UNITED STATES DEPARTMENT OF THE INTERIOR
Harold L. Ickes, Secretary

GEOLOGICAL SURVEY
W. C. Mendenhall, Director

Professional Paper 182

THE TERTIARY FLORAS OF ALASKA

BY

ARTHUR HOLLICK

WITH A CHAPTER ON

THE GEOLOGY OF THE TERTIARY DEPOSITS

BY

PHILIP S. SMITH

UNITED STATES
GOVERNMENT PRINTING OFFICE
WASHINGTON : 1936

For sale by the Superintendent of Documents, Washington, D. C. - Price $1.00

CONTENTS

ILLUSTRATIONS

FOREWORD

By Philip S. Smith

The determination of the relative age of geologic events and their assignment to definite positions in the geologic time scale is one of the most significant phases of geologic investigation. Pertinent as a subject of research for itself, this determination becomes of inestimable value in any application of geologic principles to practical problems, because it at once eliminates untenable assumptions and focuses attention on the probable solutions. Just as in trials before the courts of law the time of the commission of an act is one of the principal facts to be established, so before the searching analysis involved in the investigation of geologic events the time of occurrence is of paramount importance. Various lines of evidence are used in arriving at a conclusion as to the time of a geologic event, but of all those commonly used the most conclusive is the chronology that has been built up as an outcome of the study of the forms of life found as fossils buried in the rocks that were in process of formation when the fossils were living plants or animals. The building of such a chronology is not a simple process. Each step in its construction must be based on critical evidence and carefully tested in the light of all available information, in which the stratigraphic succession shown by the rocks is balanced against the developmental stage of the fossils they contain.

Obviously the developmental progress of life is best traced by skilled systematists, who approach the problem primarily from its biologic aspect, though they fortify their conclusions by drawing freely on the evidence afforded through study by geologists of actual rock sequences in the field. In the main, the accompanying report represents the results obtained by such a systematist in the course of his studies of the plant remains that have been collected during many years in Alaska from rocks that are regarded as forming a single major time unit—the Tertiary. The correct identification of species, the accurate description of the forms that have been differentiated, and the placing of them in their systematic relations with all other known forms constitute a notable contribution to science. This information furnishes a firm foundation and one from which subsequent studies may be made with sureness.

The long experience that Dr. Hollick had in examining and reporting on practically all the plants from the Tertiary rocks of Alaska made him the outstanding authority on this subject. Not only did his specialized knowledge include the Alaskan plants of this particular period but he also studied the Alaskan floras of the preceding epoch—the Upper Cretaceous—and prepared the most authoritative report that has been published on that subject also.[1] These two volumes therefore combine to give the specialist a comprehensive inventory of plants that are known to have tenanted Alaska during the final epoch of the Mesozoic era and the succeeding Tertiary period. They therefore treat of the plants of a most significant and interesting period in the geologic history of Alaska.[2]

To the geologist interested primarily in the geologic aspects of the distribution of past floras the accompanying report may, in a measure, prove disappointing, because those aspects have been given least attention by the author. To suggest some of the geologic setting of these floras, a section on the general field occurrence of the Tertiary rocks in Alaska has been inserted. That section is principally a compilation from the reports of others, and its value lies in bringing together in a brief form the more salient facts that have been scattered through many volumes. Unquestionably much material is already in hand for a more adequate correlation of the known Tertiary deposits of Alaska than is attempted in this geologic sketch, but the assimilation and interpretation of that material would have required much longer delay in the publication of Dr. Hollick's report. Such delay did not seem desirable, for his systematic studies are in themselves most valuable tools for botanists and paleobotanists, as well as of use in further deciphering the history of the Tertiary and thus affording means of advancing geologic knowledge.

[1] Hollick, Arthur, The Upper Cretaceous floras of Alaska: U. S. Geol. Survey Prof. Paper 159, 123 pp., 1930.

[2] It is regrettable that Dr. Hollick did not live to see the present volume through the press. He had completed the manuscript before his death on Mar. 11, 1933, but the proof reading has been done by some of his associates.

THE TERTIARY FLORAS OF ALASKA

By Arthur Hollick

INTRODUCTION

OBJECT AND SCOPE OF THIS PAPER

The object of this paper is to describe and discuss the Tertiary floras of Alaska, so far as they are known, in a manner similar to that in which the Upper Cretaceous floras were treated,[1] in order that the two contributions may constitute companion papers on the later extinct floras of the Territory.

HISTORICAL REVIEW

Probably the earliest published references to what may be identified as Alaskan Tertiary plant remains were made by Grewingk,[2] who mentioned the following forms:

Neuropteris acutifolia? [=*N. acutifolia* Brongniart?], Unga Island (pp. 170, 364).

Abies sp., Kadjak [Kodiak] Island (p. 364) [=" Pinus-arten ", p. 166?].

Taxodium sp., Tschugatsk [Kenai] Peninsula and Unalaschka [Unalaska] Island (pp. 114, 364).

Coniferous wood, Unga Island (p. 364) [=" Bituminöses Holz ", p. 170?].

Impressions suggestive of Gramineen, Unga Island (p. 170).

Alnus sp., Tschugatsk Peninsula (pp. 114, 364).

It may be assumed that it was Grewingk's intention to identify *Neuropteris acutifolia* as the Carboniferous species *N. acutifolia* Brongniart. Inasmuch, however, as Paleozoic fossils are unknown from Unga Island, it is almost certainly the Tertiary fern from that island subsequently described under the name *Osmunda doroschkiana* Goeppert. (See p. 40, pl. 2, fig. 1a; pl. 109, fig. 7.) Grewingk did not give any authority after the name, but a comparison between our figures of *O. doroschkiana*, above cited, and those of *N. acutifolia* Brongniart[3] shows a closely similar surficial appearance between the two species.

An abstract of the original paper, by the same author,[4] was issued subsequently, in which he mentioned (p. 235) fossil stumps, trunks, and branches of trees, presumably of Tertiary age, on Unga Island.

During the years 1847–52 specimens of fossil plants were collected at several localities on the shores of Cook Inlet, Alaska Peninsula, and the Aleutian Islands,[5] and in southeastern Alaska.[6] Of these specimens 17 were listed by Goeppert[7] and were, for the most part, identified as Old World Miocene species. Three were named as new species, including *Osmunda doroschkiana*, from Unga Island (named in honor of the collector, and probably identical with the specimen provisionally identified by Grewingk as the Paleozoic species *Neuropteris acutifolia* Brongniart, previously mentioned), but without descriptions, and others were identified generically only. Most of these names are therefore nomina nuda. One species only was identified as other than Tertiary in age. This was represented by several specimens from Alaska Peninsula, north of Cape Jaklek [Gaklek or Aklek], contained in " grauwacken artigen Gesteine ", two of which were described as resembling *Calamites*, in regard to which Goeppert remarked:[8] " nicht in den Bereich der Tertiär formation gehörend."

Three other papers by Goeppert were issued under the same title—two of them[9] identical with the original, the third one[10] in the form of an abstract.

In the meantime a much more extensive collection of fossil plants from southeastern Alaska and the Cook Inlet region was made by Hjalmar Furuhjelm, of Helsingfors, Finland, who, for about a decade, was governor of the Russian-American possessions. The larger part of the specimens collected by Furuhjelm were lost when the vessel on which they were shipped was wrecked; but those that were saved ultimately came into the possession of Baron Nils Adolf Eric von Nordenskiöld, of Arctic exploration fame, who

[1] Hollick, Arthur, The Upper Cretaceous floras of Alaska, with a description of the plant-bearing beds by G. C. Martin: U. S. Geol. Survey Prof. Paper 159, pp. 1–123, pls. 1–87, text figs. 1–5, 1930.

[2] Grewingk, C. C. A., Beitrag zur Kenntniss der orographischen und geognostischen Beschaffenheit der Nordwest Küste Amerikas, mit den anliegenden Inseln: Russ. k. min. Gesell. St. Petersburg Verh., Jahrg. 1848–49, pp. 76–424, pls. 4–7, maps 1–3 and two in text, 1850.

[3] Brongniart, A. T., Histoire des végétaux fossiles, vol. 1, pl. 64, figs. 6, 7, Paris, 1828 [1830].

[4] Grewingk, C. C. A., Beitrag zur Kenntniss der orographischen und geognostischen Beschaffenheit der Nordwest Küste Amerikas mit den anliegenden Inseln: Heidelberger Jahrb. Lit., Jahrg. 44, pp. 230–244, 1851.

[5] Neniltchik [=Ninilchik]: West shore of Cook Inlet, " Mitte des Meerbusens Beketinzisnakiknu " [=?] and on " Landzunge, Taketschek oder Osipnago " [=?]; Saharoschen [=Zachareffskaia or Zachary] Bay, Unga Island; Korovin Bay, Atha [=Atka] Island; Ugolni [=Ukolnoi or Pavlof] Bay; and from the islands of Kodiak and Uyak.

[6] Hudsnoi [=Hudsunoo or Kootznahoo] Island.

[7] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Schlesischen Gesell. vaterl. Kultur, Abt. Naturwiss. u. Med., 39te Jahresb., pt. 2, Abh., pp. 195–207, 1861.

[8] Idem, p. 204.

[9] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Acad. imp. sci. St.-Pétersbourg Bull., vol. 3, pp. 448–461, 1861; Mélanges physiques et chimiques tirés du Bulletin, vol. 4, pp. 695–712, 1861.

[10] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Schlesischen Gesell. vaterl. Kultur, 44te Jahresb., pp. 50–52, 1866 [1867].

submitted them to the eminent paleobotanist Prof. Oswald Heer, of Zurich, Switzerland, for identification and description; and subsequently the results of Heer's studies were presented before the Royal Academy of Science of Sweden by Nordenskiöld.[11] About 50 identifications were listed, including 28 species previously described, mostly from the Tertiary of the Old World; 12 identified generically only; and 10 described as new species. The list was arranged according to localities, and the new species, for the most part, were briefly described.

Up to this time none of the identifications or descriptions had been accompanied by an illustration, but in 1869 Heer's paper on the fossil flora of Alaska [12] was issued, in which the species previously published, together with others subsequently identified (about 50 in all), were described and figured and were discussed in connection with their botanic and geologic relationship and climatic significance.

In 1871 Eichwald [13] published a list of the Alaskan fossil plants recorded by Goeppert and Heer, of which he figured 9 species, including *Calamites ambiguus* n. sp.,[14] from the coast of Alaska Peninsula north of Cape Jaklök [= Aklek, Taklek, Iaklek], which is evidently identical with the unnamed species of *Calamites* mentioned by Goeppert (see p. 1) as having come from Alaska Peninsula north of Cape "Jaklek." The figure is clearly indicative of a *Calamites* and may be definitely eliminated from the Tertiary flora.

In 1883 Lesquereux [15] described and figured 21 Tertiary species from the Cook Inlet-Alaska Peninsula region, collected by William Healey Dall, at that time on the United States Coast and Geodetic Survey. Seven of these were described as new, and the remainder were identified as previously recorded Alaska and Old World Miocene species. A reprint of the text of this paper, without the illustrations, under the same title, was subsequently included as a separate chapter or section in Lesquereux's report on the Cretaceous and Tertiary floras.[16]

Also in 1883 Newberry [17] described a number of fossil plants, mostly from the western part of the United States, and seven new Tertiary species from Alaska, in part from southeastern Alaska and in part from the Cook Inlet region. One of the specimens was stated to have been collected by the United States steamer *Saginaw*, February 18, 1869, and the others by Captain Howard, United States Navy.[18]

The Captain Howard mentioned was evidently Capt. W. A. Howard, of the United States Revenue Cutter Service. In 1867 the revenue cutter *Lincoln*, under command of Capt. J. W. White, was dispatched to Alaska for the purpose of obtaining information in regard to the then recently purchased territory, and Captain Howard was in general charge of the expedition.[19]

In 1886 Felix [20] described and figured, under the name *Pityoxylon inaequale*, a specimen of fossil coniferous wood, presumably of Tertiary age, collected by one of the Krause brothers—Arthur or Aurel—in the vicinity of Danaáku [=Silver] Lake, near Yakutat Bay.

In a list of identifications of fossil plants by Lesquereux,[21] published in 1887, four specimens of Tertiary age from Alaska were included as follows:

Carex, leaves, Sitka. E. W. Nelson, collector.[22]
Sagittaria n. sp.?, idem.
Ginkgo adiantoides (Unger) Heer, idem.
Corylus macquarrii (Forbes) Heer, Unga Island. W. H. Dall, collector.

In 1892 Dall and Harris [23] briefly referred to fossil plants as correlation factors and, under the heading "Alaska", listed 9 of Tertiary age—5 from Kuiu Island, southeastern Alaska, 1 from Port Graham or English Bay, Kenai Peninsula, 1 from Unga Island, Alaska Peninsula, and 2 from the district adjacent to Norton Sound (Topanica Creek and Ulukak

[11] Heer, Oswald, Utdrag ur ett bref af Professor Oswald Heer rörande fossila vexter frän Nordvestra Amerika, insamlade of Bergmästaren Hj. Furuhjelm: K. svenska vet. akad. Öfvers. Förh., vol. 25, no. 1, pp. 63–68, 1868.

[12] Heer, Oswald, Fossile Flora von Alaska: K. svenska vet.-akad. Handl., vol. 8, no. 4, pp. 1–41, pls. 1–10 and two text figs., 1869. Reprinted as Flora fossilis Alaskana: Flora fossilis arctica, vol. 2, pt. 2, 1869.

[13] Eichwald, Edward von, Die Miocän- and Kreideformation von Alaska und den Aleutischen Inseln, Abt. 1, Fossile Pflanzen der Miocänformation: Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak [a peninsula in the Caspian Sea] und die Aleutischen Inseln, pp. 107–116, pl. 4 (VI on plate and in text), figs. 1–9, St. Petersburg, 1871.

[14] Idem, p. 114, pl. 4 (VI), fig. 9.

[15] Lesquereux, Leo, Contribution to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, pp. 443–449, pls. 6–10, 1882 [Feb. 13, 1883].

[16] U. S. Geol. Survey Terr. Rept., vol. 8, pp. 257–263, 1883.

[17] Newberry, J. S., Brief descriptions of fossil plants, chiefly Tertiary, from western North America: U. S. Nat. Mus. Proc., vol. 5, pp. 502–514, 1882 [Mar. 21, 1883].

[18] The steamer *Saginaw*, United States Navy, cruised through the Alexander Archipelago of southeastern Alaska during the winter of 1868–69, under Commander (subsequently Rear-Admiral) Richard Worsam Meade, according to Marcus Baker (Geographic dictionary of Alaska, 2d ed.: U. S. Geol. Survey Bull. 299, p. 48, 1906).

[19] Communication dated February 17, 1912, from Capt. Commandant E. P. Bertholf, United States Revenue Cutter Service, to Alfred H. Brooks, United States Geological Survey.

