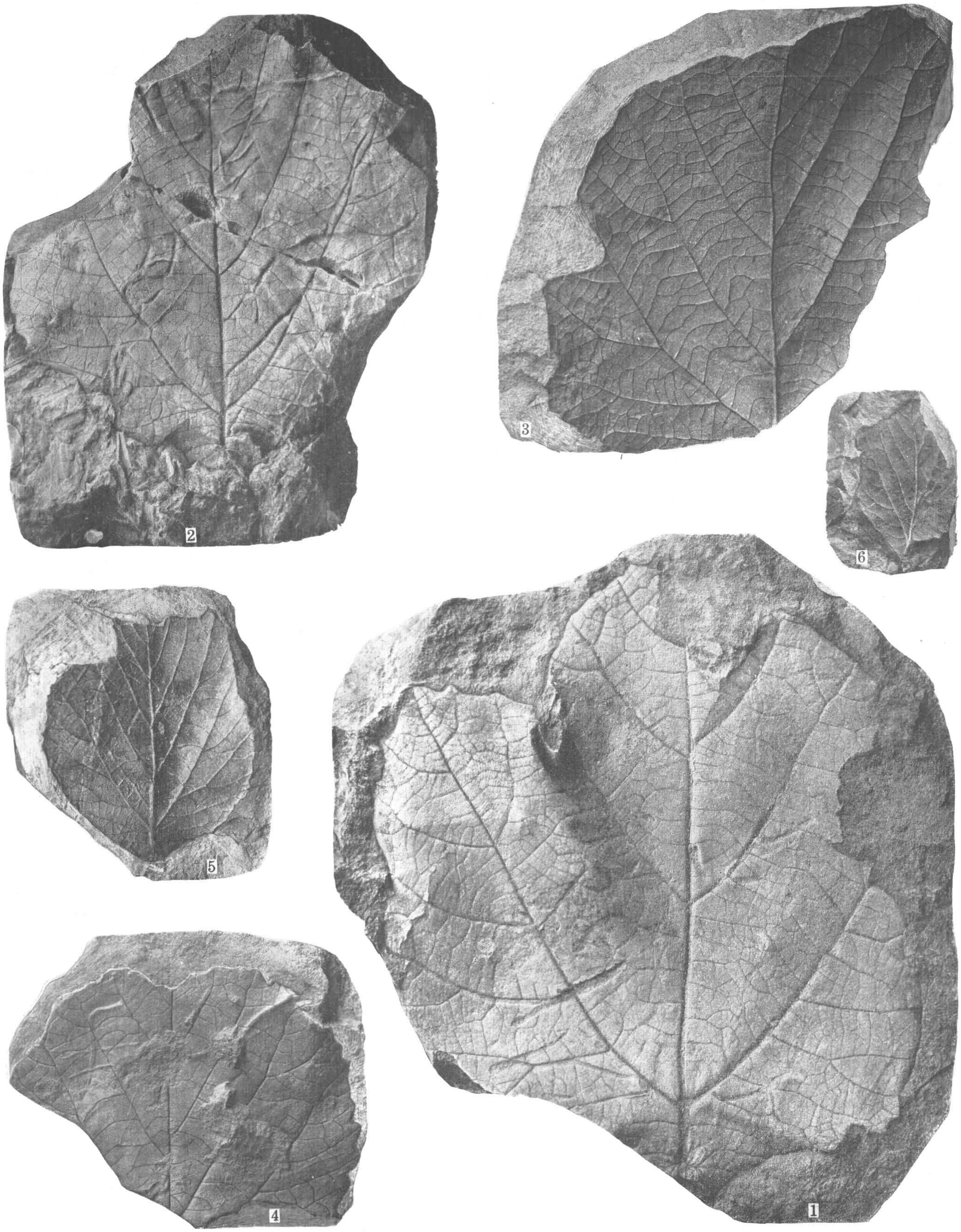
UPPER CRETACEOUS FLORAS OF ALASKA

Credneria longifolia Hollick, n. sp. (U.S.N.M. 37584; p. 87).



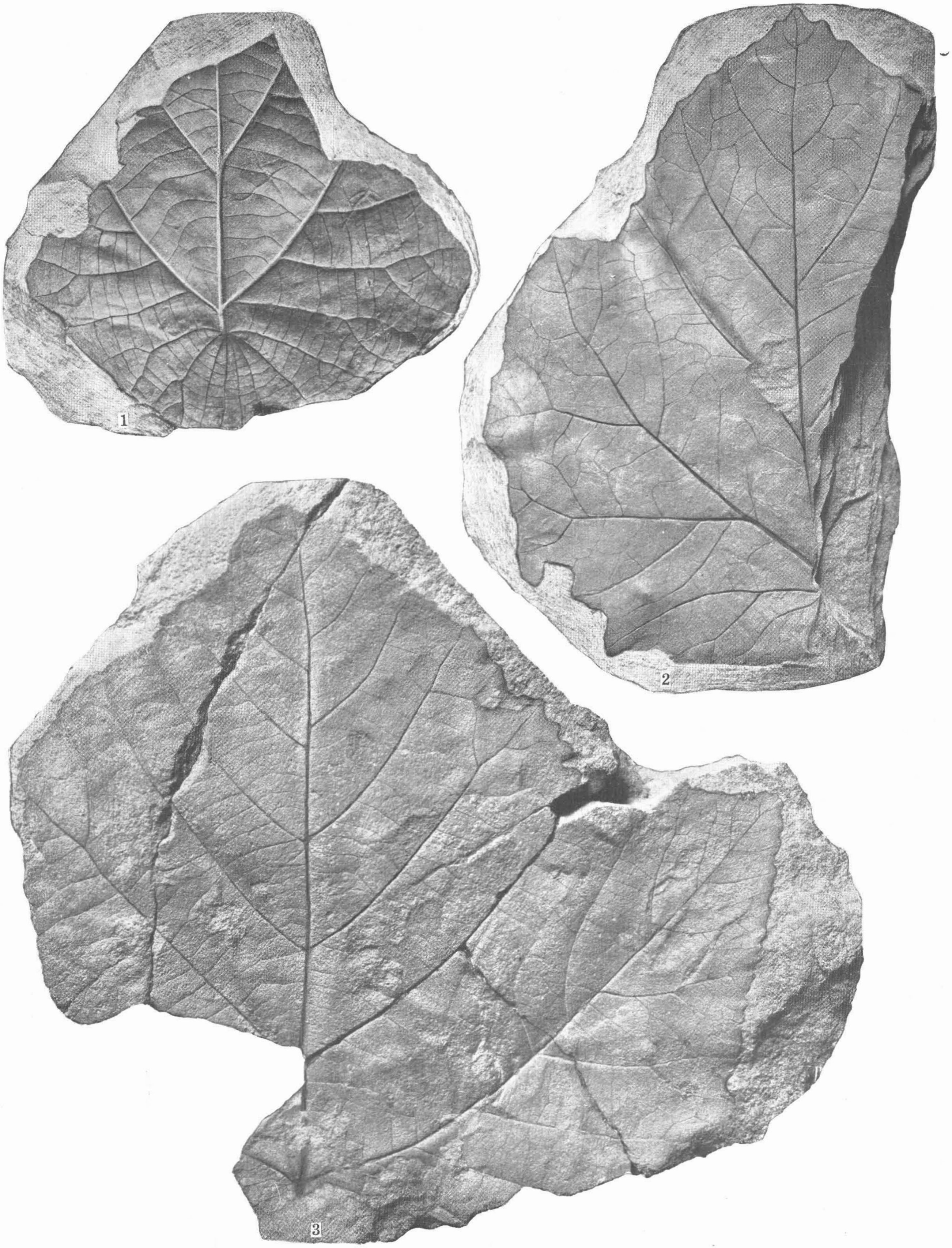
UPPER CRETACEOUS FLORAS OF ALASKA

Pseudoaspidiophyllum memorabile Hollick, n. sp. (U.S.N.M. 37585; p. 96).



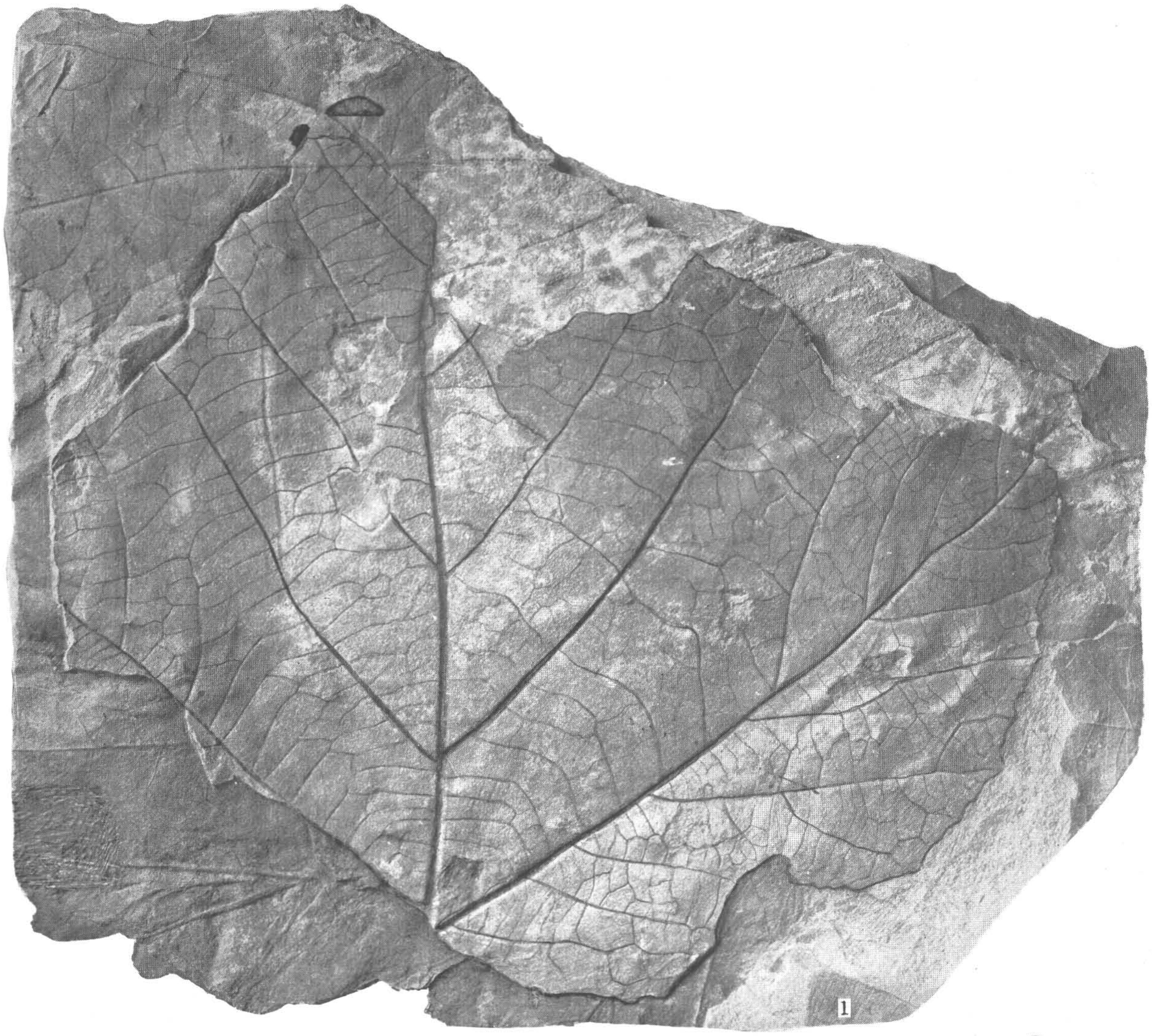
UPPER CRETACEOUS FLORAS OF ALASKA

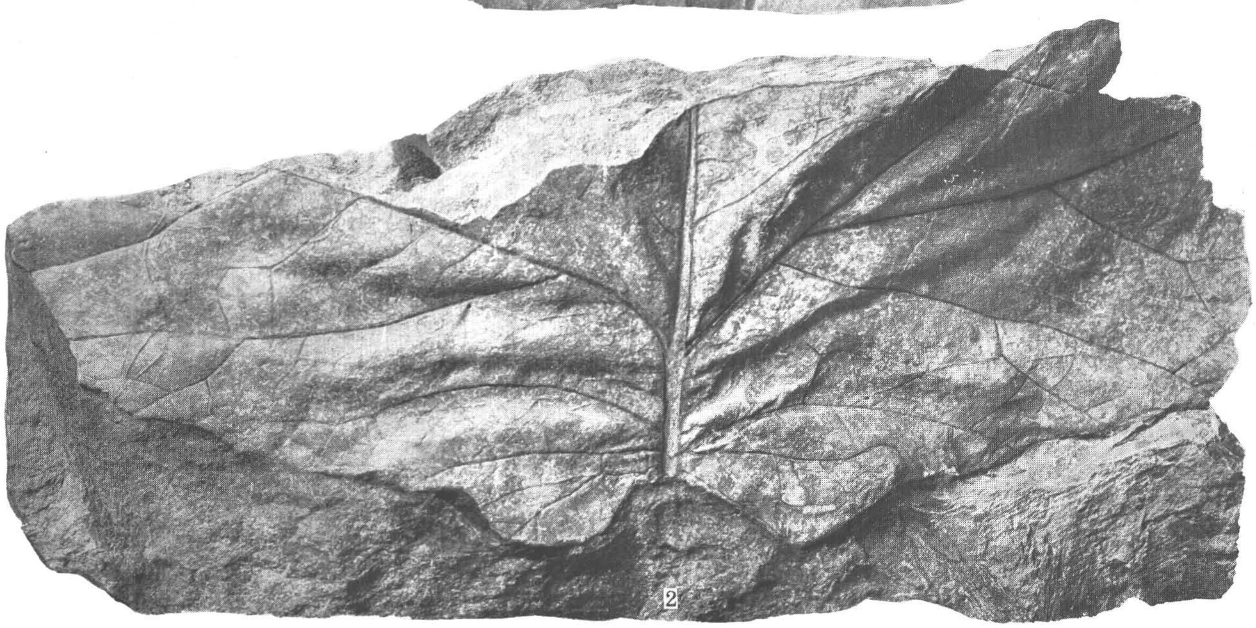
1, 2. *Pseudoaspidiophyllum platanoides* Hollick, n. sp. (U.S.N.M. 37586; p. 96).
3, 4. *Pseudoprotophyllum venustum* Hollick, n. sp. (U.S.N.M. 37587; p. 92).
5, 6. *Pseudoprotophyllum viburnifolium* Hollick, n. sp. (U.S.N.M. 37588, 37589; p. 92).