[20] Felix, Johannes, Untersuchungen über fossile Hölzer, Abt. 2: Deutsche geol. Gesell. Zeitschr., vol. 38, Jahrg. 1886, p. 483, pl. 12, fig. 3.

[21] Lesquereux, Leo, List of recently identified fossil plants belonging to the United States National Museum, with descriptions of several new species: U. S. Nat. Mus. Proc., vol. 10, pp. 21–46, pls. 1–4, 1887.

[22] F. H. Knowlton (Fossil flora of Alaska: Geol. Soc. America Bull., vol. 5, footnote ††, p. 575, 1893) remarked: "I am informed by Mr. Nelson that he never visited Sitka and did not bring back any fossil plants from Alaska. This throws doubt on the specimens so recorded, and their locality and collector remain unknown. I have retained them, however, as recorded by Lesquereux."

[23] Dall, W. H., and Harris, G. D., Correlation papers—Neocene: U. S. Geol. Survey Bull. 84, pp. 232–268 and map, 1892.

[=Ulukuk] River, a branch of the Unalakleet). The district in the vicinity of Norton Sound represents a site for fossil plants not previously recorded.

It may also be of interest to note here that the descriptive designation Kenai was applied in this bulletin, for the first time, to the strata in which the Tertiary plant remains were recognized; but it is not very clear whether it was the intention of the authors to restrict the application of the term to such strata and their included plant remains as could be correlated with those of Kenai Peninsula, or to apply it to the Tertiary of Alaska in general. Personally I am inclined to think that it would be best to restrict the use of the term, in connection with the Alaska fossil floras, to species that may be correlated with those from the type locality at Port Graham and adjacent territory, on Kenai Peninsula. In regard to the exact age of the Kenai flora the authors were noncommittal, but Miocene? was the stratigraphic term generally used in connection with it, and Dall [24] remarked:

> The distribution and character of this group have been somewhat fully discussed because, up to very recently, authorities were practically unanimous in referring it to the Miocene, a view which cannot yet be said to be definitely refuted. * * * It must be conceded that the view that the latter [Kenai group] is probably of Eocene age does not appear unreasonable.

Incidentally it may also be pertinent to recall here that, of the approximately 100 Alaska Tertiary plants described or listed up to that time, all but 13 had been recorded from Port Graham and the Cook Inlet-Alaska Peninsula coastal region. Of the 13 mentioned 10 were collected at localities in southeastern Alaska, 1 in the vicinity of Yakutat Bay (the only intermediate locality), and 2 in the vicinity of Norton Sound, about 500 miles northwest of Cook Inlet and 700 miles north of the farthest fossil-plant locality on Alaska Peninsula.

In 1890 fossil plants were collected by C. H. Townsend, resident naturalist on the United States Fish Commission steamer *Albatross*, at Herendeen Bay, on the north side of Alaska Peninsula. They were identified as Tertiary species and were described and figured in a comprehensive paper by Knowlton,[25] in which were listed all the then recognized fossil plants of Alaska, arranged in taxonomic sequence, without regard to locality or stratigraphic position. In this paper 98 Tertiary species were included, and following the systematic part is a discussion of the floras, especially in connection with the views expressed by various authorities in regard to the exact stratigraphic position of the flora recognized as Tertiary in age. Several expressions of opinion are cited, and Knowlton remarks: [26]

> The geological age of these coal-bearing rocks, from which most of the plants enumerated in this paper came, has usually been regarded as Miocene. Heer * * * referred them unhesitatingly to this horizon. * * * Lesquereux and at first Newberry do not appear to have seriously questioned their Miocene age. * * * Mr. J. Starkie Gardner appears to have been the first to question the Miocene age * * * of the Arctic floras in general. * * * This change of view as to the age of the so-called Arctic Miocene, as proposed by Gardner,[27] has already received considerable confirmation from American paleobotanists, and while it can hardly be regarded as settled, it may be accepted as extremely probable.

In 1896 fossil plants were collected in the Yukon River Valley by J. E. Spurr and others, which were examined and reported upon by Knowlton.[28] For the most part the identifications were provisional, and the principal matter of interest in connection with them is that certain of them represent the first identified remains of a Tertiary flora from the Yukon region.

In 1898 appeared a posthumous work on the Cretaceous and Tertiary floras of North America by Newberry,[29] in which were again described and for the first time figured the specimens from Alaska mentioned on page 2 as having been collected in 1867 and 1869 in southeastern Alaska and the Cook Inlet region. Specimens from the Yukon Valley, collected by W. H. Dall, were identified by Newberry as the Arctic Miocene species *Pterospermites dentatus* Heer,[30] but this was subsequently recognized as an erroneous identification of a Cretaceous species [31] and may therefore be here regarded as merely representing an item of incidental interest.

In 1902 an impetus was given to the investigation of the fossil floras of Alaska by Collier,[32] who made collections of fossil plants at a number of localities on the Yukon River. The specimens were recognized as representing important factors in connection with the identification and correlation of the stratigraphy of

[24] Dall, W. H., and Harris, G. D., op. cit., p. 252.

[25] 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, pl. 9, 1894; also an abstract of this paper, under the title "Fossil flora of Alaska": Geol. Soc. America Bull., vol. 5, pp. 573–590 (without plate), 1893; and a contribution practically identical in contents with the original paper, under the heading "Report on the fossil plants collected in Alaska in 1895, as well as an enumeration of those previously known," in Dall, W. H., Report on coal and lignite of Alaska: U. S. Geol. Survey 17th Ann. Rept., pt. I, pp. 876–897, 1896.

[26] Knowlton, F. H., op. cit. (1894), pp. 237–238.

[27] Gardner, J. S., and Ettingshausen, Constantin, A monograph of the British Eocene flora, vol. 1, pp. 7–8, London, Palaeont. Soc., May 1879.

[28] 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 18th Ann. Rept., pt. 3, pp. 194–196, 1898.

[29] Newberry, J. S., The later extinct floras of North America, edited by Arthur Hollick: U. S. Geol. Survey Mon. 35, pp. 1–295, pls. 1–68, 1898.

[30] Idem, p. 133, pl. 53, figs. 1, 2; pl. 54, fig. 4.

[31] Hollick, Arthur, The Upper Cretaceous floras of Alaska: U. S. Geol. Survey Prof. Paper 159, p. 2, 1930.

[32] Collier, A. J., The coal resources of the Yukon, Alaska: U. S. Geol. Survey Bull. 218, pp. 1–71, pls. 1–6, 1903.

the region, and in 1903 I was detailed to explore the region further, with Sidney Paige as assistant, and to collect additional material, especially fossil plants. Specimens of Cretaceous and Tertiary plants were collected at numerous localities between Eagle City and Anvik, and those subsequently identified as Tertiary species are included in the descriptive part of this paper, together with additional identifications of similar Tertiary material subsequently collected by other Geological Survey parties in the Yukon region and elsewhere in Alaska. Many of these collections were made the subjects of brief reports by Knowlton and by me, which were included, from time to time, in papers on the geology of Alaska issued by the Geological Survey. Many of these reports, however, included merely generic identifications and provisional specific identifications, sufficient to determine the Tertiary age of the rocks in which they were found. Subsequent critical examination and study of the specimens frequently resulted in more satisfactory identifications and in the elimination of errors. Nevertheless, despite the occasional errors of identification in the original lists, the general facies of the flora was correctly recognized in almost every instance and the stratigraphic position of the plant-bearing beds was seldom misinterpreted.

In connection with the Harriman Alaska Expedition of 1899 a collection of fossil plants was made by De Alton Saunders at Kukak Bay, Alaska Peninsula, included in which were specimens that were subsequently examined, identified as Tertiary species, and described and figured by Knowlton.[33] The list of identifications was also included in a report by Atwood [34] published subsequently. Collier [35] gives a brief paragraph on fossil plants of Cenozoic age, and a plate on which are depicted five characteristic Tertiary species, reproduced from Heer.[36]

In 1907 specimens of fossil wood from Alaska were described by Platen,[37] which included two listed under the heading "Hölzer aus Alaska" (pp. 146–149 of the original publication). We may infer that these are Tertiary species, although the exact localities are uncertain.

In 1911 [38] I gave an outline of results attained and conclusions drawn from studies of collections of Alaskan fossil plants thus far identified as Tertiary; and on December 31, 1912, I read a paper before the Geological Society of America,[39] in which I discussed the differentiation and correlation of the Cretaceous and Tertiary floras of Alaska, based upon studies of the collections made personally and by other members of the Alaskan branch of the Geological Survey. These studies and the study of additional material brought in subsequently by Survey parties, from time to time, served as the basis of the paper already issued, on the Cretaceous floras,[40] and of the present one on the Tertiary floras.

Several lesser contributions directly or indirectly relating to the Tertiary flora of the Territory have been issued in the meantime, among which may be mentioned one by Thomas,[41] on a more or less problematic fossil collected by George F. Kay in the Bering River coal field, and also many individual reports by Knowlton and Hollick, included in bulletins of the Geological Survey relating to the geology of Alaska, similar to those previously listed.

All the fossil material described in the present paper is deposited in the United States National Museum.

SPECIES INCLUDED

Below is a taxonomic list of the species described in this paper:

Thallophyta:
- Algae:
  - Rhodophyceae (Rhodomeniales):
    - Rhodomelaceae:
      - Chondrites Sternberg:
        - Chondrites heeri Eichwald?

Pteridophyta:
- Filicineae:
  - Filicales:
    - Polypodiaceae:
      - Onoclea Linnaeus:
        - Onoclea sensibilis Linnaeus.
      - Dryopteris Adanson:
        - Dryopteris meyeri (Heer) Hollick, n. comb.
      - Hausmannia Dunker:
        - Hausmannia atwoodi Hollick, n. sp.
      - Dennstaedtia Bernhardi:
        - Dennstaedtia blomstrandi (Heer) Hollick, n. comb.
      - Asplenium Linnaeus:
        - Asplenium alaskanum Hollick, n. sp.
      - Pteris Linnaeus:
        - Pteris inequilateralis Hollick, n. sp.
        - Pteris oeningensis Unger?
        - Pteris pseudopennaeformis Lesquereux.
        - Pteris sitkensis Heer.

[33] Knowlton, F. H., Fossil plants from Kukak Bay: Alaska, vol. 4, pp. 149–162, pls. 22–33, Harriman Alaska Expedition, 1904.

[34] Atwood, W. W., Geology and mineral resources of parts of the Alaska Peninsula: U. S. Geol. Survey Bull. 467, pp. 52–54, 1911.

[35] Collier, A. J., Geology and coal resources of the Cape Lisburne region, Alaska: U. S. Geol. Survey Bull. 278, p. 36, pl. 6, 1906.

[36] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, pt. 2, 1869.

[37] Platen, Paul, Untersuchungen fossiler Hölzer aus dem Westen der Vereinigten Staaten von Nordamerika, pp. 1–156, pls. 1–3, Leipzig, 1907; Naturf. Gesell. Leipzig Sitzungsber., Jahrg. 34, pp. 1–164, pls. 1–3, 1907 [1908].

[38] 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.

[39] Hollick, Arthur, Preliminary correlation of the Cretaceous and Tertiary floras of Alaska [abstract]: Geol. Soc. America Bull., vol. 24, no. 1, p. 116, 1913.

[40] Hollick, Arthur, and Martin, G. C., The Upper Cretaceous floras of Alaska, with a description of the plant-bearing beds: U. S. Geol. Survey Prof. Paper 159, 1930.

[41] Thomas, A. O., On a supposed fruit or nut from the Tertiary of Alaska: Iowa Acad. Sci. Proc., vol. 24, pp. 113–117, pl. 5, figs. 1–4, 1917.

Pteridophyta—Continued.
Filicineae—Continued.
Filicales—Continued.
Osmundaceae:
Osmunda Linnaeus:
Osmunda doroschkiana Goeppert.
Osmunda dubiosa Hollick, n. sp.
Filicales of uncertain family relationship:
Pecopteris Brongniart:
Pecopteris sp. Heer.
Anthrophyopsis Nathorst:
Anthrophyopsis hamiltonensis Hollick, n. sp.
Equisetinae:
Equisetales:
Equisetaceae:
Equisetum Linnaeus:
Equisetum arcticum Heer.
Equisetum globulosum Lesquereux.
Spermatophyta:
Gymnospermae:
Cycadales:
Cycadaceae:
Ceratozamia Brongniart:
Ceratozamia wrightii Hollick.
Dioön Lindley:
Dioön inopinus Hollick.
Dioön praespinulosum Hollick.
Ginkgoales:
Ginkgoaceae:
Ginkgo Linnaeus:
Ginkgo adiantoides (Unger) Heer.
Ginkgo reniformis conformis Hollick, n. var.
Coniferales:
Taxaceae:
Taxites Brongniart:
Taxites olriki Heer.
Taxites microphyllus Heer.
Pinaceae:
Pinus Linnaeus:
Pinus macclurii Heer?
Pinus sp. Heer.
Pinus? (leaves) Knowlton.
Pinus? (scales) Knowlton.
Pinites (Witham) Lindley and Hutton:
Pinites pannonicus (Unger) Goeppert.
Pinites sp. Goeppert.
Pinites sp. Goeppert.
Pityoxylon Kraus:
Pityoxylon inaequale Felix.
Pityoxylon macclurii (Heer) Kraus.
Picea Link:
Picea harrimani Knowlton.
Picea (branches) Knowlton.
Picea? (seed) Knowlton.
Abies Hill:
Abies sp. Grewingk.
Sequoia Endlicher:
Sequoia brevifolia Heer.
Sequoia disticha Heer.
Sequoia heerii Lesquereux.
Sequoia langsdorfii (Brongniart) Heer.
Sequoia spinosa Newberry.
Sequoia (cone) Knowlton.

Spermatophyta—Continued.
Gymnospermae—Continued.
Cycadales—Continued.
Pinaceae—Continued.
Taxodium L. C. Richard:
Taxodium crassum Hollick, n. sp.
Taxodium dubium (Sternberg) Heer.
Taxodium dubium longifolium Massalongo.
Taxodium dubium normale Massalongo.
Taxodium occidentale Newberry.
Taxodium tinajorum Heer.
Taxodium sp. Grewingk.
Taxodium sp. Heer.
Glyptostrobus Endlicher:
Glyptostrobus europaeus (Brongniart) Unger.
Widdringtonia Endlicher:
Widdringtonia sp. Heer.
Thuites Sternberg:
Thuites ehrenswärdi Heer.
Thuites (Chamaecyparis) alaskensis Lesquereux.
"Coniferous wood", Grewingk.
Angiospermae (Monocotyledonae):
Pandanales:
Sparganiaceae:
Sparganium Linnaeus:
Sparganium sp. Heer.
Naiadales:
Naiadaceae:
Caulinia Willdenow:
Caulinia laevis (Goeppert) Goeppert.
Alismales:
Alismaceae:
Sagittaria Linnaeus:
Sagittaria pulchella Heer:
Sagittaria sp. Lesquereux.
Poales (Graminales):
Poaceae:
Arundo Linnaeus:
Arundo pseudogoepperti Berry?
Phragmites Trinius:
Phragmites alaskana Heer?
Phragmites sp. Heer.
Poacites Brongniart:
Poacites tenue-striatus Heer.
Poacites sp. Heer.
"Impressions suggestive of Gramineae" Grewingk.
Cyperaceae:
Carex Linnaeus:
Carex servata Heer.
Carex (leaves) Lesquereux.
Arecales (Palmales):
Arecaceae:
Flabellaria Sternberg (1822), not Defrance (1820) nor Cavanilles (1790):
Flabellaria florissanti Lesquereux.
Flabellaria alaskana Hollick, n. sp.
Liliales:
Smilacaceae:
Smilax Linnaeus:
Smilax reticulata Heer.

Spermatophyta—Continued.
- Angiospermae (Dicotyledonae—Choripetalae):
  - Piperales:
    - Piperaceae:
      - Piper Linnaeus:
        - Piper chapini Hollick, n. sp.
        - Piper concavum Hollick, n. sp.
        - Piper convertabilis Hollick, n. sp.
        - Piper disputabilis Hollick, n. sp.
        - Piper septentrionalis Hollick, n. sp.
  - Salicales:
    - Salicaceae:
      - Populus Linnaeus:
        - Populus amblyrhyncha Ward.
        - Populus arctica Heer.
        - Populus arctica var. b, Heer.
        - Populus balsamoides Goeppert.
        - Populus congerminalis Hollick, n. sp.
        - Populus flexuosa Hollick, n. sp.
        - Populus genetrix Newberry.
        - Populus gaudini Fischer-Ooster.
        - Populus glandulifera Heer.
        - Populus hookeri Heer.
        - Populus latior Alex. Braun.
        - Populus leucophylla Unger.
        - Populus mutabilis Heer.
        - Populus obscura Hollick, n. sp.
        - Populus richardsoni Heer.
        - Populus speciosa Ward?
        - Populus zaddachi Heer?
        - Populus sp.?
      - Salix Linnaeus:
        - Salix abbreviata Goeppert.
        - Salix alaskana Hollick, n. sp.
        - Salix angusta Alex. Braun.
        - Salix grandifolia Weber.
        - Salix integra Goeppert.
        - Salix lavateri Alex. Braun.
        - Salix libbeyi Lesquereux?
        - Salix macrophylla Heer.
        - Salix minuta Knowlton.
        - Salix pilosula Goeppert.
        - Salix raeana Heer.
        - Salix tenera Alex. Braun.
        - Salix varians Goeppert.
        - Salix wimmeriana Goeppert.
        - Salix sp. Heer.
        - Salix sp.?, pistillate ament.
  - Myricales:
    - Myricaceae:
      - Comptonia Banks:
        - Comptonia cuspidata Lesquereux.
        - Comptonia praemissa Lesquereux.
      - Myrica Linnaeus:
        - Myrica banksiaefolia Unger.
        - Myrica banksiaefolia curta Hollick, n. var.
        - Myrica (Dryandroides) lignitum (Unger) Saporta.
        - Myrica speciosa Unger.
        - Myrica (Comptonia) vindobonensis (Ettingshausen) Heer.
  - Juglandales:
    - Juglandaceae:
      - Juglans Linnaeus:
        - Juglans acuminata Alex. Braun.
        - Juglans acuminata latifolia (Alex. Braun) Heer.

Spermatophyta—Continued.
- Angiospermae—Continued.
  - Juglandales—Continued.
    - Juglandaceae—Continued.
      - Juglans Linnaeus—Continued.
        - Juglans crossii Knowlton.
        - Juglans egregia Lesquereux.
        - Juglans juglandiformis (Sternberg) Giebel.
        - Juglans longiapiculata Hollick, n. sp.
        - Juglans nigella Heer.
        - Juglans picroides Heer.
        - Juglans? pseudopunctata Hollick, n. sp.
        - Juglans salicifolia Goeppert.
        - Juglans strozziana Gaudin?
        - Juglans thermalis Lesquereux.
        - Juglans townsendi Knowlton.
        - Juglans valida Hollick, n. sp.
        - Juglans woodiana Heer.
        - Juglans sp.?
      - Hicoria Rafinesque:
        - Hicoria antiquora (Newberry) Knowlton.
        - Hicoria magnifica Knowlton.
      - Pterocarya Kunth:
        - Pterocarya septentrionale Hollick, n. sp.
      - Engelhardtia Leschen:
        - Engelhardtia ettingshauseni Berry.
  - Fagales:
    - Betulaceae:
      - Carpinus Linnaeus:
        - Carpinus grandis Unger.
        - Carpinus sp. Goeppert.
      - Carpinites Goeppert and Berendt:
        - Carpinites truncatus Hollick, n. sp.
      - Corylus Linnaeus:
        - Corylus adumbrata Hollick, n. sp.
        - Corylus americana fossilis Newberry.
        - Corylus evidens Hollick, n. sp.
        - Corylus harrimani Knowlton.
        - Corylus kenaiana Hollick, n. sp.
        - Corylus macquarrii (Forbes) Heer.
        - Corylus macquarrii macrophylla Heer.
        - Corylus? palachei Knowlton.
        - Corylus sp.? staminate aments.
        - Corylus sp.? aments.
      - Betula Linnaeus:
        - Betula alaskana Lesquereux.
        - Betula brongniartii Ettingshausen.
        - Betula confusa lata Hollick, n. var.
        - Betula dubiosa Hollick, n. name.
        - Betula grandifolia Ettingshausen.
        - Betula populoides Hollick, n. sp.
        - Betula prisca Ettingshausen.
        - Betula sp.? aments.
      - Alnus Gaertner:
        - Alnus alaskana Newberry.
        - Alnus alnifolia (Goeppert) Hollick, n. comb.
        - Alnus corylina Knowlton and Cockerell.
        - Alnus grandiflora Newberry.
        - Alnus kefersteinii (Goeppert) Unger.
        - Alnus kefersteinii var. Heer [may=A. nostratum Unger].
        - Alnus sp. Grewingk.
        - Alnus sp.? catkins.
        - Alnus sp.? pistillate aments.

Spermatophyta—Continued.
- Angiospermae—Continued.
  - Fagales—Continued.
    - Fagaceae:
      - Fagus Linnaeus:
        - Fagus alnitifolia Hollick, n. sp.
        - Fagus antipofii Abich.
        - Fagus deucalionis Unger.
        - Fagus feroniae Unger.
        - Fagus sp. Heer.
      - Castanea Adanson:
        - Castanea castaneaefolia (Unger) Knowlton.
      - Quercus Linnaeus:
        - Quercus alaskana Trelease?
        - Quercus artocarpites Ettingshausen.
        - Quercus chamissoni Heer.
        - Quercus conjunctiva Hollick, n. sp.
        - Quercus dallii Lesquereux.
        - Quercus etymodrys Unger.
        - Quercus furuhjelmi Heer.
        - Quercus grönlandica Heer.
        - Quercus juglandina Heer?
        - Quercus meriani Heer.
        - Quercus nevadensis Lesquereux.
        - Quercus olafseni Heer.
        - Quercus oregoniana Knowlton.
        - Quercus platania Heer.
        - Quercus pseudocastanea Goeppert.
        - Quercus steenstrupiana Heer.
        - Quercus? sp. Knowlton.
      - Dryophyllum Debey:
        - Dryophyllum aquilonium Hollick, n. sp.
        - Dryophyllum longipetiolatum Knowlton.
        - Dryophyllum stanleyanum Dawson.
  - Urticales:
    - Ulmaceae:
      - Ulmus Linnaeus:
        - Ulmus borealis Heer.
        - Ulmus braunii Heer.
        - Ulmus carpinoides Goeppert.
        - Ulmus diptera Steenstrup?
        - Ulmus longifolia Unger.
        - Ulmus plurinervia Unger.
        - Ulmus pseudobraunii Hollick, n. sp.
        - Ulmus sorbifolia Goeppert.
      - Planera Gmelin:
        - Planera aquaticiformis Hollick, n. sp.
        - Planera ungeri Ettingshausen.
    - Moraceae:
      - Artocarpidium Unger:
        - Artocarpidium alaskanum Hollick, n. sp.
      - Artocarpus Forster:
        - Artocarpus ordinarius Hollick, n. sp.
      - Ficus Linnaeus:
        - Ficus? alaskana Newberry.
        - Ficus dalli Cockerell.
        - Ficus menzeli Hollick, n. sp.
        - Ficus overbecki Hollick, n. sp.
        - Ficus stantoni Hollick, n. sp.
      - Protoficus Saporta:
        - Protoficus inaequalis Newberry?
  - Proteales:
    - Proteaceae:
      - Grevillea Salisbury and Knight:
        - Grevillea alaskana Hollick, n. sp.

Spermatophyta—Continued.
- Angiospermae—Continued.
  - Proteales—Continued.
    - Proteaceae—Continued.
      - Hakea Schrader:
        - Hakea alaskana Hollick, n. sp.
      - Macclintockia Heer:
        - Macclintockia chignikensis Hollick, n. sp.
  - Polygonales:
    - Polygonaceae:
      - Coccolobis P. Browne:
        - Coccolobis chapini Hollick, n. sp.
  - Ranales:
    - Nymphaeaceae:
      - Nelumbo Adanson:
        - Nelumbo protolutea Berry?
    - Magnoliaceae:
      - Magnolia Linnaeus:
        - Magnolia inglefieldi Heer.
        - Magnolia nordenskiöldi Heer.
        - Magnolia ovalis Lesquereux.
        - Magnolia wormskioldi Heer.
    - Lauraceae:
      - Cinnamomum R. Brown:
        - Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb.
        - Cinnamomum ficoides Hollick, n. sp.
      - Persea Gaertner:
        - Persea spatiosa Hollick, n. sp.
      - Sassafras Nees:
        - Sassafras alaskanum Hollick, n. sp.
      - Malapoenna Adanson:
        - Malapoenna carbonensis (Ward) Knowlton.
        - Malapoenna magnifica (Saporta) Hollick, n. comb.
      - Benzoin Fabricius:
        - Benzoin antiquum Heer.
      - Laurus Linnaeus:
        - Laurus californica Lesquereux.
        - Laurus fürstenbergii Alex. Braun.
        - Laurus hamiltonensis Hollick, n. sp.
        - Laurus ocotaefolia Ettingshausen.
        - Laurus princeps Heer.
        - Laurus saliciformis Knowlton and Cockerell.
      - Daphnogene Unger:
        - Daphnogene kanii Heer.
  - Rosales:
    - Hydrangeaceae:
      - Hydrangea Linnaeus:
        - Hydrangea alaskana Hollick.
    - Hamamelidaceae:
      - Hamamelis Linnaeus:
        - Hamamelis clarus Hollick, n. sp.
      - Liquidambar Linnaeus:
        - Liquidambar europaeum Alex. Braun.
    - Platanaceae:
      - Platanus Linnaeus:
        - Platanus aceroides latifolia Knowlton.
        - Platanus nobilis Newberry.
        - Platanus rectinervis Hollick, n. sp.
        - Platanus sp.? leaves, Dall.
        - Platanus sp. Knowlton.

- Spermatophyta—Continued.
  - Angiospermae—Continued.
    - Rosales—Continued.
      - Rosaceae:
        - Spiraea Linnaeus:
          - Spiraea andersoni Heer.
          - Spiraea weaveri Hollick, n. sp.
          - Spiraea sp. Heer.
        - Rosa Linnaeus:
          - Rosa cetera Hollick, n. sp.
          - Rosa confirmata Hollick, n. sp.
      - Pomaceae:
        - Crataegus Linnaeus:
          - Crataegus alaskensis Hollick, n. sp.
          - Crataegus cappsii Hollick, n. sp.
          - Crataegus yukonensis Hollick, n. sp.
      - Drupaceae:
        - Prunus Linnaeus:
          - Prunus hartungi aequalis Hollick, n. var.
          - Prunus olympica Ettingshausen.
          - Prunus scottii Heer.
          - Prunus variabilis Newberry.
      - Mimosaceae:
        - Pithecolobium Martius:
          - Pithecolobium ceterum Hollick, n. sp.
        - Acacia Adanson:
          - Acacia aquilonia Hollick, n. sp.
      - Caesalpiniaceae:
        - Cassia Linnaeus:
          - Cassia glenni Berry?
          - Cassia phaseolites Unger?
      - Papilionaceae:
        - Sophora Linnaeus:
          - Sophora multiformis Hollick, n. sp.
        - Canavalia Adanson:
          - Canavalia eocenica Berry.
        - Dolichos [Dolichus] Linnaeus:
          - Dolichos convexus Hollick, n. sp.
    - Geraniales:
      - Malpighiaceae:
        - Tetrapteris Cavanilles:
          - Tetrapteris harpyiarum Unger.
    - Sapindales:
      - Anacardiaceae:
        - Semecarpus Linnaeus:
          - Semecarpus alaskana Hollick, n. sp.
          - Semecarpus prindlei Hollick, n. sp.
        - Rhus Linnaeus:
          - Rhus frigida Knowlton.
      - Ilicaceae:
        - Ilex Linnaeus:
          - Ilex insignis Heer.
          - Ilex? reticulata Heer.
      - Celastraceae:
        - Celastrus Linnaeus:
          - Celastrus borealis Heer.
          - Celastrus comparabilis Hollick, n. sp.
          - Celastrus sp.? Heer.
        - Elaeodendron Jacques:
          - Elaeodendron helveticum Heer.
      - Aceraceae:
        - Acer Linnaeus:
          - Acer arcticum Heer.
          - Acer disputabilis Hollick, n. sp.
          - Acer grahamensis Knowlton and Cockerell.
          - Acer inaequale Heer?