UPPER CRETACEOUS FLORAS OF ALASKA

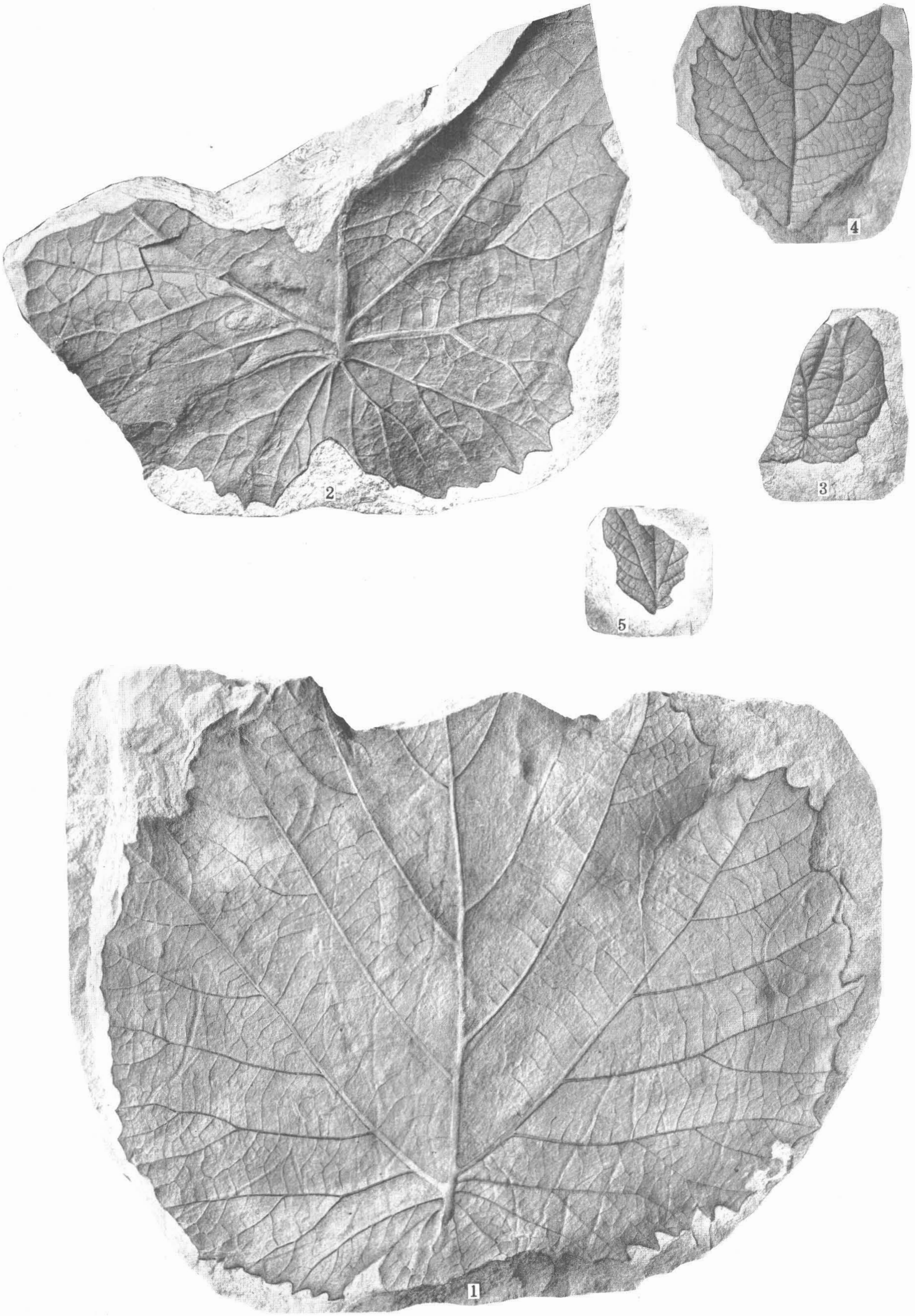
1. *Pseudoprotophyllum comparabile* Hollick, n. sp. (U.S.N.M. 37590; p. 94).
2. *Pseudoaspidiophyllum singulare* Hollick, n. sp. (U.S.N.M. 37591; p. 96).
3. *Pseudoaspidiophyllum latifolium* Hollick, n. sp. (U.S.N.M. 37592; p. 96).





UPPER CRETACEOUS FLORAS OF ALASKA

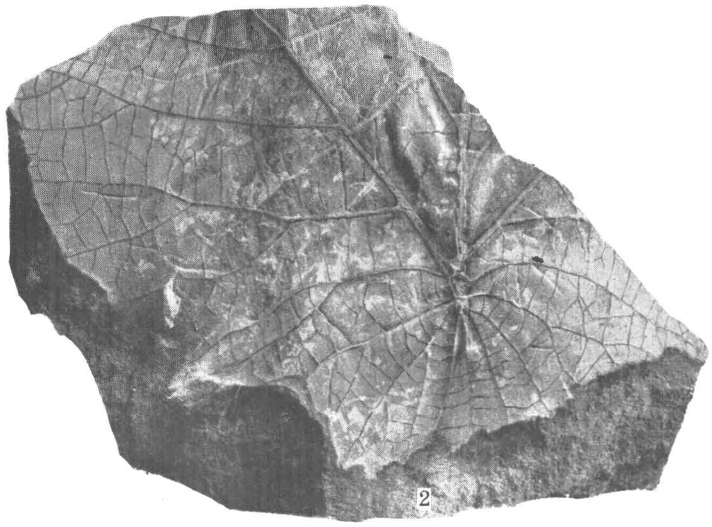
1, 2. *Pseudoaspidiophyllum latifolium* Hollick, n. sp. (U.S.N.M. 37593; p. 96)

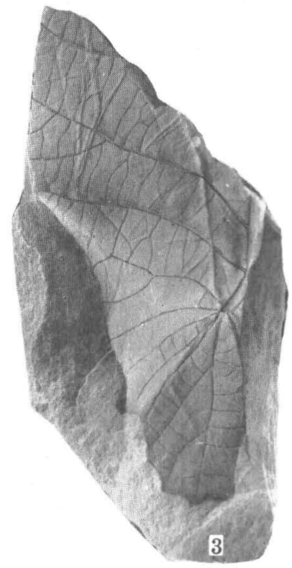


UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Pseudoprotophyllum dentatum* Hollick, n. sp. (U.S.N.M. 37594, 37595; p. 93).
3. *Pseudoprotophyllum emarginatum* Hollick, n. sp. (U.S.N.M. 37596; p. 92).
4. *Pseudoprotophyllum? basielongatum* Hollick, n. sp. (U.S.N.M. 37597; p. 95).
5. *Credneria? parva* Hollick, n. sp. (U.S.N.M. 37598; p. 89).

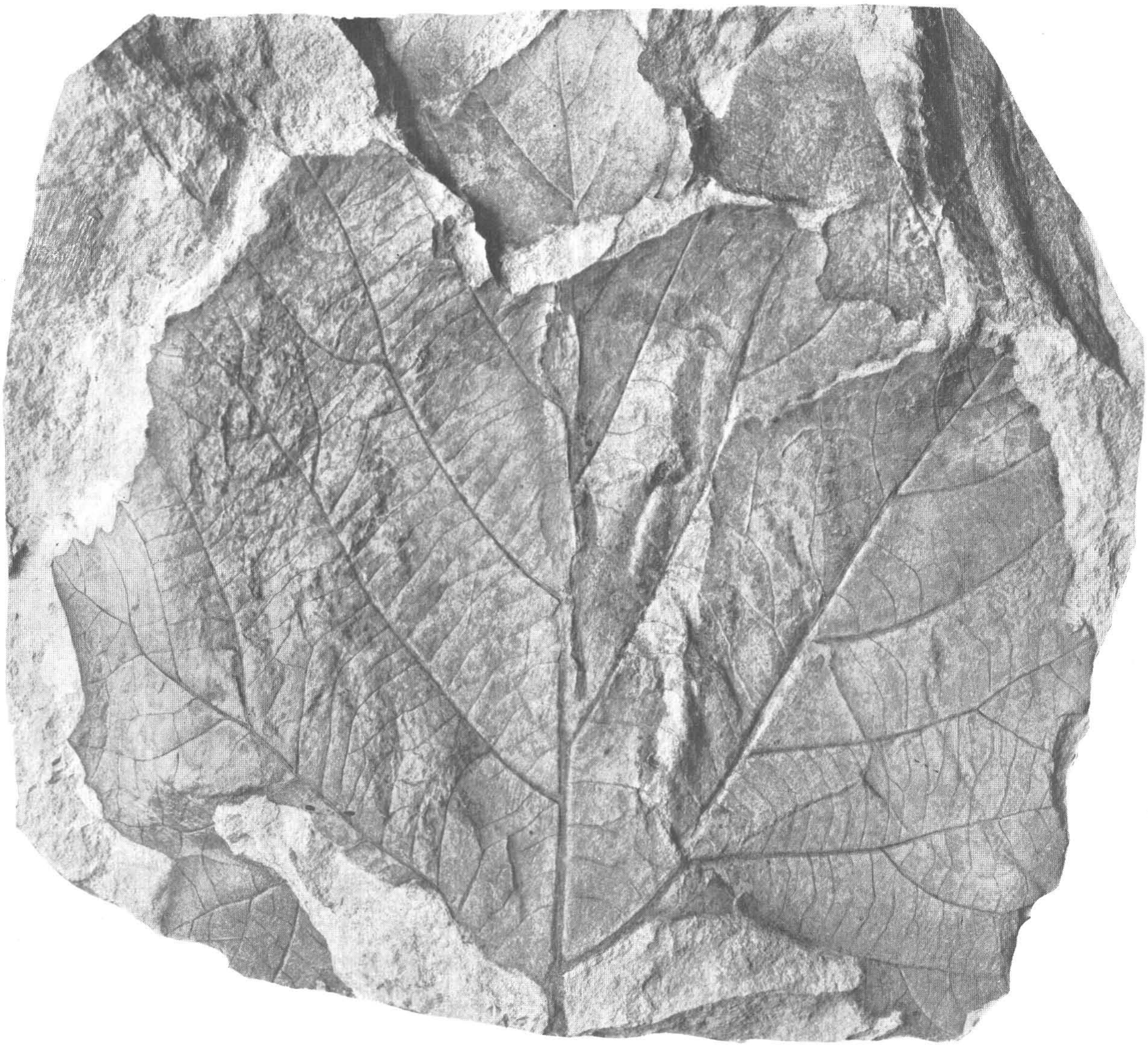
85918—30——13





UPPER CRETACEOUS FLORAS OF ALASKA

1. *Pseudoprotophyllum crenulatum* Hollick, n. sp. (U.S.N.M. 37599; p. 92).
2, 3. *Pseudoprotophyllum dentatum* Hollick, n. sp. (U.S.N.M. 37600; p. 93).