- Spermatophyta—Continued.
  - Angiospermae—Continued.
    - Sapindales—Continued.
      - Aceraceae—Continued.
        - Acer Linnaeus—Continued.
          - Acer trilobatum productum (Alex. Braun) Heer.
          - Acer trilobatum var. Knowlton.
          - Acer visibilis Hollick, n. sp.
          - Acer sp.? fruit, Hollick.
      - Aesculaceae:
        - Aesculus Linnaeus:
          - Aesculus arctica Knowlton.
      - Sapindaceae:
        - Cupania Linnaeus:
          - Cupania comparabilis Hollick, n. sp.
        - Paullinia Linnaeus:
          - Paullinia alaskana Hollick, n. sp.
        - Sapindus Linnaeus:
          - Sapindus affinis Newberry?
          - Sapindus angustifolius Lesquereux (not Blume).
          - Sapindus basilicus (Unger) Unger.
        - Koelreuteria Laxmann:
          - Koelreuteria eakini Hollick, n. sp.
    - Rhamnales:
      - Rhamnaceae:
        - Rhamnus Linnaeus:
          - Rhamnus brevifolius Alex. Braun.
          - Rhamnus decheni Weber.
          - Rhamnus gaudini Heer.
          - Rhamnus marginatus Lesquereux.
          - Rhamnus pseudogoldianus Hollick, n. sp.
          - Rhamnus rossmaessleri Unger.
        - Zizyphus Adanson.
          - Zizyphus hyperboreus Heer.
          - Zizyphus meigsii (Lesquereux) Berry? (not Schimper).
          - Zizyphus townsendi Knowlton.
        - Paliurus Jussieu:
          - Paliurus ceterus Hollick, n. sp.
          - Paliurus colombi Heer.
      - Vitaceae:
        - Vitis Linnaeus:
          - Vitis alaskana Cockerell.
          - Vitis atwoodi Hollick, n. sp.
          - Vitis heeriana Knowlton and Cockerell? (=V. crenata Heer).
          - Vitis olriki Heer.
        - Cissus Linnaeus:
          - Cissus cissoides (Saporta) Hollick, n. comb.
          - Cissus pterospermoides Hollick, n. sp.
    - Malvales:
      - Elaeocarpaceae:
        - Elaeocarpus Linnaeus:
          - Elaeocarpus alaskensis Hollick, n. sp.
      - Tiliaceae:
        - Tilia Linnaeus:
          - Tilia alaskana Heer.
          - Tilia grewioides Hollick, n. sp.
          - Tilia malmgreni Heer.
          - Tilia notabilis Hollick, n. sp.
          - Tilia sp. Hollick.

- Spermatophyta—Continued.
  - Angiospermae—Continued.
    - Malvales—Continued.
      - Tiliaceae—Continued.
        - Grewia Linnaeus:
          - Grewia crenata (Unger) Heer.
          - Grewia orbiculata Hollick, n. sp.
          - Grewia zizyphoides Hollick, n. sp.
        - Grewiopsis Saporta:
          - Grewiopsis alaskana Hollick, n. sp.
          - Grewiopsis congerminalis Hollick, n. sp.
          - Grewiopsis defectivus Hollick, n. sp.
          - Grewiopsis frustratorius Hollick, n. sp.
          - Grewiopsis grandiculus Hollick, n. sp.
        - Apeibopsis Heer:
          - Apeibopsis? discolor (Lesquereux) Lesquereux.
      - Malvaceae:
        - Abutilon Gaertner:
          - Abutilon eakini Hollick, n. sp.
          - Abutilon sp.? Hollick.
      - Bombacaceae:
        - Hampea Schlechtendahl:
          - Hampea conditionalis Hollick, n. sp.
      - Sterculiaceae:
        - Pterospermites Heer:
          - Pterospermites alaskana Knowlton.
          - Pterospermites alternans Heer.
          - Pterospermites auriculaecordatus Hollick, n. sp.
          - Pterospermites conjunctivus Hollick, n. sp.
          - Pterospermites dentatus Heer (previous identification not confirmed).
          - Pterospermites imparilis Hollick, n. sp.
          - Pterospermites magnifolia Knowlton.
          - Pterospermites spectabilis Heer.
    - Parietales:
      - Dilleniaceae:
        - Dillenia Linnaeus:
          - Dillenia alaskana Hollick, n. sp.
        - Dillenites Berry:
          - Dillenites ceterus Hollick, n. sp.
          - Dillenites ellipticus Hollick, n. sp.
          - Dillenites ellipticus ulmifolius Hollick, n. var.
          - Dillenites microdentatus (Hollick) Berry.
        - Saurauja Willdenow:
          - Saurauja alaskana Hollick, n. sp.
    - Thymeleales:
      - Elaeagnaceae:
        - Lepargyraea Rafinesque:
          - Lepargyraea weaveri Hollick, n. sp.
    - Myrtales:
      - Combretaceae:
        - Terminalia Linnaeus:
          - Terminalia sp.? Hollick.
      - Trapaceae:
        - Trapa Linnaeus:
          - Trapa borealis Heer.
    - Umbellales:
      - Araliaceae:
        - Hedera Linnaeus:
          - Hedera auriculata Heer.
          - Hedera macclurii Heer.
        - Aralia Linnaeus:
          - Aralia delicatula Hollick, n. sp.
          - Aralia? sp. Hollick.
          - Aralia? sp. Hollick.

- Spermatophyta—Continued.
  - Angiospermae—Continued.
    - Umbellales—Continued.
      - Cornaceae:
        - Cornus Linnaeus:
          - Cornus büchii Heer.
          - Cornus hyperborea Heer?
          - Cornus irregularis Hollick, n. sp.
          - Cornus orbifera Heer.
        - Nyssa Linnaeus:
          - Nyssa arctica Heer.
        - Nyssidium Heer:
          - Nyssidium ekmani Heer.
  - Angiospermae (Dicotyledonae—Gamopetalae):
    - Ericales:
      - Ericaceae:
        - Rhododendron Linnaeus:
          - Rhododendron crassum Hollick, n. sp.
      - Vacciniaceae:
        - Vaccinium Linnaeus:
          - Vaccinium alaskanum Knowlton.
          - Vaccinium friesii Heer.
          - Vaccinium hollicki Knowlton.
          - Vaccinium sp. Heer.
    - Ebenales:
      - Ebenaceae:
        - Diospyros Linnaeus:
          - Diospyros alaskana Schimper.
          - Diospyros anceps Heer.
          - Diospyros brachysepala Alex. Braun.
          - Diospyros stenosepala Heer.
        - Ebenoxylon Felix:
          - Ebenoxylon boreale Platen.
      - Styracaceae:
        - Mohrodendron Britton:
          - Mohrodendron inopinum Hollick, n. sp.
    - Oleales:
      - Oleaceae:
        - Fraxinus Linnaeus:
          - Fraxinus herendeenensis Knowlton.
          - Fraxinus inordinata Hollick, n. sp.
          - Fraxinus johnstrupi Heer.
          - Fraxinus juglandina Saporta.
          - Fraxinus lateralis Hollick, n. sp.
          - Fraxinus? pseudobliqua Hollick, n. sp.
          - Fraxinus yukonensis Hollick, n. sp.
    - Rubiales:
      - Caprifoliaceae:
        - Viburnum Linnaeus:
          - Viburnum aequale Hollick, n. sp.
          - Viburnum antiquum (Newberry) Hollick.
          - Viburnum contortum Lesquereux.
          - Viburnum duriusculum Hollick, n. sp.
          - Viburnum evexum Hollick, n. sp.
          - Viburnum newberryanum Ward.
          - Viburnum nordenskiöldi Heer.
          - Viburnum obliquum Hollick.
          - Viburnum schmidtianum Heer?
          - Viburnum whymperi Heer?
          - Viburnum sp.? fruit, Hollick.
- Spermatophyta of undetermined ordinal and family relationship:
  - Nordenskiöldia Heer:
    - Nordenskiöldia borealis Heer.
  - Antholithes Brongniart:
    - Antholithes castaneoides Hollick, n. sp.
  - Palaeanthus Newberry:
    - Palaeanthus prindlei Hollick, n. sp.

Spermatophyta of undetermined ordinal and family relationship—Continued.

Phyllites Brongniart:
- Phyllites arctica Knowlton.
- Phyllites saundersi Knowlton.

Dicotyledonous leaves (gen. and sp.?) Hollick.

Carpolithes Schlotheim:
- Carpolithes auriformis Hollick, n. sp.
- Carpolithes elytraeformis Hollick, n. sp.

Carpites Schimper:
- Carpites sp. Knowlton.

Fruit or nut? Kay.

BOTANIC RELATIONS

The 388 floral elements listed in this paper include 327 described as species, 13 regarded as varieties, 42 that are merely identified generically, and 6 that consist of more or less unidentifiable remains. In connection with any numerical analysis of the flora, however, it is most convenient to enumerate and discuss it as consisting of 388 species (the term " species " being intended to signify element or entity), which may be grouped, taxonomically, as follows:

Taxonomic group	Species	Genera	Families	Orders	Percent
Thallophyta	1	1	1	1	0. 2
Pteridophyta	16	11	4	2	4. 1
Gymnospermae	40	15	4	3	10. 3
Monocotyledonae	15	10	7	6	3. 9
Dicotyledonae	306	94	47	21	78. 9
Uncertain	10	8(?)	(?)	(?)	2. 6
Total	388	139±	63+	33+	100. 0

The single representative of the Thallophyta (*Chondrites heerii* Eichwald) possesses some ecologic significance, inasmuch as it is presumably indicative of aquatic conditions; but otherwise it is an unimportant element in the flora and does not appear to require further discussion.

The group Pteridophyta, with 2 orders, is relatively well represented—the Filicales by 2 families (Polypodiaceae and Osmundaceae) that include not less than 10 genera and 12 or more species, and the Equisetales by 2 species included in a single genus (*Equisetum arcticum* Heer and *E. globulosum* Lesquereux). The Polypodiaceae is the largest family and includes the largest genus (*Pteris*, with 4 species). The order Filicales also includes such diverse and, apparently, strangely associated genera as the existing *Onoclea*, *Dryopteris*, *Asplenium*, and *Osmunda;* the more or less problematic Mesozoic *Hausmannia* and *Anthrophyopsis;* and *Pecopteris* and *Neuropteris*, which are generally recognized as strictly Paleozoic genera. The last two, however, may be disregarded, as it may be assumed that they represent early errors of identification and that the forms so assigned are actually referable to certain of the previously mentioned genera and probably to certain of the species. The species that may be regarded as of special interest are *Onoclea sensibilis* Linnaeus, by reason of its specific antiquity, being represented, apparently unchanged, in the flora of early Tertiary time and that of the present day; and *Anthrophyopsis hamiltonensis* Hollick, n. sp., by reason of its apparent close relationship to species of the tropical genus *Anthrophyum* (=*Antrophyum*) and its association with other fossil plants of tropical and subtropical facies—cycads, fan palms, etc.

Equisetum arcticum is noteworthy by reason of its abundance and its extensive areal distribution, having been identified in at least seven collections from localities scattered in such widely separated regions as the Matanuska coal field, Alaska Peninsula, and the Yukon Valley.

The Gymnospermae are abundantly represented, both numerically and relatively, by about 40 species, included in 15 genera, 4 families, and 3 orders (Cycadales, Ginkgoales, and Coniferales). Of these the order Cycadales is in certain respects, of special interest. Remains of Tertiary cycads are rare: 22 species have been previously recorded—13 in the Eastern Hemisphere and 9, of which only 3 are North American, in the Western Hemisphere. Moreover, existing cycads represent a strictly tropical type of vegetation; hence the identification of representatives of two existing genera, neither of them heretofore recorded in the fossil state, and including three new species (*Ceratozamia wrightii*, *Dioön inopinus*, and *D. praespinulosum*), in the Tertiary flora of the boreal zone in Alaska, may be regarded as one of the items of special interest in the present connection.

Of the Ginkgoales, represented in our existing flora by a single species (*Ginkgo biloba* Linnaeus), native only in eastern Asia, there are at least 2 species (*G. adiantoides* (Unger) Heer and *G. reniformis conformis* Hollick, n. var.) widely distributed in the Tertiary flora of Alaska.

The Coniferales is the largest order of the Gymnospermae. It includes 2 families—the Taxaceae, with a single genus and 2 species (*Taxites olriki* Heer and *T. microphyllus* Heer), and the Pinaceae, with about 30 species included in 10 or more genera. The two genera most abundantly represented by species and by actual number of specimens are *Sequoia* and *Taxodium*. It should be noted, however, that remains which have been identified as belonging to one or the other of these genera are frequently difficult, if not impossible, to differentiate satisfactorily, as may be appreciated by comparing the numerous figures included under the two species *Sequoia langsdorfii* (Brongniart) Heer, in its varied forms, and *Taxodium dubium* (Sternberg) Heer and its several recognized varieties. Taken together, the numerous forms and varieties of these two species might perhaps be considered one of the most characteristic and abundant features, not only of the Gymnospermae but also of the Tertiary flora as a whole. Remains of specimens referable to one or the other, or to both, of these species occur, probably, in a larger number of the collections than those of any other identified species. Those identified as *Sequoia langsdorfii*, for example, have been recorded from more than 15 localities, distributed in southeastern Alaska, the Matanuska coal field, Kenai Peninsula, Alaska Peninsula, and the upper Yukon region. In our existing flora the genus *Sequoia* is represented by two species only, both restricted in their distribution to California—*S. gigantea* Decaisne, the "bigtrees" of the Sierra, and *S. sempervirens* (Lambert) Endlicher, the "redwoods" of the coastal region. The genus *Taxodium*, in our existing flora, is limited in its range to the southern United States and Mexico, where it is represented by a single species—*T. distichum* (Linnaeus) L. C. Richard, commonly known as "bald cypress"—or possibly by two that are closely allied or that may be regarded as merely differing varietally.

Another tree that was evidently an important element in the Alaskan Tertiary flora is *Glyptostrobus europaeus* (Brongniart) Unger, which is abundantly represented in collections from southeastern Alaska, the Yakutat Bay region, and the Matanuska coal field. In our existing flora the genus is represented by a single species—*G. heterophyllus* Endlicher, native only in southeastern China—and it is closely allied, taxonomically, to *Taxodium*. All three of these genera were formerly holarctic in distribution, whereas *Sequoia* and *Taxodium* are now extinct in Eurasia and are limited to relatively small areas in subtropical and temperate regions in North America; and *Glyptostrobus* is now extinct in North America and exists only in a warm-temperate area of moderate extent in Asia.

As a climatic index the presence of the three coniferous genera above mentioned would naturally imply that warm-temperate conditions must have prevailed at the time when and in the region where they were growing. On the other hand, however, if certain other coniferous genera present in the flora (*Pinus*, *Picea*, *Abies*, etc.) are grouped together, a temperate-boreal facies would appear to be indicated.

The Angiospermae, which include the Monocotyledonae, the Dicotyledonae, and a few remains of uncertain family and ordinal relationships, form overwhelmingly the largest group or phylum, being represented by 331 species, or 85.4 percent of the entire flora.

The Monocotyledonae are represented by 15 species, included in 10 genera, 7 families, and 6 orders. None of these would attract any special attention were it not for the presence of two species (*Flabellaria florissanti* Lesquereux and *F. alaskana* Hollick, n. sp.) that are unmistakably referable to the fan palms of the Arecaceae. This family of plants, at the present time, is strictly tropical and subtropical in its distribution, and any fossil representatives of the family—as in connection with the Cycadaceae—must logically be accepted as evidence that at least subtropical climatic conditions prevailed during the time that these plants were living elements in the flora.