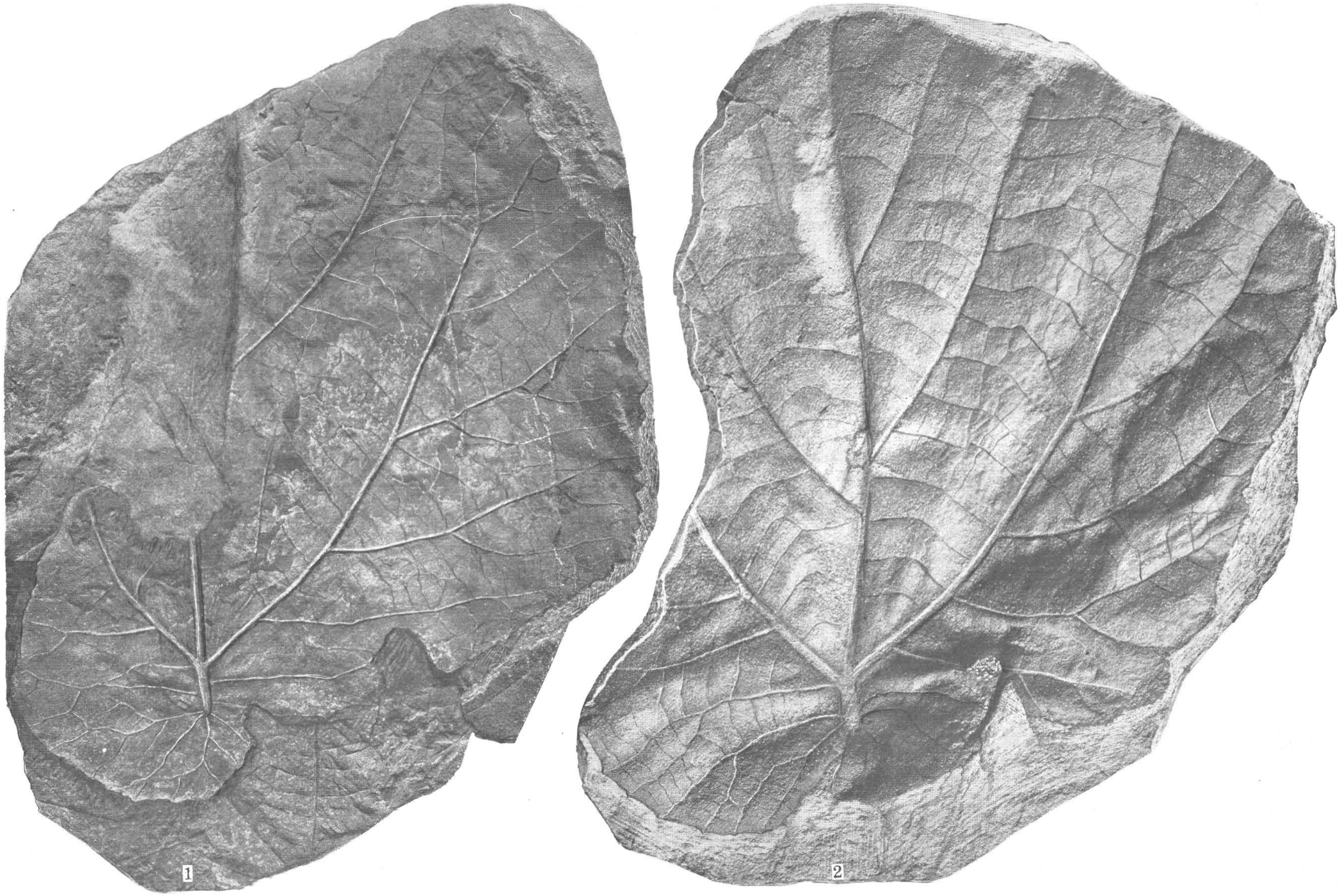


UPPER CRETACEOUS FLORAS OF ALASKA

Pseudoprotophyllum dentatum Hollick, n. sp. (U.S.N.M. 37601; p. 93).

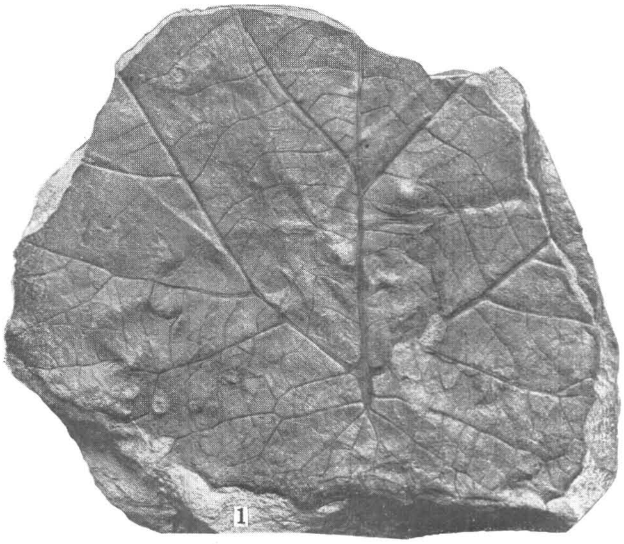
UPPER CRETACEOUS FLORAS OF ALASKA

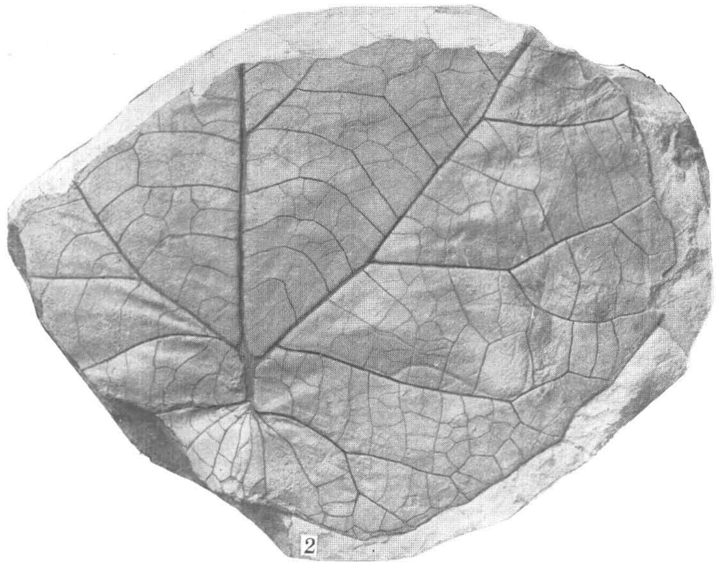
Pseudoprotophyllum crassum Hollick, n. sp. (U. S.N.M. 37602; p. 93).

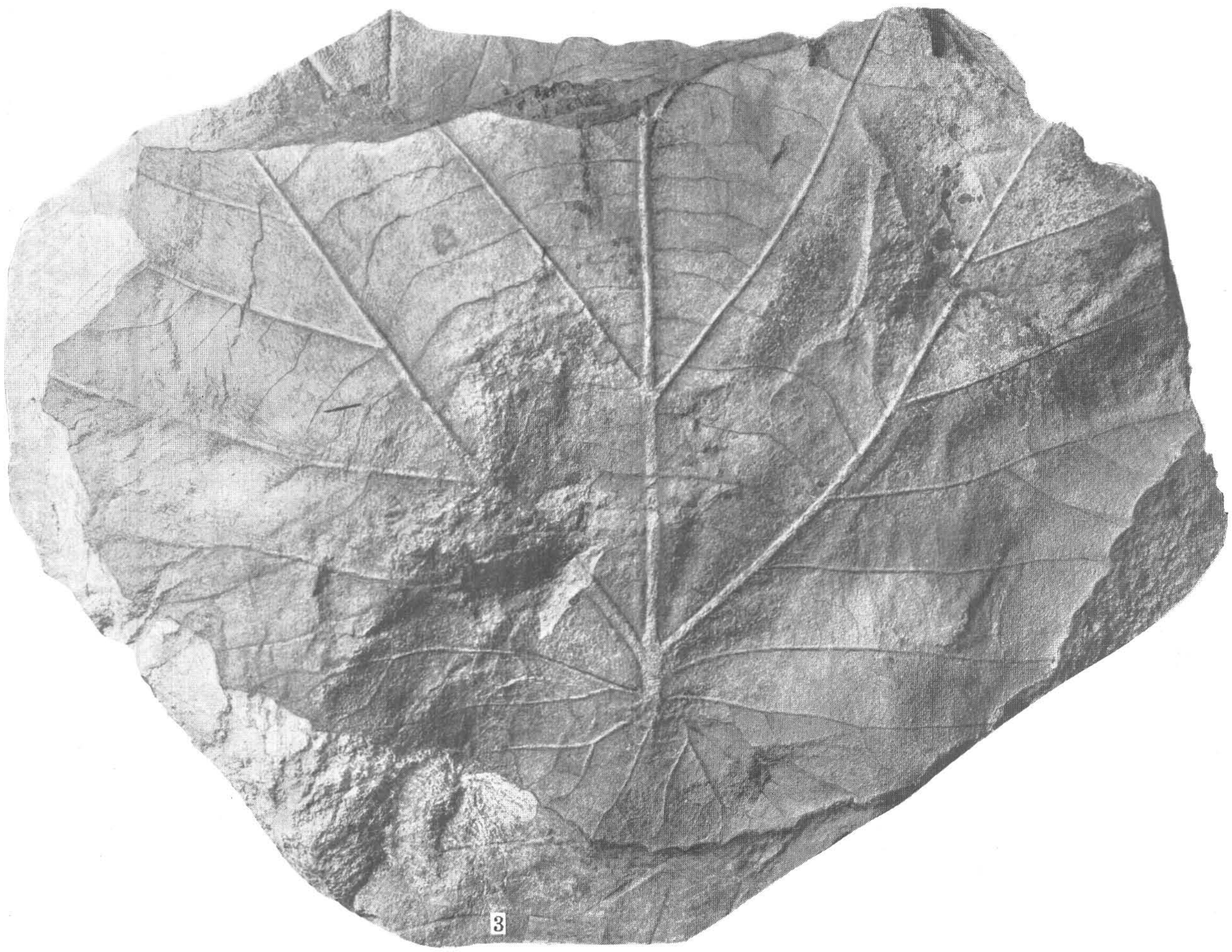


UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Pseudoprotophyllum magnum* Hollick, n. sp. (U.S.N.M. 37603, 37604. p. 95).

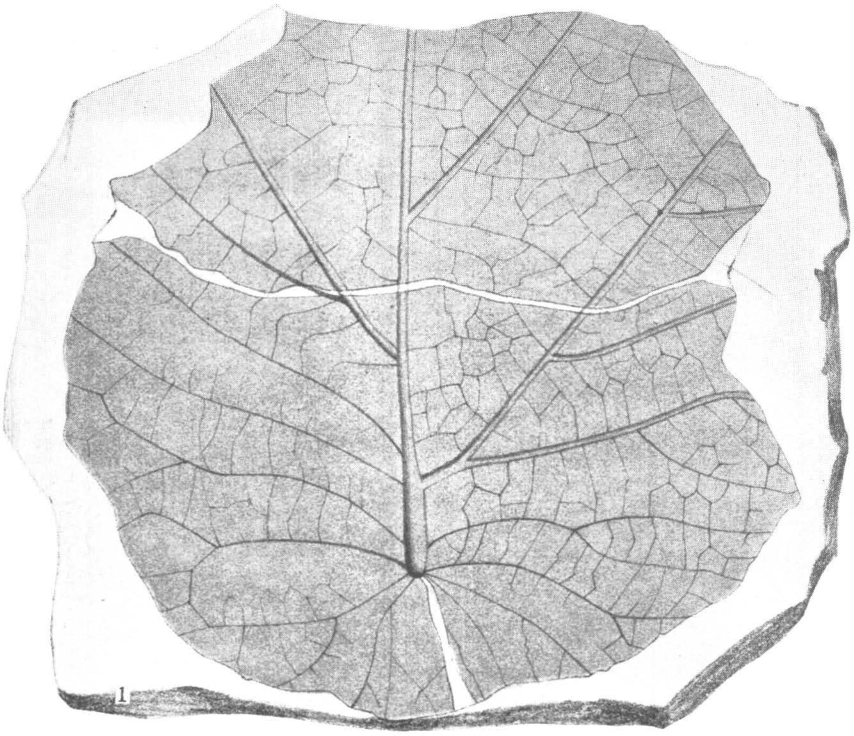


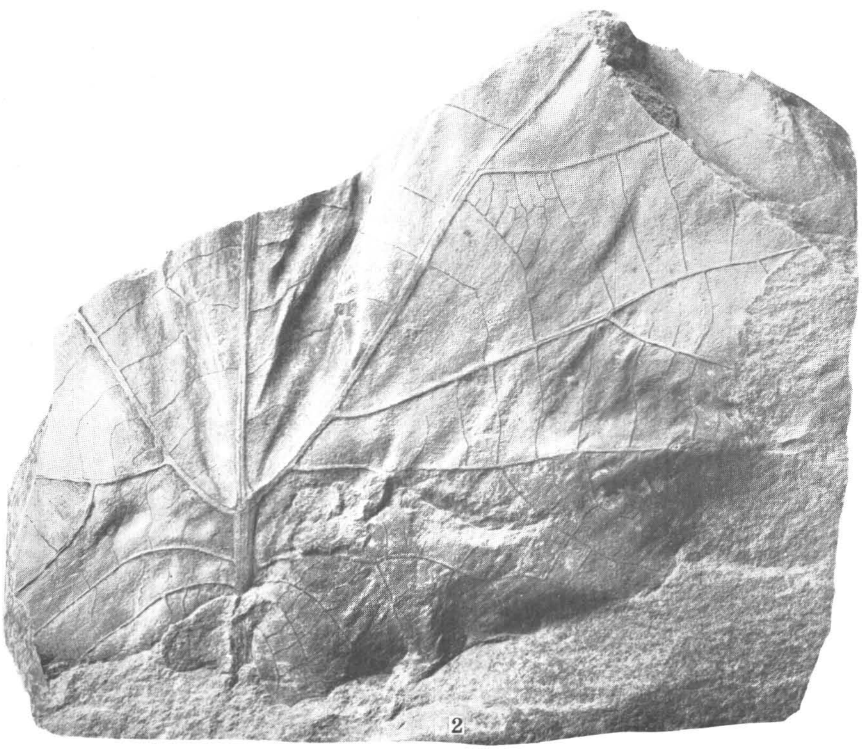




UPPER CRETACEOUS FLORAS OF ALASKA

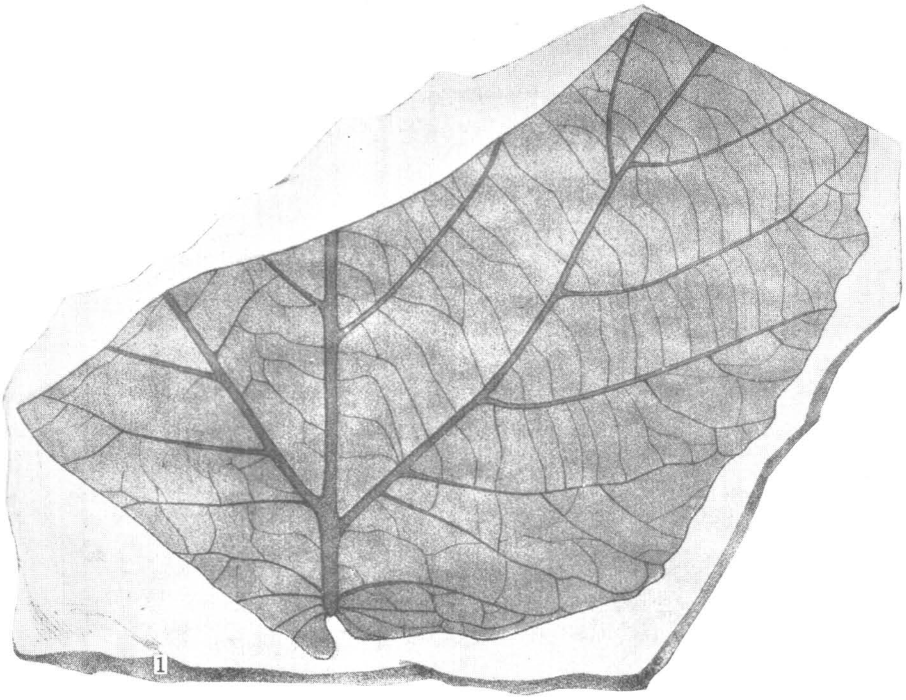
1, 2. *Pseudoprotophyllum comparabile* Hollick, n. sp. (U.S.N.M. 37605, 37606; p. 94).
3. *Pseudoprotophyllum magnum* Hollick, n. sp. (U.S.N.M. 37607; p. 95).

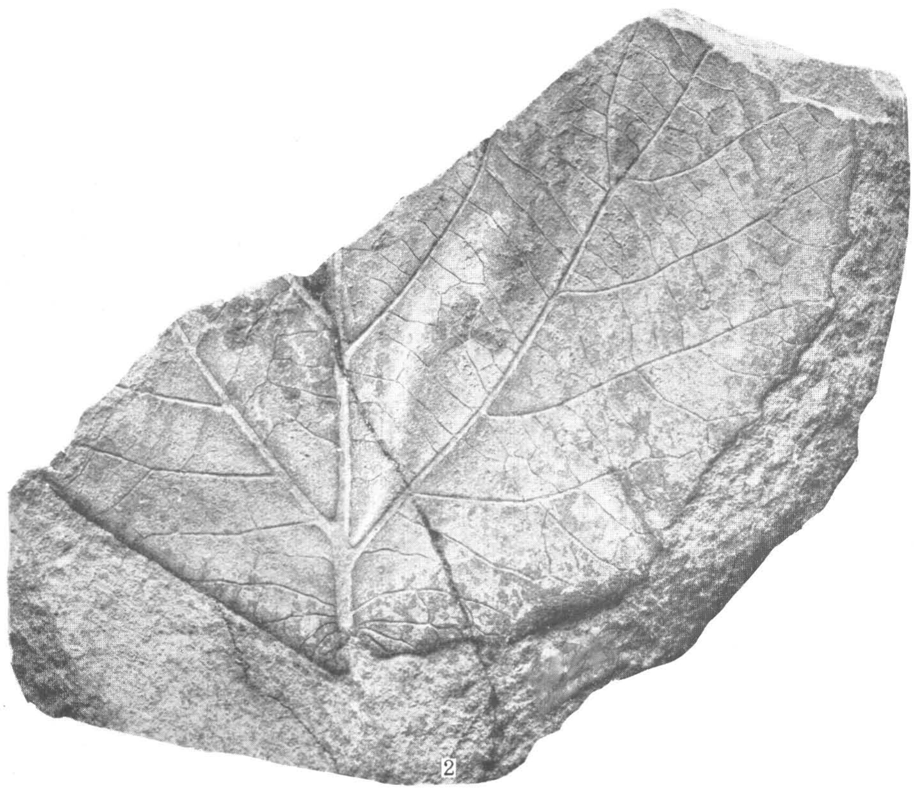




UPPER CRETACEOUS FLORAS OF ALASKA

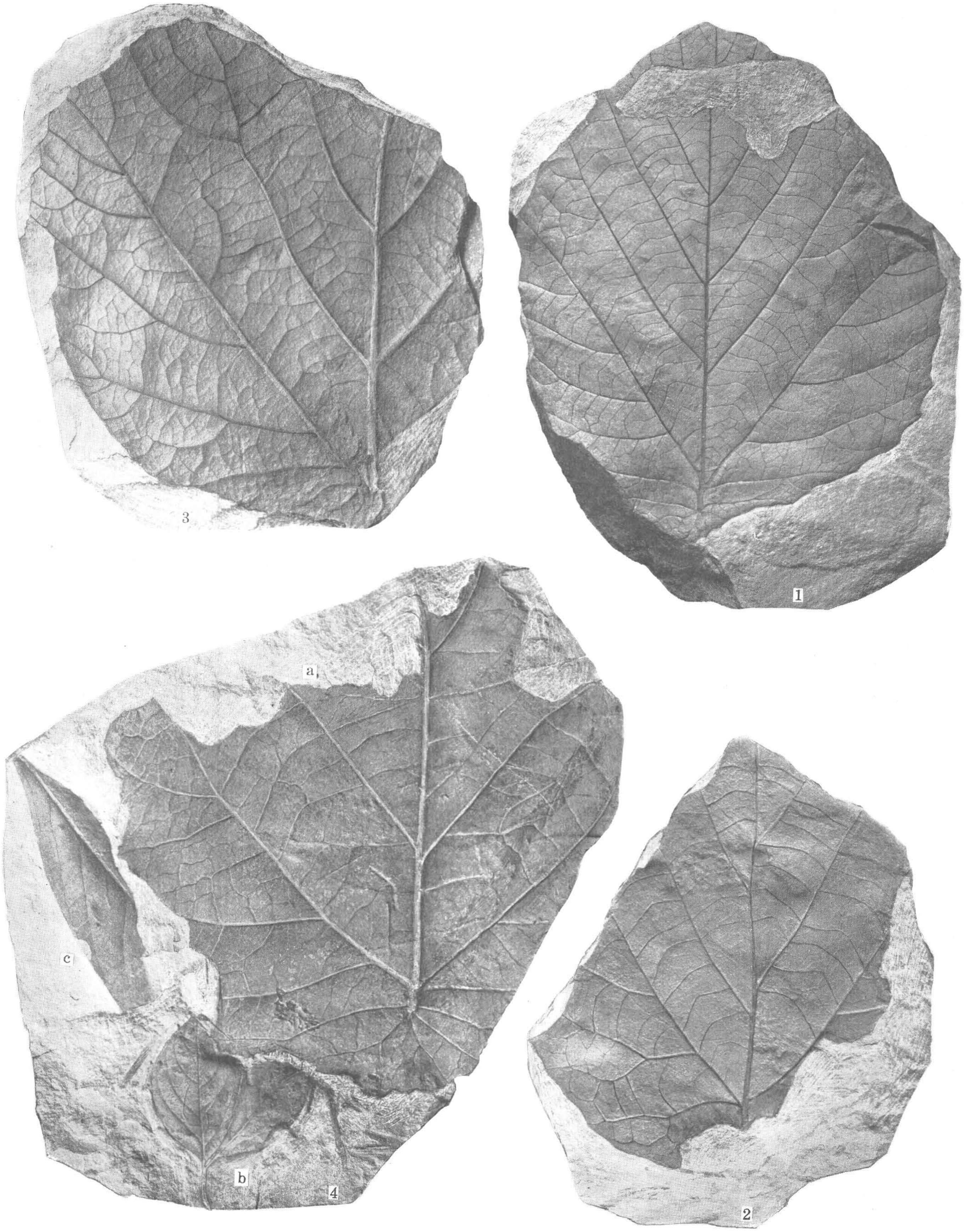
1. *Pseudoprotophyllum dalli* Hollick, n. sp. (p. 94), = *Pterospermites dentatus* Heer, fide Newberry, U. S. Geol. Survey Mon. 35, pl. 54, fig. 4, 1898. Photographic reproduction of Newberry's figure.
2. Photograph of a specimen of *Pseudoprotophyllum comparabile* Hollick, introduced for comparison (U.S.N.M. 37608; p. 94).