The Dicotyledonae represent the largest class assemblage of species in the flora. They include 306 specific elements, or 78.9 percent of the entire flora, of which the Choripetalae number 277 and the Gamopetalae 29; and, in addition, there are 10 species referable to the Dicotyledonae whose group relationships have not been definitely determined. If the class is analyzed by utilizing the genera as climatic indices, the inferences that may be deduced appear to be more or less contradictory or inconclusive, although a broad statement to the general effect that the general facies indicates a north-temperate flora, with a considerable representation of subtropical and tropical elements, would probably be accepted by those who are informed on the subject. For example, the amentiferous genera (*Populus*, *Salix*, *Myrica*, *Juglans*, *Betula*, *Carpinus*, *Corylus*, *Alnus*, *Fagus*, *Castanea*, *Quercus*, and *Ulmus*) included in the Salicales, Myricales, Juglandales, Fagales, and Urticales, representing about 126 species, or about 33.5 percent of the entire flora and 41 percent of the Dicotyledonae, are in the existing flora prevailingly characteristic of temperate and boreal regions. It may also be noted as significant that the genus *Populus* is represented in the Tertiary flora of Alaska by 18 species, *Salix* by 16, *Juglans* by 16, *Quercus* by 17, *Corylus* by 10, and *Betula*, *Alnus*, and *Ulmus* by 8 each. The only other genera of the Dicotyledonae that exceed or equal any of these in number of species are *Viburnum*, with 11, and *Acer* and *Pterospermites*, 8 each. *Viburnum* and *Acer* are characteristically north temperate in their distribution, and *Pterospermites*, a fossil genus of uncertain systematic status, is the only one prolific in species that may be inferred to represent warmer climate.

Other genera inferentially representing elements of a tropical and subtropical flora are: *Piper*, *Engelhardtia*, *Artocarpus* (and *Artocarpidium?*), *Ficus* (and *Protoficus?*), *Grevillea*, *Hakea*, *Coccolobis*, *Magnolia*, *Cinnamomum*, *Persea*, *Malapoenna*, *Laurus*, *Pithecolobium*, *Acacia*, *Sophora*, *Canavalia*, *Dolichos*, *Tetrapteris*, *Semecarpus*, *Elaeodendron*, *Cupania*, *Paullinia*, *Sapindus*, *Zizyphus*, *Cissus*, *Elaeocarpus*, *Grewia* (and *Grewiopsis?*), *Apeibopsis?*, *Abutilon*, *Hampea*, *Dillenia* (and *Dillenites?*), *Saurauja*, and *Terminalia*. This represents an impressive array of evidence in favor of warm climatic conditions; and it may also be noted that certain other genera, such as *Smilax*, *Nelumbo*, *Liquidambar*, *Cassia*, *Aralia*, *Nyssa*, *Diospyros*, and *Mohrodendron*, although represented by many temperate-zone species in our existing flora, are equally well represented by species that are subtropical and tropical in their distribution.

A salient fact, also, which may not be ignored in this connection is that the existing genera characteristic of temperate and boreal zone distribution (*Populus*, *Salix*, *Juglans*, *Corylus*, etc.) are the genera in the Tertiary flora that are most prolific in species; whereas those that may be regarded as characteristically subtropical and tropical in their distribution (*Ceratozamia*, *Dioön*, *Flabellaria*, *Piper*, *Artocarpus*, *Ficus*, *Laurus*, *Paullinia*, *Dillenia*, *Saurauja*, *Terminalia*, etc.) are but sparsely represented in specific elements, the largest number (6) being included under *Laurus*, while most of the other genera in the same category (*Grevillea*, *Coccolobis*, *Sophora*, *Cupania*, *Mohrodendron*, etc.)—some 20 or more—are represented each by only a single species. Obviously some explanation should be forthcoming to account for what appears to be such an incongruous association of floral elements. In the first place, however, we should realize that in the systematic arrangement of the flora it is treated as if it represented a single florule or floral assemblage, regardless of regional and zonal distribution, or probable differences in stratigraphic position here and there.

Analysis and comparison of lists of species from different localities do not assist to any appreciable extent in explaining the meaning or significance of the apparently peculiar generic associations. A geographic arrangement of the flora, however, does appear to result in a slight indication of regional differentiation. The collections from localities in the southern part of the Territory, for example, present a somewhat more tropical facies than those from localities farther north. Thus it is only in collections from southeastern Alaska that typically tropical genera such as *Anthrophyopsis*, *Ceratozamia*, *Dioön*, and *Flabellaria* have been identified, associated with species of *Piper*, *Laurus*, *Sapindus*, *Acacia*, *Dillenia*, *Dillenites*, *Mohrodendron*, *Saurauja*, etc., and a small minority of genera that would be indicative of cooler climatic conditions, such as *Populus*, *Juglans*, *Alnus*, and *Ulmus*. On the other hand, if the collections from the Cook Inlet region, about 200 miles farther north, are analyzed in a similar manner, it will at once be apparent that the temperate-zone genera are in overwhelming majority and that the tropical and subtropical elements are so few as to be almost negligible. Similar minor regional differences may be noted in connection with collections from other localities, but whether these obvious floral differences are due to geographic distribution, or to relative stratigraphic position, cannot be satisfactorily determined until the stratigraphy of the plant-bearing beds has been more thoroughly coordinated and correlated.

If the existing genera represented in the flora are analyzed from the viewpoint of modern phytogeography several interesting facts are revealed:

(*a*) Twelve are exclusively New World in their distribution, as follows:

Ceratozamia, 6 species	Mexico.
Dioön, 2 species	Mexico.
Sequoia, 2 species	California.
Taxodium, 2 species	Southern North America and Mexico.
Comptonia, 1 species	Canada, eastern United States to Florida.
Hicoria, 10 species	Eastern North America and Mexico.
Coccolobis, about 25 species	Tropical and subtropical regions.
Tetrapteris, about 50 species	Tropical regions.
Cupania, about 30 species	Tropical and subtropical regions.
Hampea, 2 species	Mexico and Colombia.
Lepargyrea,[42] 3 species	Temperate and boreal North America.
Mohrodendron, 3 species	Southeastern North America.

(*b*) Eleven are exclusively Old World genera, restricted in their distribution to eastern and southern Asia and Australia, as follows:

Hausmannia (*Dipteris*), 4 species.	Southeastern Asia.
Ginkgo, 1 species	China and Japan.
Glyptostrobus, 2 species	China.
Engelhardtia, 9 species	Southern Asia.
Artocarpus, about 40 species	Southeastern Asia.
Grevillea, about 150 species	Australia.
Hakea, about 100 species	Australia.
Cinnamomum, about 50 species	Eastern Asia and Australia.
Semecarpus, about 40 species	Southern Asia and Australia.
Koelreuteria, 2 species	China.
Dillenia, about 25 species	Eastern Asia and Australia.

(*c*) Eleven are common to both the New World and the Old but are, with three exceptions, exclusively eastern Asiatic in their Old World distribution, as follows:

Onoclea, 1 species	Eastern North America and eastern Asia.
Nelumbo, 2 species	Eastern and southern North America, northern South America, and Asia, mostly eastern.
Magnolia, 20 species	Eastern North America and Asia, mostly eastern.
Persea, about 10 species	Tropical and subtropical America and eastern Asia.

[42] *Elaeagnus*, the genus most closely allied, includes about 12 species—one native in North America, the others in eastern Asia.

Sassafras, 2 species	Eastern North America and China.
Benzoin, about 12 species	Eastern North America and eastern Asia.
Hamamelis, 3 species	Eastern North America and eastern Asia.
Liquidambar, 3 species	Eastern and southern North America, Central America, Island of Formosa, and Asia Minor.
Celastrus, about 25 species	North America, northern South America(?), eastern Asia, and Australia.
Saurauja, about 60 species	Tropical America and Asia.
Nyssa, about 6 species	Eastern and southern North America and eastern Asia.

Also, if those genera that are of more or less cosmopolitan distribution are analyzed and considered in this connection, it may be noticed that America and eastern Asia are linked together in a large number of the generic distributional regions, of which, as a few characteristic examples, the following may be cited:

Dennstaedtia, about 15 species.	Eastern North America, eastern Asia, and elsewhere.
Asplenium, about 200 species.	North and South America, eastern Asia, and elsewhere.
Osmunda, about 6 species	Eastern North America, West Indies, eastern Asia, and elsewhere.
Smilax, about 200 species	North and South America, eastern Asia, and elsewhere.
Myrica, about 40 species	North America, eastern Asia, and elsewhere.
Corylus, 7 species	Eastern North America, central and eastern Asia, and elsewhere.
Fagus, 4 species	Eastern North America, Japan, and elsewhere.

And a number of others are characteristically eastern Asiatic, although occurring elsewhere, such as the following:

Pterocarya, about 4 species.	Japan, China, and southern Europe.
Paliurus, 2 species	Japan, China, and southern Europe.
Elaeocarpus, about 60 species.	Eastern Asia, Australia, and Hawaii.
Grewia, about 80 species.	Eastern Asia, Australia, and South Africa.

On the other hand, the cosmopolitan genera that include Europe in their distribution are largely confined to the Northern Hemisphere, and none are exclusively European. In this connection the following may be noted:

Pinus, about 70 species.	Temperate and boreal Europe, Asia, and North America.
Picea, 12 species	Europe, northern Asia, and North America.
Abies, 20 species	Europe, temperate and boreal Asia, and North America.
Populus, about 18 species.	Europe, temperate and boreal Asia, northern Africa, and North America.
Carpinus, 12 species	Europe, central and eastern Asia, and North America.
Betula, 35 species	Europe, northern Asia, and North America.
Castanea, 2 species	Europe and eastern North America.
Ulmus, 16 species	Europe, Asia, and North America.
Platanus, 2 species	Europe and North America.
Spiraea, about 40 species.	Europe, temperate and boreal Asia, temperate and boreal North America.
Crataegus, about 40 species.	Europe, temperate and boreal Asia, temperate and boreal North America.
Aesculus, about 14 species.	Europe, northern temperate Asia, and North America.

When the above-listed facts of existing generic distribution are interpreted the logical conclusion that may be deduced appears to be that the Tertiary flora of Alaska, in its entirety, had its closest Old World relationships with that of eastern Asia and Australasia, as would naturally be expected.

FOSSIL-PLANT LOCALITIES

In the following pages are given lists of the Tertiary plants collected in Alaska, arranged geographically by general regions.

SOUTHEASTERN ALASKA REGION

210. Baranof Island:
  - Ginkgo adiantoides (Unger) Heer.
  - Sagittaria sp. Lesquereux.
  - Carex sp. (leaves) Lesquereux.

3651. Kuiu Island:
  - Asplenium alaskanum Hollick, n. sp.
  - Taxodium dubium (Sternberg) Heer.
  - Taxodium tinajorum Heer.
  - Carpinus grandis Unger.
  - Alnus alnifolia (Goeppert) Hollick, n. comb.
  - Ulmus carpinoides Goeppert.

7580. Kuiu Island:
  - Osmunda doroschkiana Goeppert.
  - Castanea castaneaefolia (Unger) Knowlton.
  - Planera ungeri Ettingshausen.

3652. Kupreanof Island, Hamilton Bay:
  - Anthrophyopsis hamiltonensis Hollick, n. sp.
  - Taxites olriki Heer.
  - Juglans nigella Heer.
  - Juglans? pseudopunctata Hollick, n. sp.
  - Ulmus sorbifolia Goeppert.
  - Malapoenna carbonensis (Ward) Knowlton?
  - Dillenites ellipticus ulmifolius Hollick, n. var.

4389. Kupreanof Island, Hamilton Bay, highest of three horizons:
  - Dioön inopinus Hollick.
  - Dioön praespinulosum Hollick.
  - Sequoia langsdorfii (Brongniart) Heer.
  - Glyptostrobus europaeus (Brongniart) Unger.
  - Piper concavum Hollick, n. sp.
  - Juglans longiapiculata Hollick, n. sp.
  - Magnolia inglefieldi Heer?
  - Laurus hamiltonensis Hollick, n. sp.
  - Sassafras alaskanum Hollick, n. sp.
  - Malapoenna magnifica (Saporta) Hollick, n. comb.

4389. Kupreanof Island, Hamilton Bay, highest of three horizons—Continued.
   Sapindus basilicus (Unger) Unger.
   Dillenites ellipticus Hollick, n. sp.
   Dillenites ellipticus ulmifolius Hollick, n. var.
   Dillenites microdentatus (Hollick) Berry.
   Dicotyledonous leaf (gen. and sp.?).

4391. Kupreanof Island, Hamilton Bay, intermediate of three horizons:
   Taxodium tinajorum Heer.
   Sequoia langsdorfii (Brongniart) Heer.
   Glyptostrobus europaeus (Brongniart) Unger.
   Populus speciosa Ward?
   Grewiopsis frustratorius Hollick, n. sp.
   Grewiopsis defectivus Hollick, n. sp.
   Pterospermites conjunctivus Hollick, n. sp.

4392. Kupreanof Island, Hamilton Bay, lowest of three horizons:
   Anthrophyopsis hamiltonensis Hollick, n. sp.
   Dioön praespinulosum Hollick, n. sp.
   Sequoia brevifolia Heer.
   Glyptostrobus europaeus (Brongniart) Unger.
   Flabellaria alaskana Hollick, n. sp.
   Juglans egregia Lesquereux.
   Juglans valida Hollick, n. sp.
   Dryophyllum longipetiolatum Knowlton.
   Malapoenna magnifica (Saporta) Hollick, n. comb.
   Laurus fürstenbergii Alex. Braun.
   Rhamnus rossmaessleri Unger.
   Dillenites ceterus Hollick, n. sp.
   Dillenites ellipticus Hollick, n. sp.
   Fraxinus? pseudobliqua Hollick, n. sp.

7474. Kupreanof Island:
   Onoclea sensibilis Linnaeus.
   Ceratozamia wrightii Hollick.
   Taxodium crassum Hollick, n. sp.
   Laurus californica Lesquereux.
   Dillenia alaskana Hollick, n. sp.
   Dillenites ellipticus Hollick, n. sp.

7565. Kupreanof Island:
   Pteris sitkensis Heer.
   Dioön praespinulosum Hollick.
   Taxodium occidentale Newberry.
   Sequoia langsdorfii (Brongniart) Heer.
   Flabellaria alaskana Hollick, n. sp.
   Populus balsamoides Goeppert.
   Populus glandulifera Heer.
   Castanea castaneaefolia (Unger) Knowlton.
   Dryophyllum stanleyanum Dawson.
   Magnolia inglefieldi Heer.
   Malapoenna magnifica (Saporta) Hollick, n. comb.
   Laurus californica Lesquereux.
   Vitis olriki Heer.
   Saurauja alaskana Hollick, n. sp.

4390. Admiralty Island, Kootznahoo Inlet:
   Sequoia langsdorfii acuta Heer.
   Sequoia langsdorfii angustifolia Heer.
   Taxodium dubium longifolium Massalongo.
   Taxodium dubium (Sternberg) Heer.
   Populus amblyrhyncha Ward.
   Populus flexuosa Hollick, n. sp.
   Juglans nigella Heer.
   Juglans strozziana Gaudin?
   Quercus furuhjelmi Heer.
   Vitis atwoodi Hollick, n. sp.
   Tilia grewioides Hollick, n. sp.
   Tilia malmgreni Heer.