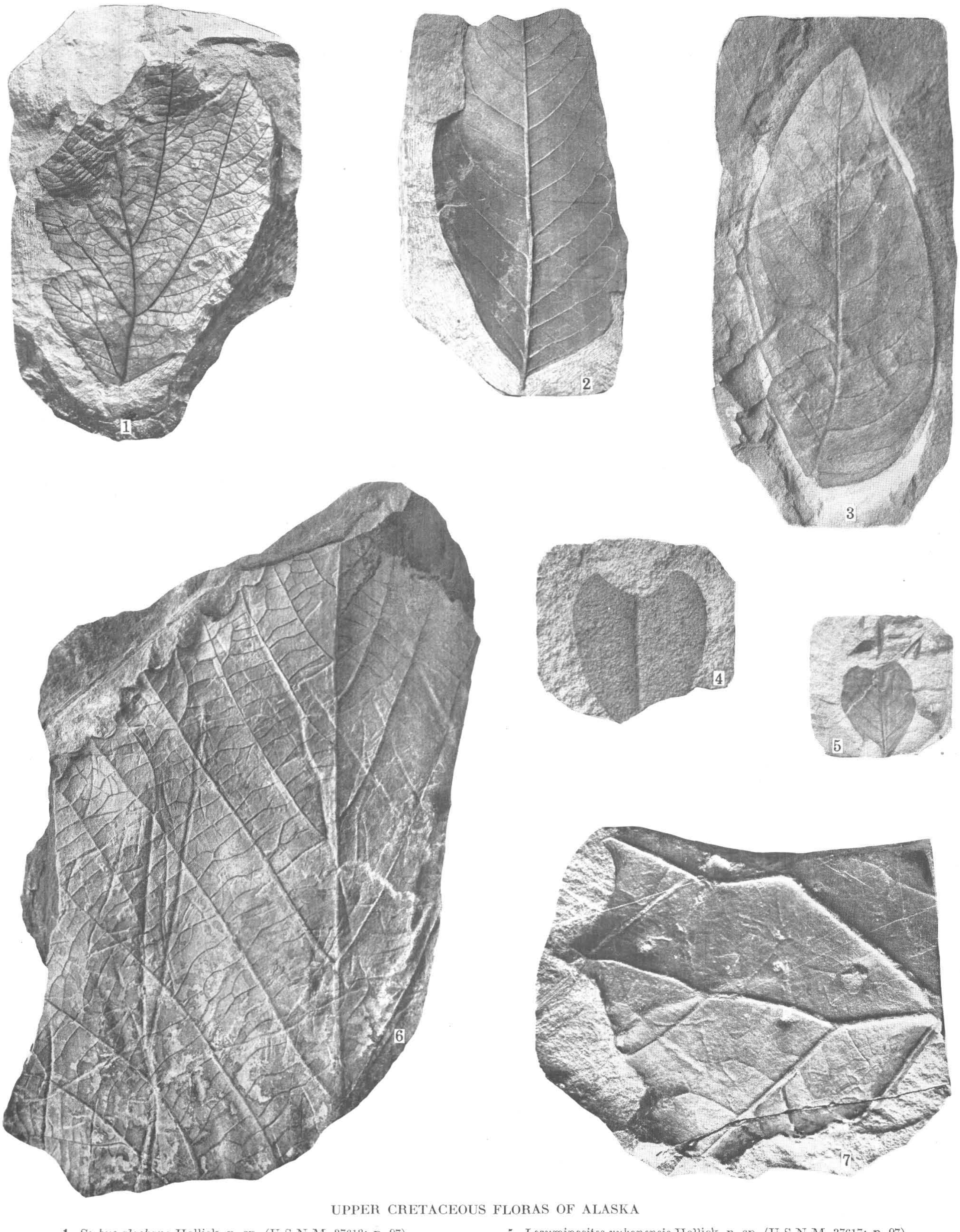
UPPER CRETACEOUS FLORAS OF ALASKA

1, 2. *Pseudoprotophyllum magnum* Hollick, n. sp. (p. 95), =*Pterospermites dentatus* Heer, fide Newberry, U. S. Geol. Survey Mon. 35, pl. 53, fig. 2, 1898. 1, Photographic reproduction of Newberry's figure; 2, photograph of specimen from which the drawing for Newberry's figure was made (U.S.N.M 7123).



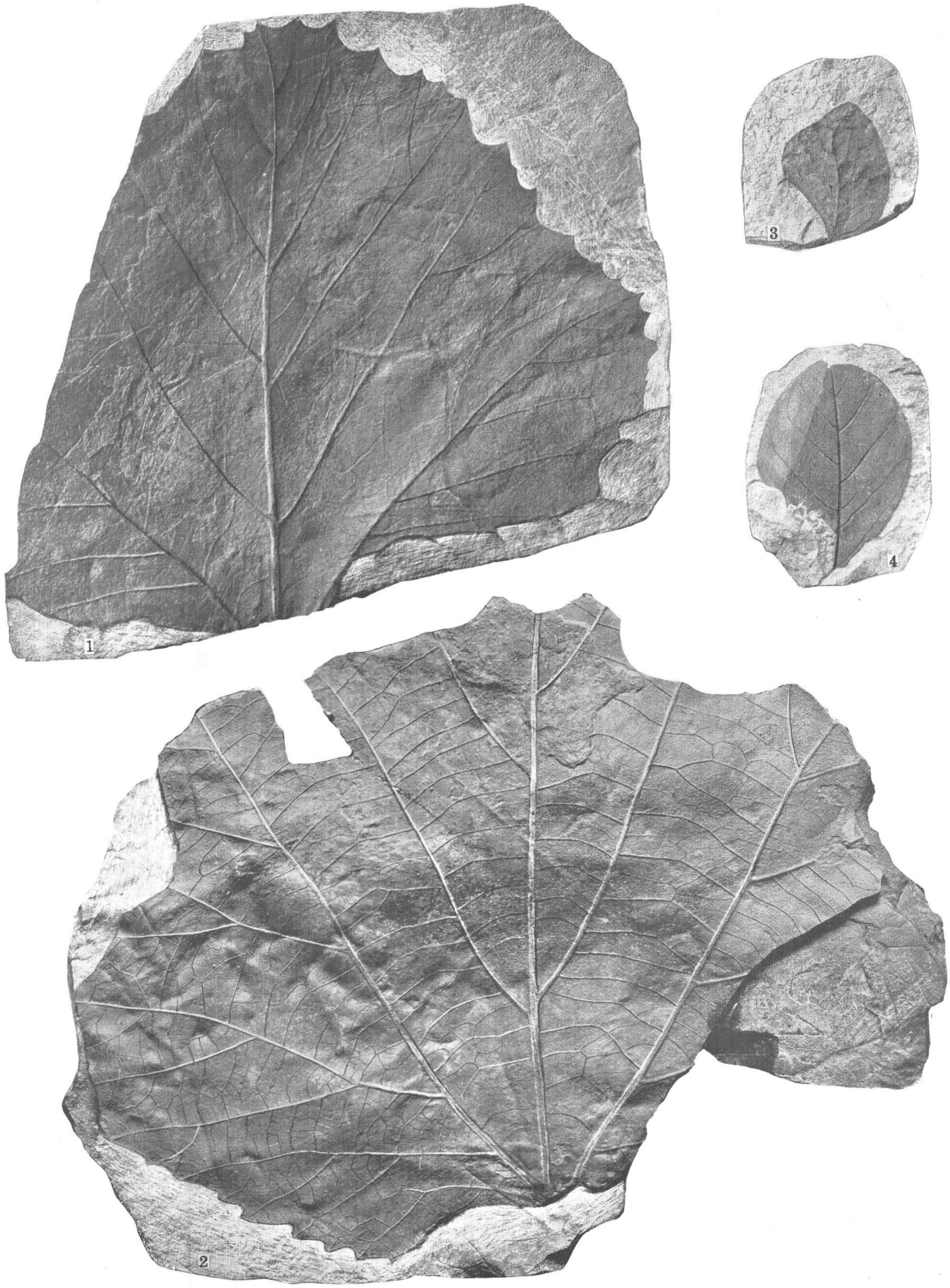
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Pseudoprotophyllum venustum* Hollick, n. sp. (U.S.N.M. 37587; p. 92).
2. *Pseudoprotophyllum comparabile* Hollick, n. sp. (U.S.N.M. 37609; p. 94).
3. *Pseudoprotophyllum dentatum* Hollick, n. sp. (U.S.N.M. 37594; p. 93).
4a. *Pseudoprotophyllum magnum* Hollick, n. sp. (U.S.N.M. 37610; p. 95).
4b. *Leguminosites yukonensis* Hollick, n. sp. (U.S.N.M. 37611; p. 97).
4c. *Laurus antecedens* Lesquereux (U.S.N.M. 37612; p. 81).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Sorbus alaskana* Hollick, n. sp. (U.S.N.M. 37613; p. 97).
2, 3. *Cassia alaskana* Hollick, n. sp. (U.S.N.M. 37614, 37615; p. 98).
4. *Colutea primordialis* Heer (U.S.N.M. 37616; p. 97).
5. *Leguminosites yukonensis* Hollick, n. sp. (U.S.N.M. 37617; p. 97).
6. *Protophyllum?* sp. (U.S.N.M. 37618; p. 91).
7. *Phyllites crassus* Hollick, n. sp. (U.S.N.M. 37619; p. 115).

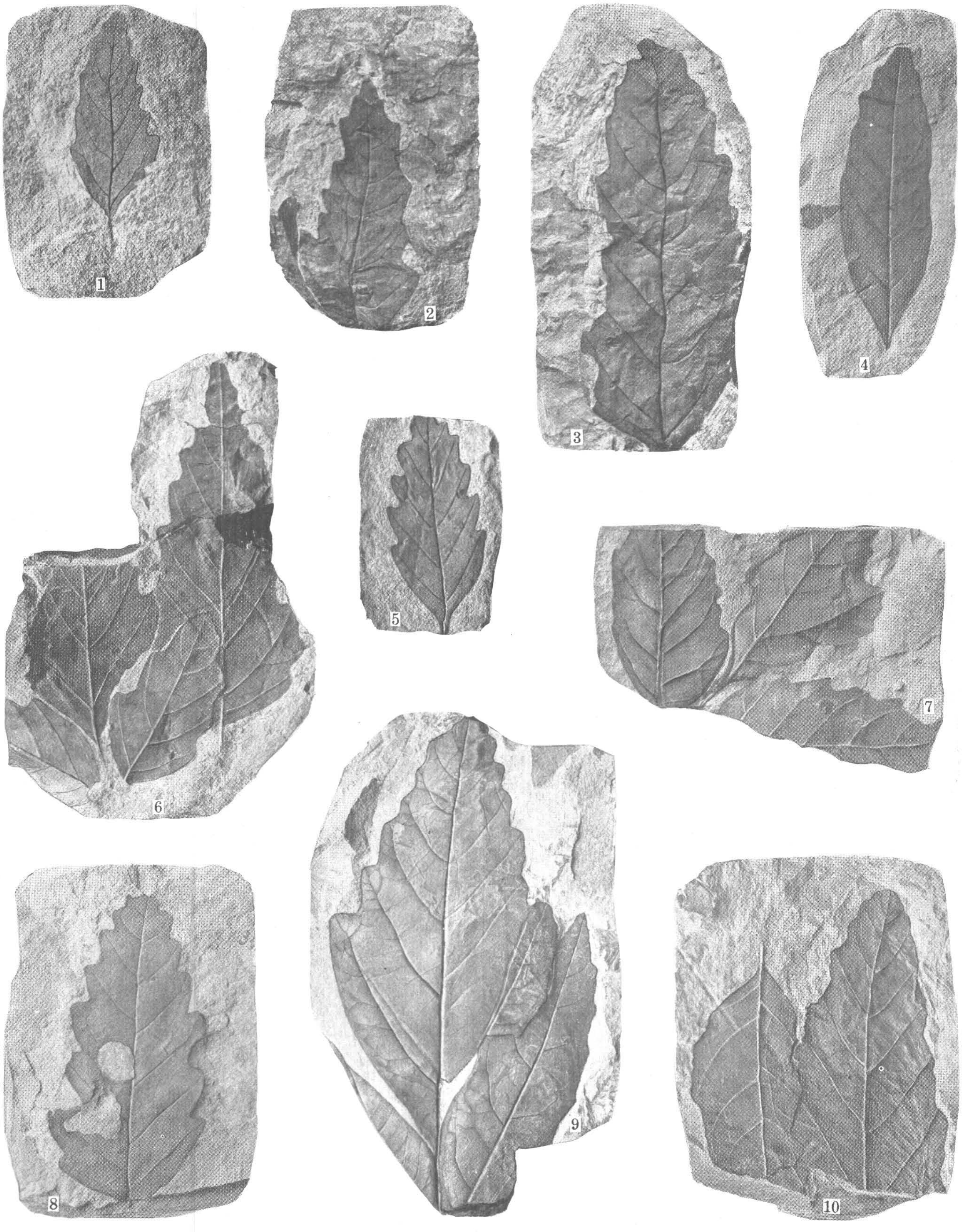


UPPER CRETACEOUS FLORAS OF ALASKA

1. *Platanus latior intermedia* Hollick, n. var. (U.S.N.M. 37620; p. 84).
2. *Platanus valida* Hollick, n. sp. (U.S.N.M. 37621; p. 84).
3. *Guajacum informe* Hollick, n. sp. (U.S.N.M. 37622; p. 98).
4. *Cotinus cretacea* Hollick, n. sp. (U.S.N.M. 37623; p. 98).

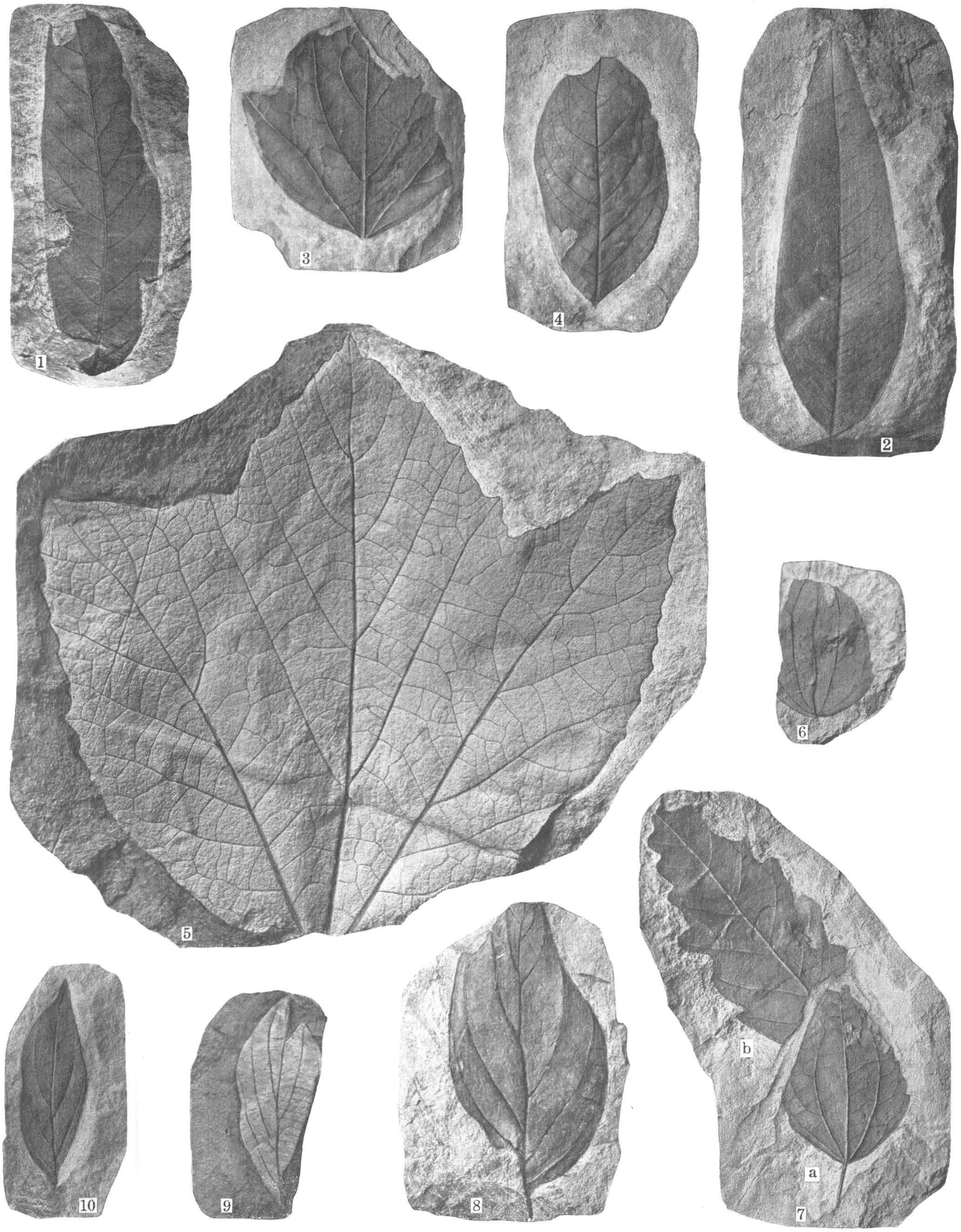
UPPER CRETACEOUS FLORAS OF ALASKA

1-4. *Celastrus herendeenensis* Hollick, n. sp. (U.S.N.M. 37624; p. 99).
5. *Celastrus pseudocurvinervis* Hollick, n. sp. (U.S.N.M. 37625; p. 99).



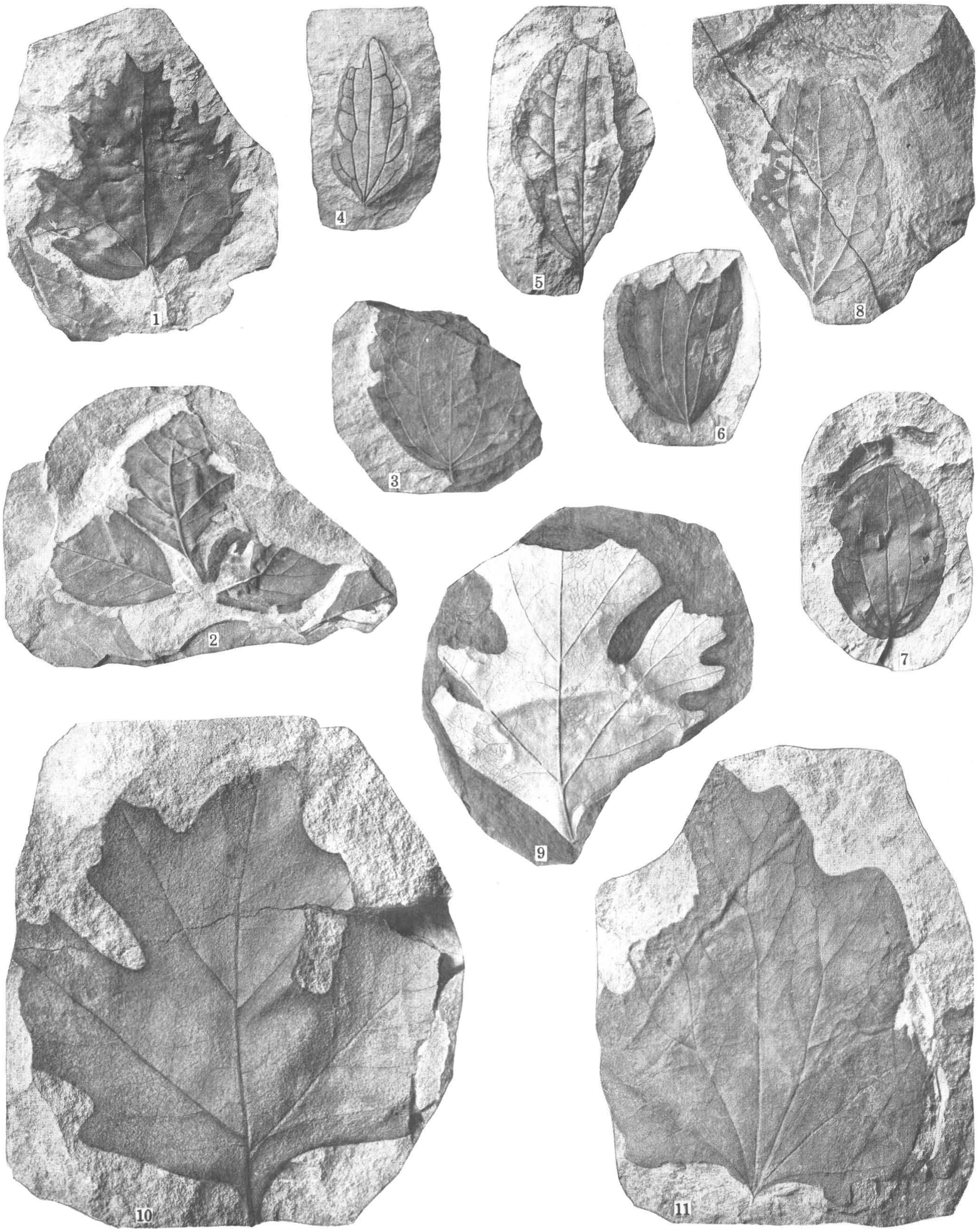
UPPER CRETACEOUS FLORAS OF ALASKA

1-10. *Rulac quercifolium* Hollick, n. sp. (U.S.N.M. 37626 (1), 37627 (2, 3), 37628 (4-10); p. 100).



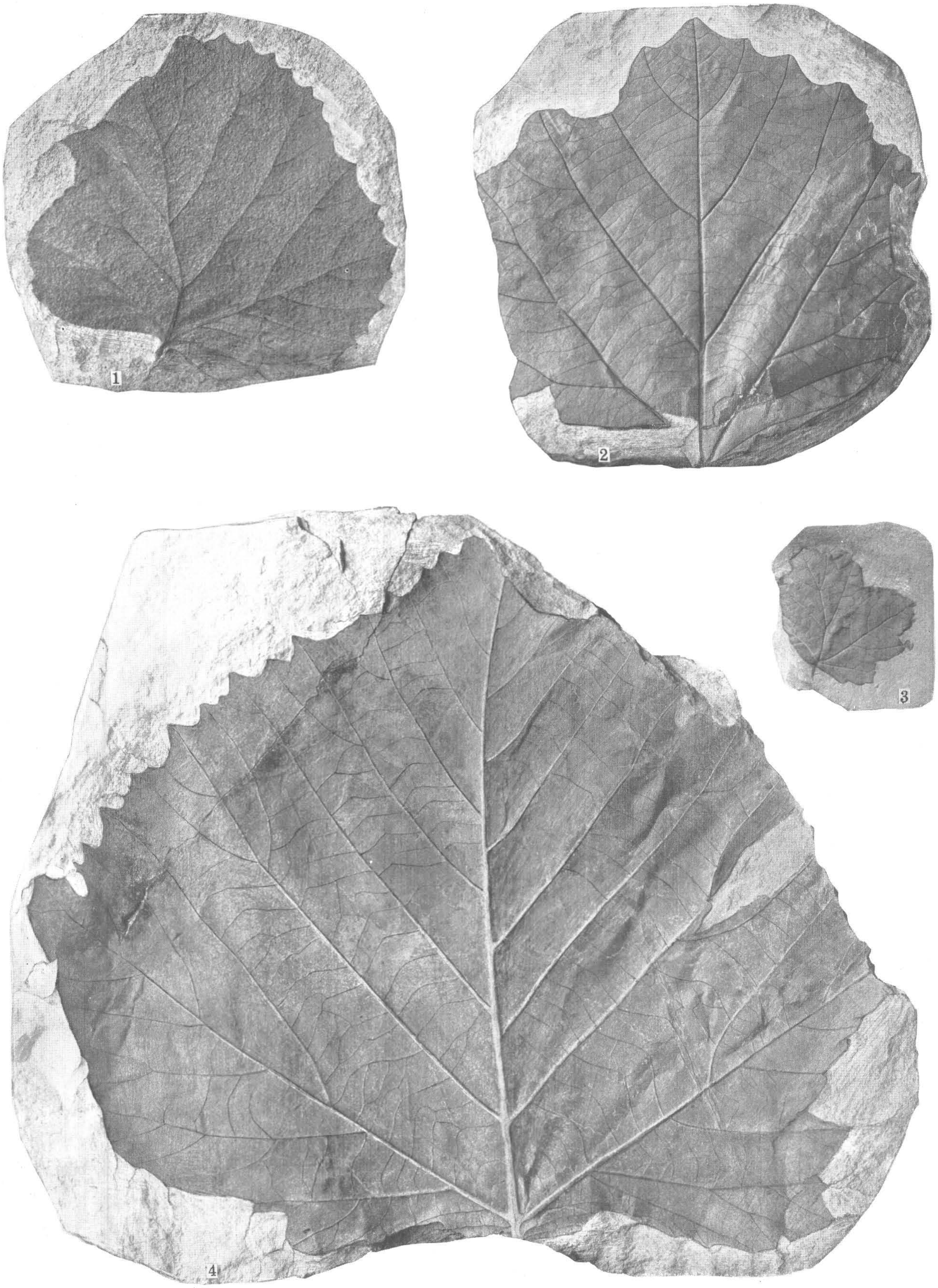
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Sapindus morrisoni* Lesquereux MS., Heer (U.S.N.M. 37629; p. 100).
2. *Sapindus apiculatus* Velenovsky (U.S.N.M. 37630; p. 101).
3. *Acerites multiformis* Lesquereux (U.S.N.M. 37631; p. 100).
4. *Rhamnites cornifolius* Hollick, n. sp. (U.S.N.M. 37632; p. 102).
5. *Acer collieri* Hollick, n. sp. (U.S.N.M. 37633; p. 99).
6, 7a. *Zizyphus varietas* Hollick, n. sp. (U.S.N.M. 37634; p. 103).
7b. *Rulac quercifolium* Hollick, n. sp. (U.S.N.M. 37628; p. 100).
8-10. *Rhamnus herendeenensis* Hollick, n. sp. (U.S.N.M. 37635 (8), 37636 (9, 10); p. 102).