4390. Admiralty Island, Kootznahoo Inlet—Continued.
   Tilia notabilis Hollick, n. sp.
   Tilia sp.?
   Acacia aquilonia Hollick, n. sp.
   Mohrodendron inopinum Hollick, n. sp.
   Rhamnus pseudogoldianus Hollick, n. sp.
   Nyssidium ekmani Heer.

7518. Zarembo Island:
   Sequoia langsdorfii (Brongniart) Heer.

7566. Whitney Island:
   Chondrites heeri Eichwald?

Collections by others than members of United States Geological Survey

[List compiled from paleobotanic literature]

Alexander Archipelago, "prope Sitka." Furuhjelm, fide Heer:
   Taxodium distichum miocenum Heer.

Alexander Archipelago [Sitka?]. Nelson, E. W., fide Lesquereux:
   Carex, leaves.
   Sagittaria n. sp.
   Ginkgo adiantoides (Unger) Heer.

Kuiu ["Kuju"] Island. Furuhjelm, fide Heer, Eichwald:
   Pteris sitkensis Heer, fide Eichwald.
   Pecopteris sp. (=P. lignitum Giebel?), fide Heer.
   Glyptostrobus europaeus (Brongniart) Unger, fide Heer.
   Corylus macquarrii (Forbes) Heer, fide Eichwald.

Kuiu Island. Dall:
   Pteris.
   Sequoia langsdorfii.
   Glyptostrobus.
   Castanea.
   Corylus macquarrii.

Keku Island. Furuhjelm, fide Heer:
   Sequoia langsdorfii (Brongniart) Heer.
   Widdringtonia sp. Heer.
   Corylus macquarrii (Forbes) Heer.

"Insel Hudsnoi" [=Hudsunos, Kootznahoo, or Admiralty Island]. Doroschin, fide Goeppert, 1861; Newberry, 1882 (1883):
   Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer, fide Goeppert].
   Populus balsamoides Goeppert, fide Goeppert.
   Populus eximia Goeppert.
   Juglans acuminata Alex. Braun.

"Admiralty Inlet", fide Newberry:
   Alnus alaskana Newberry.

"Admiralty Inlet." Capt. W. A. Howard, 1867, fide Newberry:
   Ficus? alaskana Newberry.
   Vitis alaskana Cockerell [may=Vitis rotundifolia Newberry (not V. rotundifolia Michaux)].

YAKUTAT-COPPER RIVER REGION

3879. Yakutat Bay:
   Asplenium alaskanum Hollick, n. sp.
   Pteris pseudopennaeformis Lesquereux.
   Glyptostrobus europaeus (Brongniart) Unger.
   Magnolia wormskioldi Heer.
   Celastrus comparabilis Hollick, n. sp.
   Tetrapteris harpyiarum Unger.
   Hampea conditionalis Hollick, n. sp.
   Carpolithes elytraeformis Hollick, n. sp.

"Danaáku", Silver Lake, Krause brothers, fide Felix:
   Pityoxylon inaequale Felix.

3702. Bering Lake:
Canavalia eocenica Berry.
3705. Bering River:
Daphnogene kanii Heer.
Bering River coal field:
Fruit or nut? Thomas [shales of Toku formation, fide Kay].
3842. Grade trail, Cabin coal opening:
Piper concavum Hollick, n. sp.
3846. Creek flowing into head of Canyon Creek:
Pteris inaequilateralis Hollick, n. sp.
Piper disputabilis Hollick, n. sp.
Dryophyllum stanleyanum Dawson.
Cornus büchii Heer.
Cornus hyperborea Heer?
Cornus irregularis Hollick, n. sp.
3847. Happy Hollow trail, Berg Lake:
Asplenium alaskanum Hollick, n. sp.
Populus balsamoides Goeppert.
Juglans thermalis Lesquereux.
Planera aquaticiformis Hollick, n. sp.
Ulmus pseudobraunii Hollick, n. sp.
Artocarpidium alaskanum Hollick, n. sp.
Mohrodendron inopinum Hollick, n. sp.
Magnolia ovalis Lesquereux.
Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb.
Persea spatiosa Hollick, n. sp.
Malapoenna magnifica (Saporta) Hollick, n. comb.
Rhamnus marginatus Lesquereux.
Rhamnus pseudogoldianus Hollick, n. sp.
Terminalia sp.?
Semecarpus alaskana Hollick, n. sp.
Cornus hyperborea Heer?
Rhododendron crassum Hollick, n. sp.
Fraxinus lateralis Hollick, n. sp.
3848. Glacier Creek:
Rhamnus decheni Weber.
3021. Copper River Basin, Gakona Glacier:
Ulmus diptera Steenstrup.
Taxites olriki Heer.

MATANUSKA-COOK INLET REGION

3672. Chickaloon River:
Ficus menzeli Hollick, n. sp.
Acer inaequale Heer?
Fraxinus juglandina Saporta.
6289. T. E. O'Brien coal claim, 14 miles above mouth of Chickaloon River:
Taxites olriki Heer.
Piper septentrionalis Hollick, n. sp.
3954. Moose Creek:
Magnolia inglefieldi Heer.
5892. Matanuska River near Moose Creek:
Equisetum arcticum Heer.
Glyptostrobus europaeus (Brongniart) Unger.
Arundo pseudogoepperti Berry?
Populus balsamoides Goeppert.
Myrica (Comptonia) vindobonensis (Ettingshausen) Heer.
Juglans crossii Knowlton.
Juglans juglandiformis (Sternberg) Giebel.
Pterocarya septentrionalis Hollick, n. sp.
Quercus alaskana Trelease?
Quercus artocarpites Ettingshausen.
Quercus conjunctiva Hollick, n. sp.
Quercus juglandina Heer?

5892. Matanuska River near Moose Creek—Continued.
Quercus meriani Heer.
Prunus scottii Heer.
Cassia phaseolites Unger?
Ilex? reticulata Heer.
Rhamnus gaudini Heer.
Viburnum sp?, fruit.
Pterospermites auriculaecordatus Hollick, n. sp.
Pterospermites imparilis Hollick, n. sp.
Mohrodendron inopinum Hollick, n. sp.
Fraxinus inordinata Hollick, n. sp.
Fraxinus juglandina Saporta.
Fraxinus lateralis Hollick, n. sp.
Fraxinus yukonensis Hollick, n. sp.
Antholithes castanaeoides Hollick, n. sp.
5901. Matanuska River, west from Moose Creek:
Juglans crossii Knowlton.
Juglans juglandiformis (Sternberg) Giebel.
Quercus conjunctivus Hollick, n. sp.
Quercus juglandina Heer?
Dryophyllum aquilonium Hollick, n. sp.
Magnolia inglefieldi Heer.
Laurus saliciformis Knowlton and Cockerell.
Rosa cetera Hollick, n. sp.
Cassia glenni Berry?
Pterospermites auriculaecordatus Hollick, n. sp.
Fraxinus johnstrupi Heer.
3955. Kings River:
Pterospermites spectabilis Heer.
Viburnum contortum Lesquereux.
5895. Kings River:
Onoclea sensibilis Linnaeus.
Taxodium occidentale Newberry.
Piper septentrionalis Hollick, n. sp.
Hampea conditionalis Hollick, n. sp.
Protoficus inaequalis Newberry?
5896. Little Kings Creek, near Kings River:
Flabellaria florissanti Lesquereux.
5898. South of pond on mountain between Kings River and Youngs Creek:
Equisetum arcticum Heer.
Glyptostrobus europaeus (Brongniart) Unger.
Piper convertabilis Hollick, n. sp.
Nyssidium ekmani Heer.
5904. Red Mountain, 4 miles north of Youngs Creek:
Populus gaudini Fischer-Ooster.
5897. Eska Creek:
Sequoia langsdorfii (Brongniart) Heer.
Taxodium dubium (Sternberg) Heer.
Taxites olriki Heer.
Arundo pseudogoepperti Berry?
Piper chapini Hollick, n. sp.
Populus amblyrhyncha Ward.
Populus arctica Heer.
Populus gaudini Fischer-Ooster.
Populus latior Alex. Braun.
Populus mutabilis Heer.
Populus richardsoni Heer.
Hakea alaskana Hollick, n. sp.
Juglans nigella Heer.
Juglans? pseudopunctata Hollick, n. sp.
Castanea castaneaefolia (Unger) Knowlton.
Quercus grönlandica Heer.
Ulmus longifolia Unger.
Coccolobis chapini Hollick, n. sp.
Laurus ocotaefolia Ettingshausen.
Dolichos convexus Hollick, n. sp.

5897. Eska Creek—Continued.
Sapindus affinis Newberry?
Sapindus angustifolius Lesquereux? (not Blume).
Acer arcticum Heer.
Acer inaequale Heer?
Paliurus ceterus Hollick, n. sp.
Cissus cissoides (Saporta) Hollick, n. comb.
Cissus pterospermoides Hollick, n. sp.
Grewiopsis alaskana Hollick, n. sp.
Viburnum obliquum Hollick, n. sp.
Viburnum newberryanum Ward.

5900. Sheep Valley (Arkose series):
Populus zaddachi Heer?
Quercus platania Heer.

5899. Northeast of U. S. L. M. 1:
Quercus grönlandica Heer.
Quercus platania Heer
Paliurus ceterus Hollick, n. sp.

3518. Port Graham (Coal Bay):
Quercus oregoniana Knowlton.

4129. Kachemak Bay, Troublesome Gulch:
Sequoia langsdorfii (Brongniart) Heer.
Sequoia langsdorfii acuta Heer.
Taxodium dubium normale Massalongo.
Taxodium tinajorum Heer.
Salix raeana Heer.
Salix tenera Alex. Braun.
Salix grandifolia Weber.
Juglans salicifolia Goeppert.
Engelhardtia ettingshauseni Berry.
Corylus adumbrata Hollick, n. sp.
Betula prisca Ettingshausen.
Betula sp.?, pistillate ament.
Betula sp.?, aments.
Fagus alnitifolia Hollick, n. sp.
Quercus steenstrupiana Heer.
Ulmus sorbifolia Goeppert.
Grevillea alaskana Hollick, n. sp.
Magnolia inglefieldi Heer.
Laurus saliciformis Knowlton and Cockerell.

4131. Kachemak Bay, Fritz Creek:
Taxodium tinajorum Heer.
Salix abbreviata Goeppert.
Juglans? pseudopunctata Hollick, n. sp.
Corylus adumbrata Hollick, n. sp.
Alnus corylina Knowlton and Cockerell.
Alnus sp.?, pistillate aments.
Ulmus sorbifolia Goeppert.
Benzoin antiquum Heer.
Spiraea weaveri Hollick, n. sp.
Rhamnus brevifolius Alex. Braun.
Lepargyraea weaveri Hollick, n. sp.
Diospyros anceps Heer.

5820. Kachemak Bay, Bluff Point:
Salix alaskana Hollick, n. sp.
Betula sp.?, pistillate ament.
Prunus hartungi aequalis Hollick, n. var.
Prunus olympica Ettingshausen.
Rosa confirmata Hollick, n. sp.

5821. Kachemak Bay, Bluff Point:
Salix angusta Alex. Braun.
Salix varians Goeppert.
Corylus americana fossilis Newberry.
Corylus kenaiana Hollick, n. sp.
Corylus sp.?, aments.
Betula confusa lata Hollick, n. var.
Betula prisca Ettingshausen.

5821. Kachemak Bay, Bluff Point—Continued.
Betula sp.?, aments.
Alnus corylina Knowlton and Cockerell.
Ulmus borealis Heer.
Grevillea alaskana Hollick, n. sp.
Laurus saliciformis Knowlton and Cockerell.
Rhamnus gaudini Heer.
Elaeocarpus alaskensis Hollick, n. sp.
Fraxinus juglandina Saporta.

5822. Kachemak Bay, east of Bradley Creek:
Laurus princeps Heer.
Laurus saliciformis Knowlton and Cockerell.

6061. Southwest of Point Naskowhak:
Fagus antipofii Abich.

4130. Cook Inlet, west shore, south of Old Tyonek:
Taxodium tinajorum Heer.
Corylus adumbrata Hollick, n. sp.
Carpinus grandis Unger.
Alnus alaskana Newberry.
Quercus olafseni Heer.
Quercus dallii Lesquereux.
Fagus deucalionis Unger.

3505. Chinitna Bay:
Ginkgo reniformis conformis Hollick, n. var.
Taxodium tinajorum Heer.

6063. Yentna River, Cache Creek:
Quercus pseudocastanea Goeppert.
Acer sp.?, fruit.

Collections by others than members of the United States Geological Survey

[List compiled from paleobotanic literature]

Port Graham. Furuhjelm, fide Heer:
Taxites olriki Heer.
Taxites microphyllus Heer.
Pinus sp. Heer.
Pinus sp. Heer.
Sequoia langsdorfii (Brongniart) Heer.
Taxodium sp. Heer.
Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer].
Taxodium tinajorum Heer.
Phragmites alaskana Heer.
Phragmites sp. Heer.
Poacites tenue-striatus Heer.
Poacites sp. Heer.
Carex servata Heer.
Populus balsamoides Goeppert.
Populus glandulifera Heer.
Populus latior Alex. Braun.
Populus leucophylla Unger.
Populus zaddachi Heer?
Salix lavateri Heer.
Salix macrophylla Heer.
Salix varians Goeppert.
Salix sp. Heer.
Myrica banksiaefolia Unger.
Juglans acuminata Alex. Braun.
Juglans nigella Heer.
Juglans picroides Heer.
Juglans woodiana Heer.
Carpinus grandis Unger.
Corylus macquarrii (Forbes) Heer.
Corylus macquarrii macrophylla Heer.
Betula grandifolia Ettingshausen.
Betula prisca Ettingshausen.
Betula sp. Heer.

Port Graham—Continued.
- Alnus nostratum Unger [may=A. kefersteinii var. Heer].
- Fagus antipofii Abich.
- Fagus castaneaefolia Unger [=Castanea castaneaefolia (Unger) Knowlton].
- Fagus feroniae Unger.
- Fagus lancifolia Heer [=F. antipofii Abich].
- Fagus sp. Heer.
- Quercus alaskana Trelease?
- Quercus chamissoni Heer.
- Quercus furuhjelmi Heer.
- Quercus pandurata Heer [=Q. alaskana Trelease?]
- Quercus pseudocastanea Goeppert.
- Ulmus plurinervia Unger.
- Planera ungeri Ettingshausen.
- Liquidambar europaeum Alex. Braun.
- Spiraea andersoni Heer.
- Spiraea sp. Heer.
- Ilex insignis Heer.
- Celastrus borealis Heer.
- Celastrus sp.? Heer.
- Acer grahamensis Knowlton and Cockerell [=A. macropterum Heer (not A. macropterum Visiani)].
- Vitis heeriana Knowlton and Cockerell? [=V. crenata Heer].
- Tilia alaskana Heer.
- Trapa Dall.
- Trapa borealis Heer.
- Hedera auriculata Heer.
- Vaccinium friesii Heer.
- Vaccinium sp. Heer.
- Diospyros alaskana Schimper [=D. lancifolia Lesquereux].
- Diospyros stenosepala Heer.

Kachemak Bay, Kenai Peninsula. Furuhjelm, fide Heer and Eichwald:
- Chondrites sp. Heer.
- Chondrites heeri Eichwald?

Ninilchik River, east shore of Cook Inlet. Furuhjelm:
- Sequoia langsdorfii (Brongniart) Heer.
- Taxodium dubium (Sternberg) Heer.
- Taxodium sp. Heer.
- Sparganium sp. Heer.
- Myrica (Comptonia) vindobonensis (Ettingshausen) Heer.
- Myrica sp. Heer.
- Salix macrophylla Heer [not S. macrophylla Reuss].
- Salix varians Goeppert.
- Corylus macquarrii (Forbes) Heer.
- Betula macrophylla Goeppert [not B. macrophylla Ettingshausen (=B. dubiosa Hollick, n. name)].
- Betula prisca Ettingshausen.
- Tilia sp. Heer.
- Trapa borealis Heer.
- Vaccinium sp. Heer.
- Diospyros lancifolia Lesquereux [not D. lancifolia Alex. Braun, may=D. alaskana Schimper].

Near village of Ninilchik, west shore of Kenai Peninsula, east shore of Cook Inlet. Doroschin, fide Goeppert:
- Taxodium dubium (Sternberg) Heer.
- Caulinia laevis (Goeppert) Goeppert.
- Salix pilosula Goeppert.
- Salix wimmeriana Goeppert.
- Salix integra Goeppert?
- Alnus subglutinosa Nathorst [=A. kefersteinii (Goeppert) Unger].

Ninilchik village, west shore of Kenai Peninsula. Furuhjelm, fide Eichwald:
- Taxodium tinajorum Heer var.
- Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer].
- Glyptostrobus europaeus (Brongniart) Unger.
- Sagittaria pulchella Heer.
- Corylus macquarrii (Forbes) Heer.
- Betula dubiosa Hollick, n. name.
- Alnus kefersteinii Goeppert.
- Alnus kefersteinii var. Heer.
- Viburnum nordenskiöldi Heer.

Tschugatsk (=Kenai) Peninsula, no locality. Grewingk, 1850:
- Taxodium sp. Grewingk.
- Alnus sp. Grewingk.

West shore of Cook Inlet. Doroschin, 1847–52, fide Goeppert, 1861:
- Pinites sp. Goeppert.
- Sequoia langsdorfii (Brongniart) Heer.
- Taxodium dubium (Sternberg) Heer.

Cook Inlet, no locality. Newberry:
- Sequoia spinosa Newberry.
- Juglans nigella Heer.
- Alnus grandiflora Newberry.
- Quercus grönlandica Heer.
- Ficus? alaskana Newberry.
- Ficus membranacea Newberry [=F. dalli Cockerell].
- Prunus variabilis Newberry.

Cook Inlet. Dall, fide Lesquereux:
- Osmunda torelli Heer [=O. doroschkiana Goeppert].
- Salix raeana Heer.
- Quercus dallii Lesquereux.
- Vaccinium reticulatum Alex. Braun [=V. hollicki Knowlton].
- Diospyros anceps Heer.

Cook Inlet, no locality. Capt. W. A. Howard, 1867, fide Newberry:
- Sequoia spinosa Newberry.
- Alnus grandiflora Newberry.
- Ficus? alaskana Newberry.
- Ficus dalli Cockerell [=F. membranacea Newberry].
- Prunus variabilis Newberry.
- Juglans nigella Heer.

Cook Inlet, no locality. Dall, 1880, fide Lesquereux:
- Quercus dallii Lesquereux.
- Cornus orbifera Heer.
- Vaccinium hollicki Knowlton [=V. reticulatum Alex. Braun].

Kachemak Bay. Dall, fide Lesquereux:
- Carpinus grandis Unger.
- Fagus deucalionis Unger.
- Ulmus sorbifolia Goeppert.
- Alnus corylina Knowlton and Cockerell.

ALASKA PENINSULA REGION

3526. Cape Douglas:
- Osmunda dubiosa Hollick, n. sp.
- Ulmus braunii Heer.

3527. Cape Douglas:
- Dennstaedtia blomstrandi (Heer) Hollick, n. comb.

3547. Cape Douglas:
- Equisetum arcticum Heer.
- Sequoia langsdorfii (Brongniart) Heer.
- Crataegus alaskensis Hollick, n. sp.

5939. Cape Douglas:
- Sequoia langsdorfii (Brongniart) Heer.
- Myrica banksiaefolia curta Hollick, n. var.

5939. Cape Douglas—Continued.
Myrica speciosa Unger.
Myrica (Dryandroides) lignitum (Unger) Saporta.

3517. Kukak Bay:
Populus congerminalis Hollick, n. sp.
Corylus evidens Hollick, n. sp.
Corylus sp.?, staminate aments.
Cupania comparabilis Hollick, n. sp.
Ilex insignis Heer.

P–21. King Salmon Lake:
Dryopteris meyeri (Heer) Hollick, n. comb.
Glyptostrobus europaeus (Brongniart) Unger.
Carpolithes auriformis Hollick, n. sp.

P–23. Mountain 1 mile southwest of forks of Pumicestone Creek:
Dryopteris meyeri (Heer) Hollick, n. comb.
Populus arctica Heer.
Ulmus braunii Heer.
Prunus variabilis Newberry.
Zizyphus hyperboreus Heer.
Acer disputabilis Hollick, n. sp.

P–24. Mountain ½ mile east from head of north branch of Russel Creek:
Dryopteris meyeri (Heer) Hollick, n. comb.
Populus flexuosa Hollick, n. sp.
Myrica banksiaefolia curta Hollick, n. var.
Myrica (Dryandroides) lignitum (Unger) Saporta.
Myrica speciosa Unger.
Cinnamomum ficoides Hollick, n. sp.
Apeibopsis? discolor (Lesquereux) Lesquereux.
Aralia sp.?

P–25. Jaw Mountain:
Hydrangea alaskana Hollick.
Zizyphus hyperboreus Heer.
Paliurus colombi Heer.

3519. Chignik Bay, 200 yards south of native village:
Populus arctica Heer.
Alnus kefersteinii (Goeppert) Unger.
Ficus stantoni Hollick, n. sp.
Grewiopsis alaskana Hollick, n. sp.
Grewiopsis congerminalis Hollick, n. sp.
Pterospermites auriculaecordatus Hollick, n. sp.
Pterospermites conjunctivus Hollick, n. sp.
Pterospermites spectabilis Heer.
Viburnum evexum Hollick, n. sp.
Dicotyledonous leaf (gen. and sp.?).

3522. Chignik Bay (Anchorage Bay):
Carpinus grandis Unger.
Piper convertabilis Hollick, n. sp.
Piper septentrionalis Hollick, n. sp.

3523. Chignik Bay (Anchorage Bay):
Equisetum arcticum Heer.
Sequoia disticha Heer.
Populus richardsoni Heer.
Hicoria antiquora (Newberry) Knowlton.
Juglans picroides Heer.
Pterospermites conjunctivus Hollick, n. sp.
Pterospermites imparilis Hollick, n. sp.
Fraxinus inordinata Hollick, n. sp.
Fraxinus juglandina Saporta.
Fraxinus? pseudobliqua Hollick, n. sp.

3524. Chignik Bay (Anchorage Bay):
Sequoia langsdorfii angustifolia Heer [=S. langsdorfii (Brongniart) Heer].
Taxodium crassum Hollick, n. sp.
Populus richardsoni Heer.
Viburnum nordenskiöldi Heer.

5177. Portage (Balboa) Bay:
Paliurus colombi Heer.

5178. Portage (Balboa) Bay:
Pteris oeningensis Unger?
Juglans egregia Lesquereux.
Quercus artocarpites Ettingshausen.
Acer arcticum Heer.
Nordenskiöldia borealis Heer.
Populus arctica Heer.

5179. Portage (Balboa) Bay:
Aralia sp.?

539. Herendeen Bay:
Ginkgo adiantoides (Unger) Heer.
Poacites tenue-striatus Heer.
Carex servata Heer.
Salix minuta Knowlton.
Juglans townsendi Knowlton.
Rhus frigida Knowlton.
Zizyphus townsendi Knowlton.
Fraxinus herendeenensis Knowlton.
Phyllites arctica Knowlton.

5180. Herendeen Bay, east of Portage Valley:
Osmunda doroschkiana Goeppert.
Hausmannia atwoodi Hollick, n. sp.
Populus arctica Heer.
Comptonia cuspidata Lesquereux.

5181. Herendeen Bay, on trail to, east of Divide:
Acer arcticum Heer.

5182. Herendeen Bay, west side, opposite Marble Point:
Salix grandifolia Weber.
Salix lavateri Alex. Braun.
Salix libbeyi Lesquereux?
Salix raeana Heer.
Salix tenera Alex. Braun.
Salix sp.?, pistillate ament.
Populus zaddachi Heer?

5902. Herendeen Bay:
Populus zaddachi Heer?

5183. Herendeen Bay, west side, north of location 19:
Arundo pseudogoepperti Berry.
Piper convertabilis Hollick, n. sp.
Hedera macclurii Heer.

5186. Between Herendeen Bay and Port Moller, shore east of Point Divide:
Sequoia langsdorfii (Brongniart) Heer.
Corylus americana fossilis Newberry.
Betula brongniartii Ettingshausen.
Aralia delicatula Hollick, n. sp.
Viburnum aequale Hollick, n. sp.
Viburnum duriusculum Hollick, n. sp.
Abutilon eakini Hollick, n. sp.

5298. Chignik River opposite Nun Point:
Sequoia langsdorfii (Brongniart) Heer.
Glyptostrobus europaeus (Brongniart) Unger.
Populus arctica Heer.
Populus arctica var. b Heer.
Populus amblyrhyncha Ward.
Populus obscura Hollick, n. sp.
Betula populoides Hollick, n. sp.
Macclintockia chignikensis Hollick, n. sp.
Zizyphus meigsii (Lesquereux) Berry? [not Schimper].
Abutilon sp.?
Grewia zizyphoides Hollick, n. sp.
Grewiopsis grandiculus Hollick, n. sp.
Dillenia alaskana Hollick, n. sp.

Collections by others than members of the United States Geological Survey

[List compiled from paleobotanic literature]

"Kadjak" (Kodiak) Island. Grewingk, 1850:
Abies sp. Grewingk (="Pinus-arten").

Kukak Bay. De Alton Saunders, 1899 (Harriman Alaska Expl. Exped.), fide Lesquereux:
Equisetum globulosum Lesquereux.
Pinus? (scales) Knowlton.
Pinus? (leaves) Knowlton.
Picea harrimani Knowlton.
Picea (branches) Knowlton.
Picea (seed) Knowlton.
Sequoia heerii Lesquereux.
Sequoia (cone) Knowlton.
Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer].
Taxodium tinajorum Heer.
Juglans acuminata Alex. Braun.
Hicoria magnifica Knowlton.
Betula (branch) Knowlton.
Corylus macquarrii (Forbes) Heer.
Corylus? palachei Knowlton.
Corylus harrimani Knowlton.
Alnus corylifolia Lesquereux [=A. corylina Knowlton and Cockerell].
Alnus sp. Knowlton.
Ulmus braunii Heer.
Acer trilobatum var. Knowlton.
Aesculus arctica Knowlton.
Pterospermites alaskana Knowlton.
Pterospermites magnifolia Knowlton.
Vaccinium alaskanum Knowlton.
Phyllites saundersi Knowlton.

Chignik Bay. Dall, 1880, fide Lesquereux:
Comptonia praemissa Lesquereux.
Juglans woodiana Heer.
Betula alaskana Lesquereux.
Magnolia nordenskiöldi Heer.
Populus richardsoni Heer.
Alnus corylifolia Lesquereux [=A. corylina Knowlton and Cockerell].

Lower Chignik Lake, valley to right of South Mountain. Waldo F. Schmidt, 1911:
Piper septentrionalis Hollick, n. sp.

Ugolni (Ukolni) (Pavlof?) Bay. Doroschin, fide Goeppert, 1861:
Carpinus sp. Goeppert.

Herendeen Bay. C. H. Townsend, 1892, fide Knowlton:
Sequoia langsdorfii (Brongniart) Heer.
Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer].
Glyptostrobus europaeus (Brongniart) Heer.
Ginkgo adiantoides (Unger) Heer.
Poacites tenue-striatus Heer.
Carex servata Heer.
Salix minuta Knowlton.
Juglans townsendi Knowlton.
Corylus macquarrii (Forbes) Heer.
Rhus frigida Knowlton.
Acer trilobatum productum (Alex. Braun) Heer.
Paliurus colombi Heer.
Zizyphus townsendi Knowlton.
Fraxinus herendeenensis Knowlton.
Phyllites arctica Knowlton.

Unga Island. Doroschin, 1847–52, fide Grewingk, 1850, Goeppert, 1861, and Heer, 1869; Dall, 1880, fide Lesquereux, 1883:
Neuropteris acutifolia, fide Grewingk [=N. acutifolia Brongniart? and Osmunda doroschkiana Goeppert?].
Osmunda doroschkiana Goeppert.
Osmunda dubiosa Hollick, n. sp.?
Equisetum globulosum Lesquereux. Dall, fide Lesquereux (locality questioned).
Pinites pannonicus (Unger) Goeppert. Doroschin, fide Goeppert and Heer.
Sequoia langsdorfii (Brongniart) Heer. Doroschin, fide Goeppert.
Thuites (Chamaecyparis) alaskensis Lesquereux. Dall, fide Lesquereux.
Coniferous wood, Grewingk.
Comptonia cuspidata Lesquereux.
"Impressions suggestive of Gramineae", Grewingk.
Elaeodendron helveticum Heer. Dall, fide Lesquereux
Nyssa arctica Heer, fide Lesquereux.
Fossil stumps, trunks, and branches of trees, Grewingk (Tertiary?).

Alaska Peninsula, "Nahe der Katmaschen." Doroschin, fide Goeppert:
Taxodium dubium (Sternberg) Heer.

Unalaska Island. Grewingk, 1850:
Taxodium sp. Grewingk.

Atka (Atchka or Atha) Island; Andreanof Island; Korovin Bay. Doroschin, 1847–52, fide Goeppert:
Pinites sp. Goeppert.

LOWER YUKON-NORTON SOUND REGION

Ulukak (=Ulukuk, a branch of Unalaklik) River, east shore of Norton Sound. W. H. Dall, 1892:
Platanus leaves, Dall.

Topanica Creek, Norton Sound region. W. H. Dall, 1892, fide Dall:
Platanus nobilis Newberry.