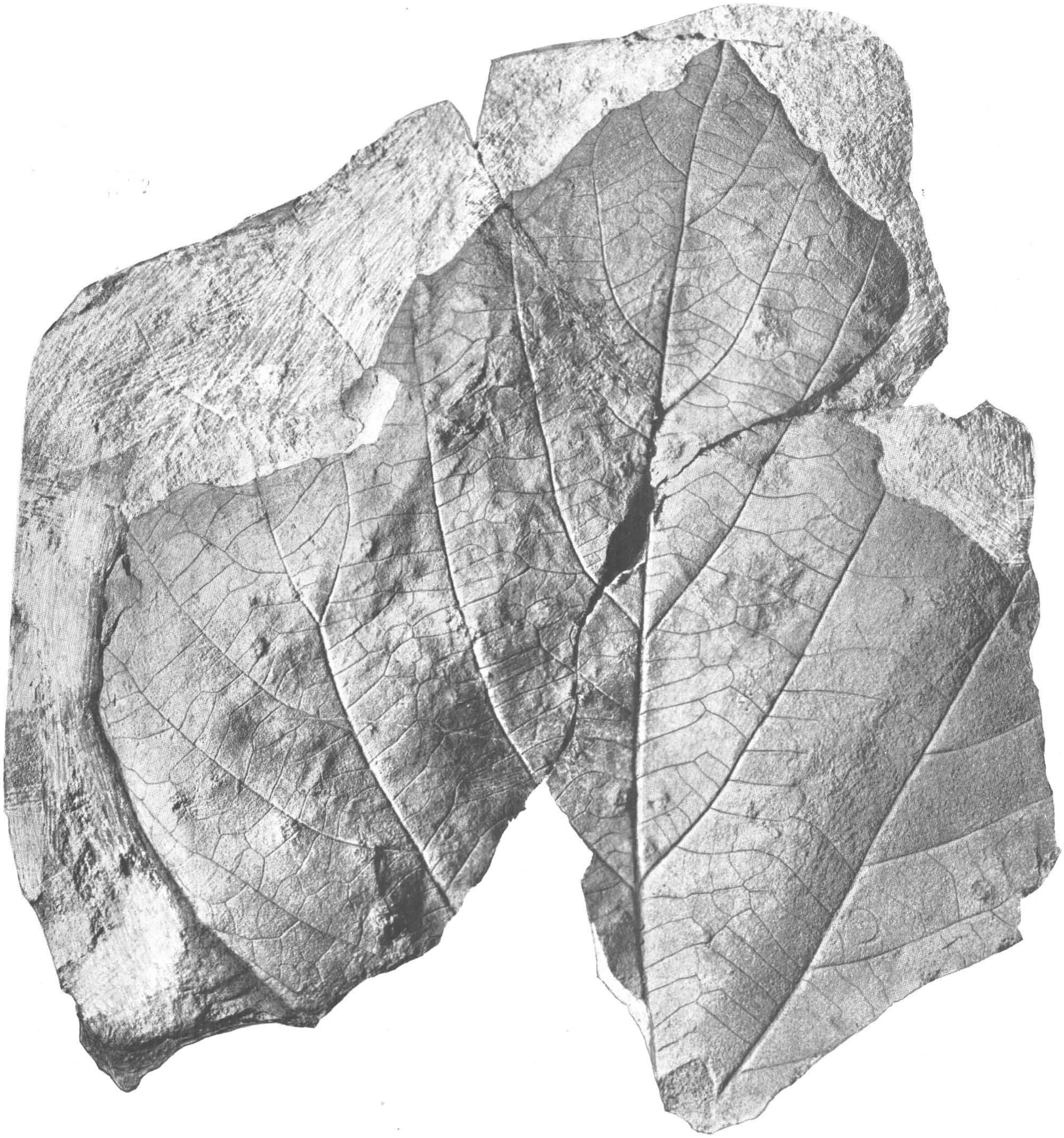
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Vitis populoides* Hollick, n. sp. (U.S.N.M. 37637; p. 104).
2. *Ampelopsis? multesima* Hollick, n. sp. (U.S.N.M. 37638; p. 106).
3. *Zizyphus pseudomeeki* Hollick, n. sp. (U.S.N.M. 37474; p. 103).
4. *Paliurus visibilis* Hollick, n. sp. (U.S.N.M. 37639; p. 102).
5, 6. *Paliurus pseudopinsonensis* Hollick, n. sp. (U.S.N.M. 37640; p. 102)
7. *Zizyphus electilis* Hollick, n. sp. (U.S.N.M. 37641; p. 103).
8. *Zizyphus abnormalis* Hollick, n. sp. (U.S.N.M. 37642; p. 103).
9, 10. *Cissites comparabilis* Hollick, n. sp. (U.S.N.M. 37643, 37644 p. 105).
11. *Cissites yukonensis* Hollick, n. sp. (U.S.N.M. 37645; p. 106).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Vitis inequilateralis* Hollick, n. sp. (U.S.N.M. 37646; p. 104).
2. *Cissites pseudoplatanus* Hollick, n. sp. (U.S.N.M. 37647; p. 105).
3. *Vitis paleotruncata* Hollick, n. sp. (U.S.N.M. 37648; p. 104).
4. *Vitis venusta* Hollick, n. sp. (U.S.N.M. 37649; p. 104).



UPPER CRETACEOUS FLORAS OF ALASKA

Grewiopsis yukonensis Hollick, n. sp. (U.S.N.M. 37650; p. 107).

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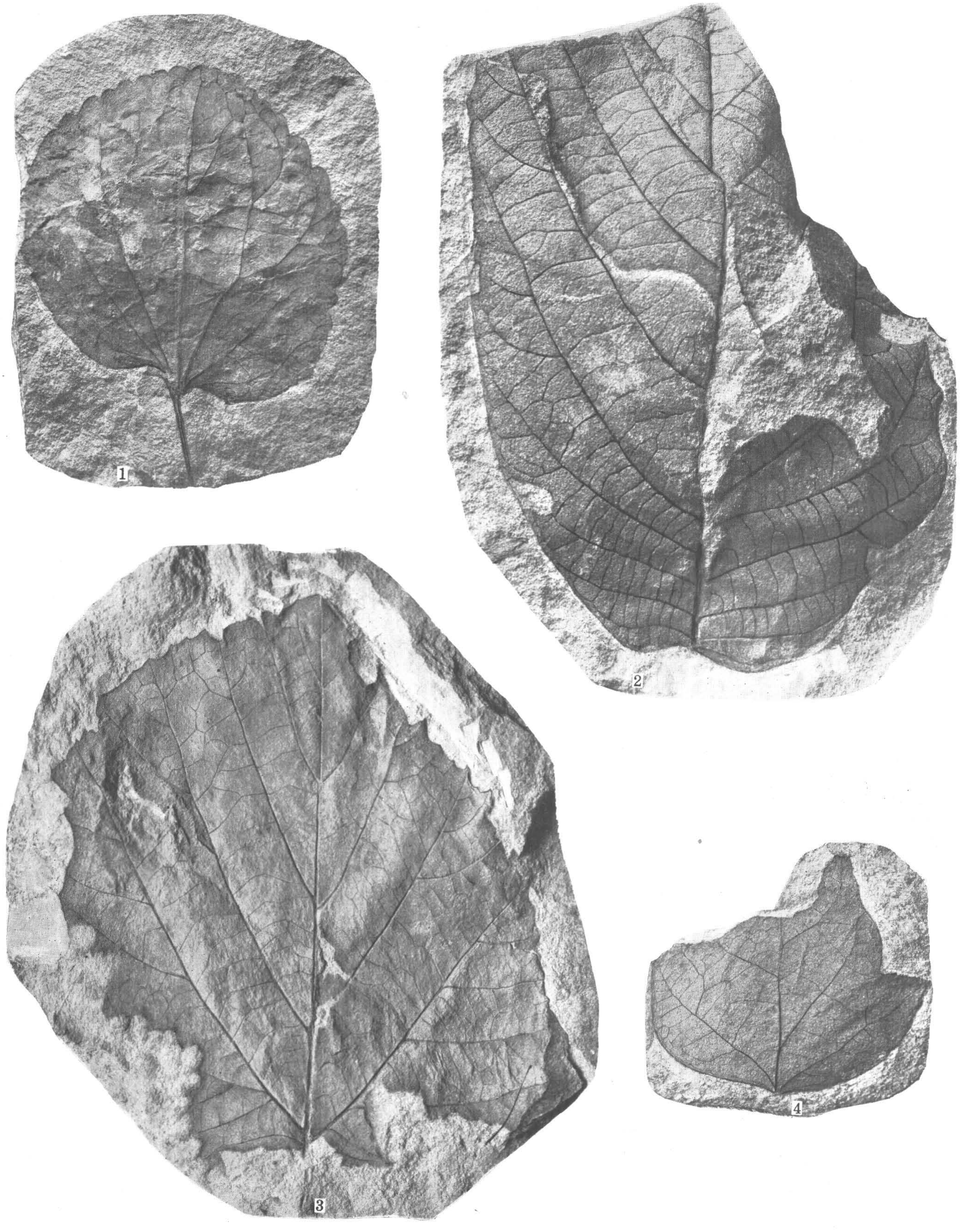
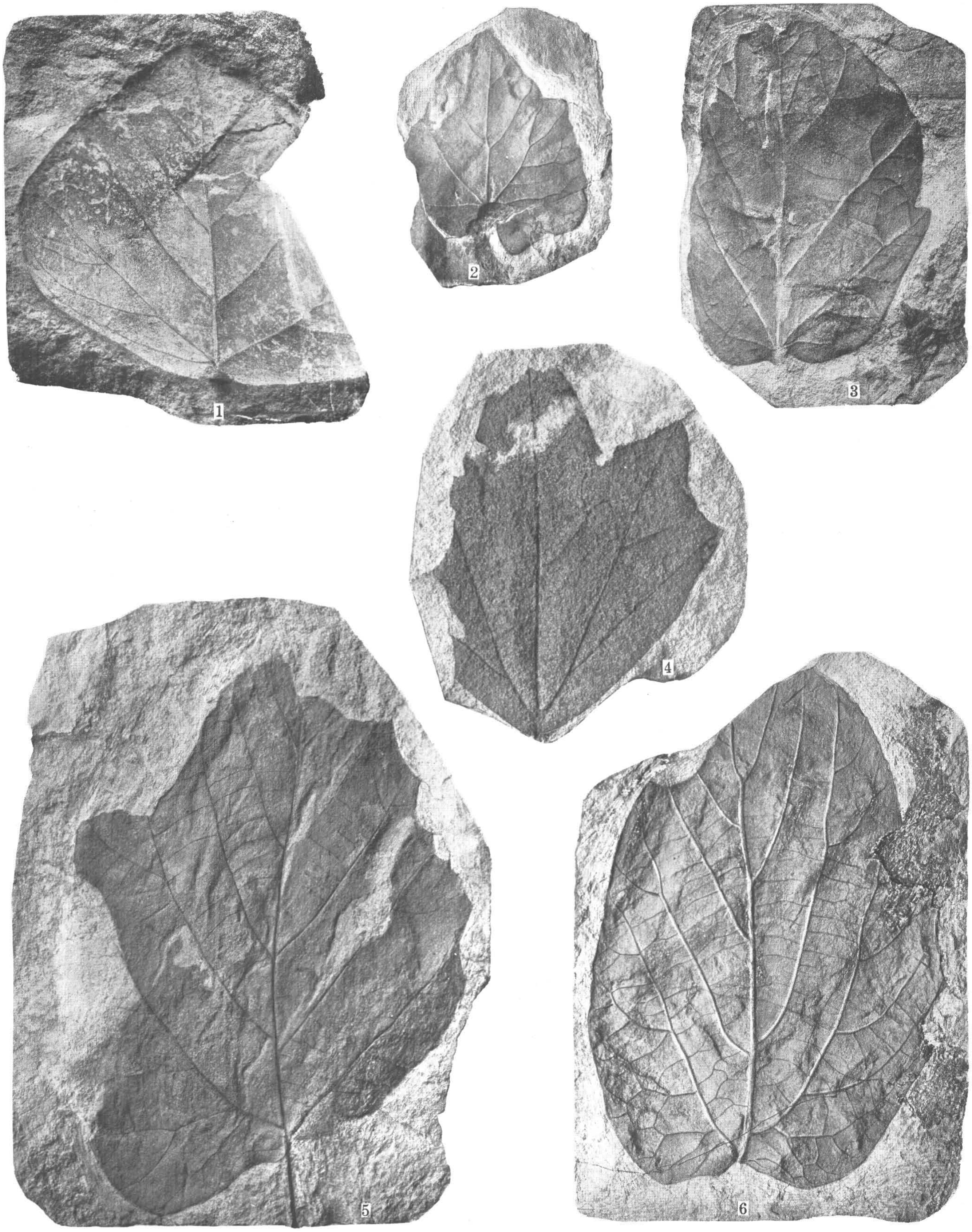


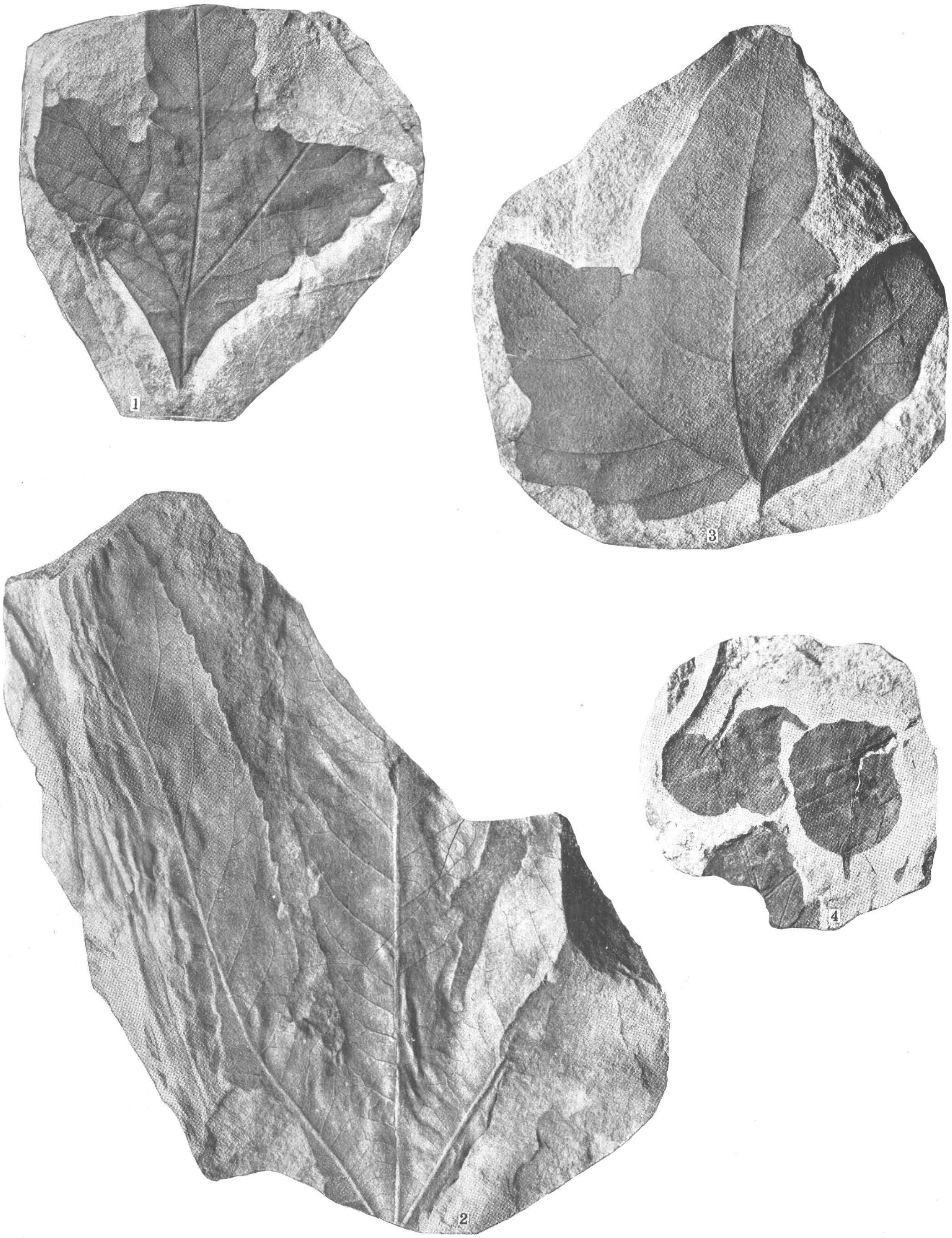
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Grewia alaskana* Hollick, n. sp. (U.S.N.M. 37651; p. 107).
2. *Apeibopsis atwoodi* Hollick, n. sp. (U.S.N.M. 37652; p. 107).
3. *Tilia cretacea* Hollick, n. sp. (U.S.N.M. 37653; p. 106).
4. *Hedera curva* Hollick, n. sp. (U.S.N.M. 37654; p. 112).



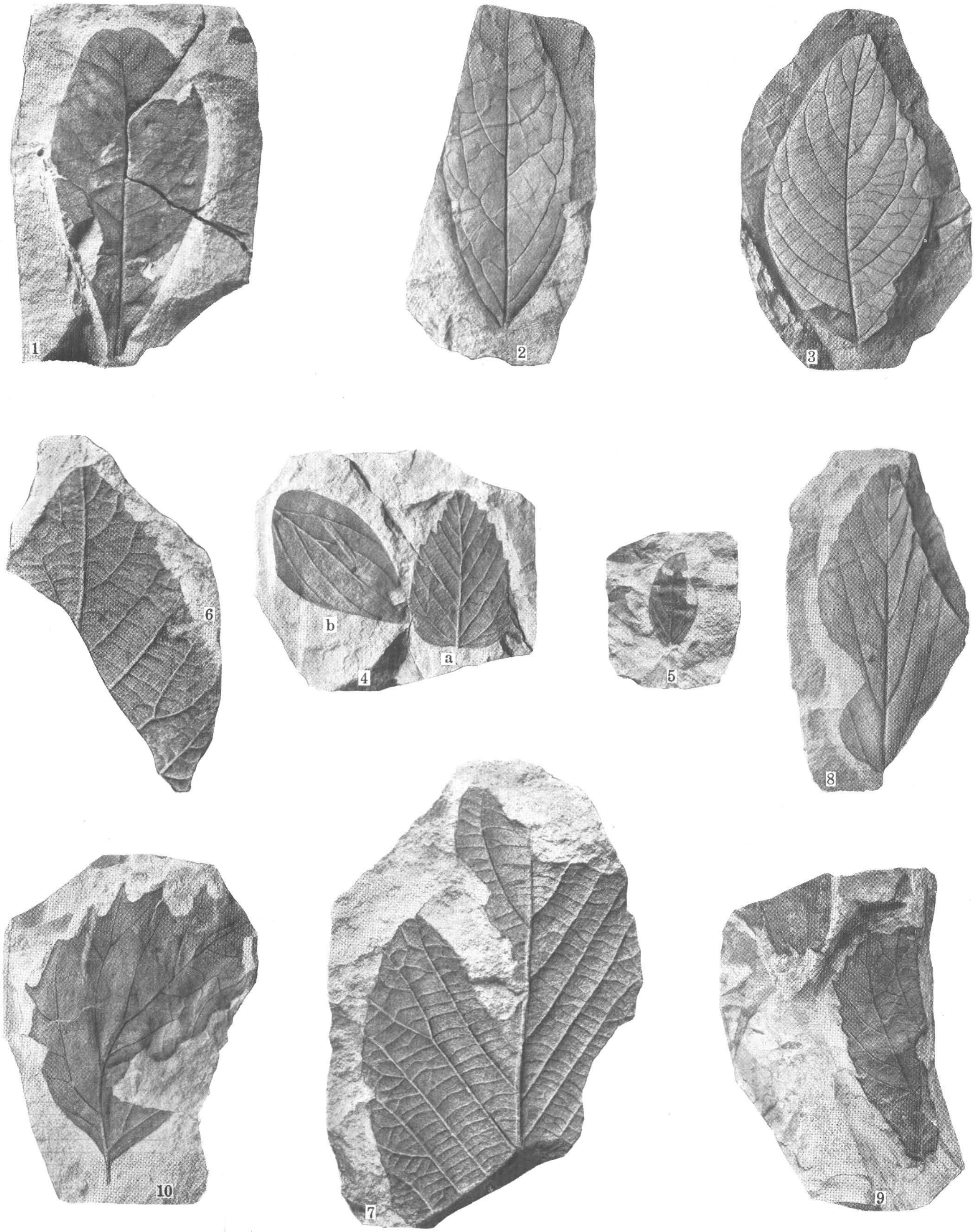
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Hedera schraderi* Hollick, n. sp. (U.S.N.M. 37655; p. 111).
2. *Hedera vera* Hollick, n. sp. (U.S.N.M. 37656; p. 111).
3. *Pterospermum conforme* Hollick, n. sp. (U.S.N.M. 37657; p. 108).
4. *Aralia pseudoplatanoidea* Hollick, n. sp. (U.S.N.M. 37658; p. 110).
5. *Sterculia basiauriculata* Hollick, n. sp. (U.S.N.M. 37659; p. 108).
6. *Sterculia atwoodi* Hollick, n. sp. (U.S.N.M. 37660; p. 108).



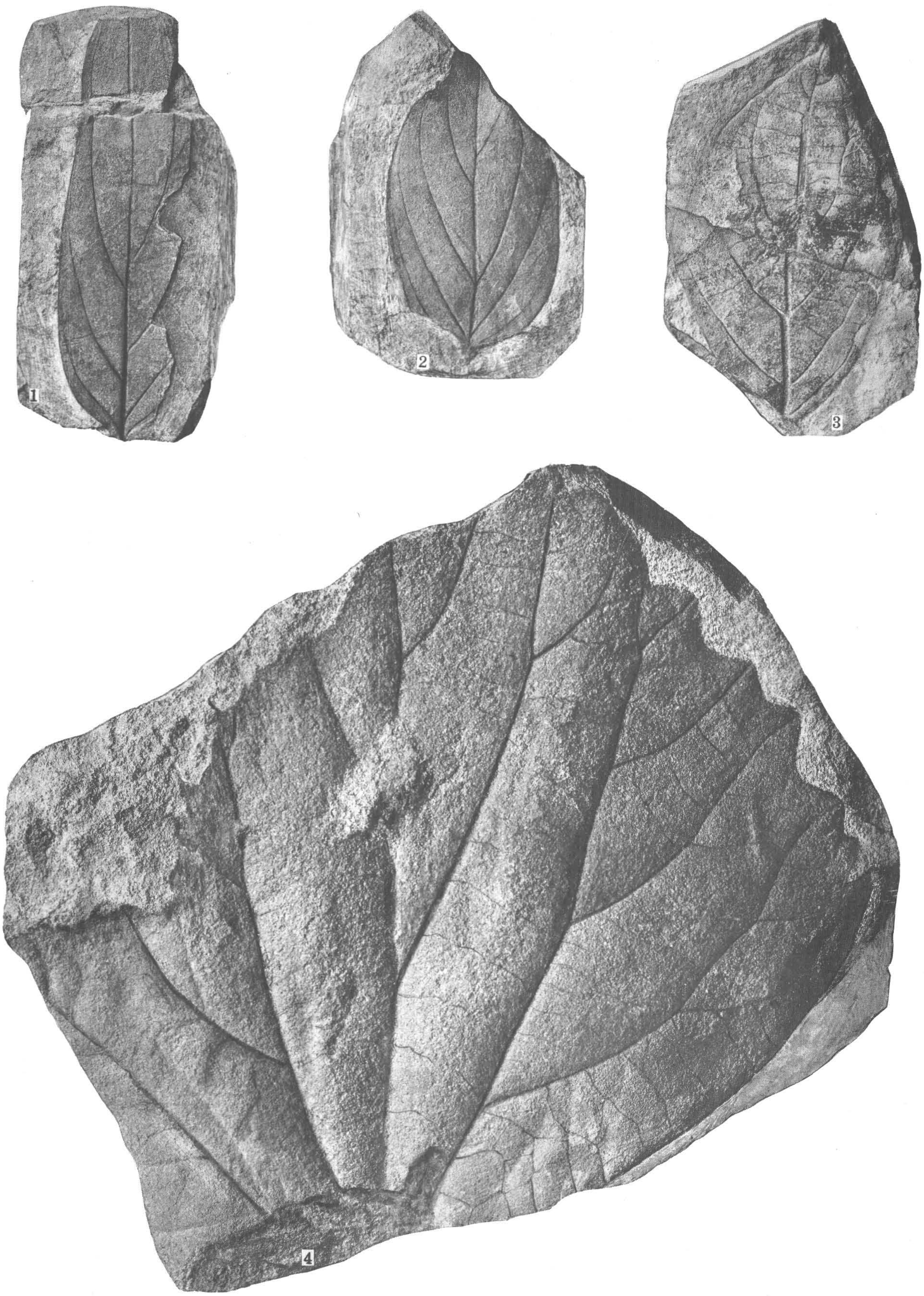
UPPER CRETACEOUS FLORAS OF ALASKA

1. *Aralia wellingtoniana* Lesquereux (U.S.N.M. 37661; p. 109).
2. *Aralia parvidens* Hollick, n. sp. (U.S.N.M. 37662; p. 110).
3. *Aralia polymorpha* Newberry (U.S.N.M. 37663; p. 110).
4. *Trapa? microphylla* Lesquereux (U.S.N.M. 37664; p. 109).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Sapotacites alaskensis* Hollick, n. sp. (U.S.N.M. 37665; p. 113).
2. *Diospyros steenstrupi* Heer (U.S.N.M. 37666; p. 114).
3. *Diospyros cornifolius* Hollick, n. sp. (U.S.N.M. 37667; p. 114).
4a. *Alnus pyramidalis* Hollick, n. sp. (U.S.N.M. 37668; p. 69).
4b, 5. *Cornus benjamini* Hollick, n. sp. (U.S.N.M. 37669; p. 112).
6, 7. *Viburnum* sp. (U.S.N.M. 37670, 37671; p. 115).
8. *Viburnum simile* Knowlton? (U.S.N.M. 37672; p. 114).
9. *Viburnum zizyphoides* Hollick, n. sp. (U.S.N.M. 37673, p. 115).
10. *Viburnum arcuatile* Hollick, n. sp. (U.S.N.M. 37674; p. 115).



UPPER CRETACEOUS FLORAS OF ALASKA

1. *Cornus ceterus* Hollick, n. sp. (U.S.N.M. 37675; p. 113).
2. *Cornus forchhammeri* Heer (U.S.N.M. 37676; p. 112).
3. *Cornus rhamnoides* Hollick, n. sp. (U.S.N.M. 37677; p. 112).
4. *Viburnum grossecrenatum* Hollick, n. sp. (U.S.N.M. 37678; p. 115).

INDEX