NORTHWESTERN ALASKA REGION

Kobuk River, below mouth of Reed River. W. C. Mendenhall, 1901, fide Knowlton, 1902; Hollick, 1912:
Ginkgo sp. [=G. adiantoides (Unger) Heer].

TANANA REGION

6567. Upper Nenana River, northwest of Wells Creek:
Viburnum schmidtianum Heer?

7007. Divide between Folger Creek and Nowi River:
Dryopteris meyeri (Heer) Hollick, n. comb.
Ginkgo adiantoides (Unger) Heer.
Populus arctica Heer.
Populus sp.?
Alnus alnifolia (Goeppert) Hollick, n. comb.

7261. California Creek:
Taxodium occidentale Newberry.
Viburnum nordenskiöldi Heer.

7263. Conglomerate beds near center of sec. 10, T. 9 S., R. 6 W.:
Populus zaddachi Heer?

7264. Sec. 10, T. 9 S., R. 6 W.:
Populus zaddachi Heer?
Hedera macclurii Heer.

7266. Lignite Creek:
Populus amblyrhyncha Ward.
Carpinites truncatus Hollick, n. sp.
Ficus overbecki Hollick, n. sp.
Vitis heeriana Knowlton and Cockerell.

7476. Fairbanks:
Taxodium dubium normale Massalongo.
Taxites olriki Heer.
Salix augusta Alex. Braun.
Artocarpidium alaskanum Hollick, n. sp.

7622. Coal Creek:
Phragmites alaskana Heer?
Juglans acuminata Alex. Braun.
Quercus etymodrys Unger.
Quercus pseudocastanea Goeppert.
Crataegus cappsii Hollick, n. sp.
Celastrus borealis Heer.
Fraxinus yukonensis Hollick, n. sp.

7634. Coal Creek, near Jinx coal bed:
Populus balsamoides Goeppert.
Juglans picroides Heer.
Ilex insignis Heer.

UPPER YUKON REGION

2966. American Creek:
Equisetum arcticum Heer.

3227. Bryant Creek:
Viburnum antiquum (Newberry) Hollick.

3229. Bryant Creek:
Sequoia langsdorfii (Brongniart) Heer.
Sequoia brevifolia Heer.
Populus hookeri Heer.
Populus latior Alex. Braun.
Quercus steenstrupiana Heer.
Palaeanthus prindlei Hollick, n. sp.
Semecarpus prindlei Hollick, n. sp.
Equisetum arcticum Heer.

3231. Mission Creek:
Viburnum whymperi Heer.

4711. Seventymile River, ½ mile below Mogul Creek:
Populus arctica Heer.
Populus zaddachi Heer.
Hamamelis clarus Hollick, n. sp.
Grewiopsis congerminalis Hollick, n. sp.
Pterospermites alternans Heer.
Pterospermites spectabilis Heer.
Viburnum whymperi Heer.
Fraxinus yukonensis Hollick, n. sp.

CENTRAL YUKON REGION

3247. South bank just above Rampart:
Thuites ehrenswärdi Heer.
Smilax reticulata Heer.
Populus balsamoides Goeppert.
Populus glandulifera Heer.
Corylus sp.?, aments.
Quercus nevadensis Lesquereux.
Artocarpus ordinarius Hollick, n. sp.
Dryophyllum stanleyanum Dawson.
Grewia orbiculata Hollick, n. sp.
Grewia crenata (Unger) Heer.
Diospyros brachysepala Alex. Braun.
Nyssidium ekmani Heer.

4710. South bank, 2 to 4 miles above Rampart:
Populus genetrix Newberry.
Acer trilobatum productum (Alex. Braun) Heer.
Pterospermites spectabilis Heer.

6094. South bank, 1.5 miles above Rampart:
Koelreuteria eakini Hollick, n. sp.

2974. South bank, 1.5 miles above Rampart:
Acer visibilis Hollick, n. sp.

6095. South bank, 1.5 miles above Rampart, 300 feet above 6094:
Populus glandulifera Heer.
Platanus aceroides latifolia Knowlton.
Platanus rectinervis Hollick, n. sp.

3246. North bank at Drew's mine:
Equisetum arcticum Heer.
Populus richardsoni Heer.
Hicoria magnifica Knowlton.
Sophora multiformis Hollick, n. sp.
Cassia glenni Berry?
Pithecolobium ceterum Hollick, n. sp.
Paullinia alaskana Hollick, n. sp.
Celastrus comparabilis Hollick, n. sp.

2972. North bank opposite mouth of Hess Creek:
Hicoria magnifica Knowlton.

4632. North bank, 10 miles below rapids below Rampart:
Nelumbo protolutea Berry?

4708. North bank, Drew's mine:
Juglans acuminata latifolia (Alex. Braun) Heer.
Crataegus yukonensis Hollick, n. sp.
Grewia orbiculata Hollick, n. sp.

7007. Divide between Folger Creek and Nowitna River:
Ginkgo adiantoides (Unger) Heer.
Populus arctica Heer.
Alnus alnifolia (Goeppert) Hollick, n. comb.

North bank, Miller's coal mine, 25 miles above Mynook Creek:
Quercus? sp. Knowlton.
Platanus sp. Knowlton.
Vitis heeriana Knowlton and Cockerell? [=V. crenata Heer].
Carpites sp. Knowlton.

35 miles below Tanana:
Pinus macclurii Heer.

1555. 1.5 miles above Rampart:
Ficus? alaskana Newberry.

1555. Yukon River, north bank opposite Hess Creek:
Ficus? alaskana Newberry.

1555. Mission Creek:
Ficus? alaskana Newberry [doubtful identification].

ALASKA, NO LOCALITY GIVEN

Collections by others than members of the United States Geological Survey

[List compiled from paleobotanic literature]

Eichwald, Platen:
Poacites tenue-striatus Heer, fide Eichwald.
Ebenoxylon boreale Platen.
Pityoxylon macclurii (Heer) Kraus, fide Platen.

GEOLOGIC RELATIONS

The Tertiary flora of Alaska, as far as it has been identified, is impossible to correlate as an entity or to differentiate satisfactorily into distinct stratigraphic groups, for the reason that its previously identified species are relatively few. This condition may be understood when it is realized that of the 388 floral elements listed, only 338 are described specifically and varietally, and that the 50 others are merely identified generically or occasionally mentioned only in indefinite terms. And further, of the 338 described species and varieties, 108 represent new descriptions, and the following 50 are not recorded from outside Alaska:

Chondrites heeri Eichwald? Kachemak Bay, Whitney Island.
Ceratozamia wrightii Hollick. Kupreanof Island.
Dioön inopinus Hollick. Kupreanof Island.
Dioön praespinulosum Hollick. Kupreanof Island.
Taxites microphyllus Heer. Port Graham.
Pityoxylon inaequale Felix. Danaáku.
Picea harrimani Knowlton. Kukak Bay.
Sequoia spinosa Newberry. Cook Inlet.
Thuites (Chamaecyparis) alaskensis Lesquereux. Unga Island.
Caulinia laevis (Goeppert) Goeppert. Ninilchik.
Sagittaria pulchella Heer. Ninilchik.
Poacites tenue-striatus Heer. Port Graham, Herendeen Bay.
Carex servata Heer. Port Graham, Herendeen Bay.
Salix pilosula Goeppert. Ninilchik.
Salix minuta Knowlton. Herendeen Bay.
Comptonia cuspidata Lesquereux. Unga Island. Herendeen Bay.
Comptonia praemissa Lesquereux. Unga Island. (?)
Juglans picroides Heer. Port Graham, Chignik Bay.
Juglans townsendi Knowlton. Herendeen Bay.
Hicoria magnifica Knowlton. Kukak Bay.
Corylus harrimani Knowlton. Kukak Bay.
Corylus palachei Knowlton. Kukak Bay.
Betula alaskana Lesquereux. Chignik Bay.
Alnus corylina Knowlton and Cockerell. Kachemak Bay, Kukak Bay.
Alnus grandiflora Newberry. Cook Inlet.
Quercus alaskana Trelease?. Port Graham, Matanuska River near Moose Creek.
Quercus chamissoni Heer. Port Graham.
Quercus furuhjelmi Heer. Port Graham, Kootznahoo Inlet.
Ficus? alaskana Newberry. Cook Inlet, Kootznahoo Inlet.
Ficus dalli Cockerell. Cook Inlet.
Hydrangea alaskana Hollick. Jaw Mountain (Alaska Peninsula).
Spiraea andersoni Heer. Port Graham.
Prunus variabilis Newberry?. Cook Inlet, Aniakchak Bay and vicinity.
Rhus frigida Knowlton. Herendeen Bay.
Ilex insignis Heer. Port Graham, Kukak Bay, Coal Creek, Nenana region.
Acer grahamensis Knowlton and Cockerell. Port Graham.
Acer trilobatum var. Knowlton. Kukak Bay.
Aesculus arctica Knowlton, Kukak Bay.
Zizyphus townsendi Knowlton. Herendeen Bay.
Vitis heeriana Knowlton and Cockerell. Port Graham, Lower Yukon, Lignite Creek, Nenana region.
Tilia alaskana Heer. Port Graham.
Pterospermites alaskana Knowlton. Kukak Bay.
Pterospermites magnifolia Knowlton. Kukak Bay.
Hedera auriculata Heer. Port Graham.
Vaccinium alaskanum Knowlton. Kukak Bay.
Vaccinium friesii Heer. Port Graham.
Ebenoxylon boreale Platen. Locality?.
Fraxinus herendeenensis Knowlton. Herendeen Bay.
Phyllites arctica Knowlton. Herendeen Bay.
Phyllites saundersi Knowlton. Kukak Bay.

The actual number of elements available for critical analysis and discussion of extraterritorial distribution and stratigraphy is therefore only 180, or less than 47 percent of the total listed flora.

Total number of floral entities	388
Described generically only	50
Described specifically and varietally	338
Not recorded from outside of Alaska	50
Newly described species and varieties	108
Previously described species and varieties	180

The most obvious fact in connection with the general facies of the flora is its unmistakable identity with the so-called Arctic Miocene flora of British America (Northwest Territory), Greenland, Iceland, Svalbard (Spitsbergen), New Siberia, Sakhalin, and elsewhere in the holarctic region. This flora is now recognized as Eocene and is believed to be approximately equivalent to the flora of the Fort Union and allied formations in the United States and the Canadian Provinces.

Following is a list of the 93 Alaskan Tertiary species that are elements in the so-called Arctic Miocene flora:

Onoclea sensibilis Linnaeus. Greenland, Scotland, Sakhalin.
Dryopteris meyeri (Heer) Hollick. Greenland, New Siberia, Sakhalin.
Dennstaedtia blomstrandi (Heer) Hollick. Greenland, Svalbard.
Pteris sitkensis Heer. Greenland.
Osmunda doroschkiana Goeppert. Sakhalin.
Equisetum arcticum Heer. Grinnell Land, Svalbard.
Ginkgo adiantoides (Unger) Heer. Greenland, Sakhalin.
Taxites olriki Heer. Greenland, Iceland, Svalbard.
Pinus macclurii Heer. Banks Land, Greenland.
Pityoxylon macclurii (Heer) Kraus. Banks Land.
Sequoia brevifolia Heer. Greenland, Svalbard.
Sequoia disticha Heer. Svalbard.
Sequoia langsdorfii (Brongniart) Heer. British America, Greenland, Svalbard, New Siberia, Sakhalin.
Taxodium dubium (Sternberg) Heer. Canada, Grinnell Land, Greenland, Svalbard, New Siberia, Sakhalin, interior of Siberia.
Taxodium tinajorum Heer. Svalbard, interior of Siberia.
Glyptostrobus europaeus (Brongniart) Unger. Canada(?), Greenland, Svalbard, New Siberia(?), interior of Siberia.
Thuites ehrenswärdi Heer. Grinnell Land, Greenland, Svalbard, Sakhalin.
Populus arctica Heer. Canada, Grinnell Land, Greenland, Svalbard, New Siberia, Sakhalin, interior of Siberia.
Populus arctica var. b Heer. Greenland.
Populus richardsoni Heer. Canada, Greenland. Svalbard, New Siberia, interior of Siberia.
Populus latior Alex. Braun. Sakhalin.
Populus hookeri Heer. Svalbard.
Populus glandulifera Heer. Sakhalin.
Populus balsamoides Goeppert. Svalbard.
Populus gaudini Fischer-Ooster. Greenland, Sakhalin.
Populus mutabilis Heer. Greenland.

Populus zaddachi Heer? Grinnell Land, Greenland, Svalbard, Sakhalin.
Salix lavateri Alex. Braun. Greenland, Sakhalin.
Salix varians Goeppert. Greenland(?), Svalbard, Sakhalin.
Salix macrophylla Heer. Svalbard.
Salix tenera Alex. Braun, Greenland.
Salix raeana Heer. Canada, Greenland, Svalbard.
Myrica (Dryandroides) lignitum (Unger) Saporta. Greenland, Svalbard.
Juglans acuminata Alex. Braun. Canada, Greenland, Sakhalin.
Juglans strozziana Gaudin? Greenland.
Juglans crossii Knowlton. Greenland.
Juglans juglandiformis (Sternberg) Giebel. Greenland, Iceland.
Juglans nigella Heer. Greenland, Sakhalin.
Carpinus grandis Unger. Greenland, Svalbard, Sakhalin.
Corylus macquarrii (Forbes) Heer. Canada, Grinnell Land, Greenland, Iceland, Scotland, Svalbard, Sakhalin.
Corylus macquarrii macrophylla Heer. Greenland, Iceland, Svalbard.
Betula brongniartii Ettingshausen. Grinnell Land, Greenland, Sakhalin.
Betula dubiosa Hollick. Canada, Iceland, Svalbard.
Betula prisca Ettingshausen. Grinnell Land, Greenland, Iceland, Svalbard, Sakhalin.
Alnus kefersteinii (Goeppert) Unger. Greenland, Iceland, Svalbard, Sakhalin.
Fagus antipofii Abich. Greenland, Sakhalin.
Fagus deucalionis Unger. Greenland, Iceland, Svalbard.
Castanea castaneaefolia (Unger) Knowlton. Greenland, Sakhalin.
Quercus grönlandica Heer. Greenland, Svalbard.
Quercus juglandina Heer? Greenland.
Quercus olafseni Heer. Canada, Greenland, Iceland, Sakhalin.
Quercus platania Heer. Greenland, Svalbard.
Quercus pseudocastanea Goeppert. Greenland.
Quercus steenstrupiana Heer. Greenland.
Ulmus braunii Heer. Svalbard, Sakhalin.
Ulmus borealis Heer. Grinnell Land, Greenland.
Ulmus diptera Steenstrup? Iceland.
Ulmus plurinervia Unger. Greenland, Sakhalin.
Planera ungeri Ettingshausen. Greenland, Iceland, Sakhalin, interior of Siberia.
Magnolia inglefieldi Heer. Greenland.
Magnolia nordenskiöldi Heer. Canada, Greenland, Svalbard, Sakhalin.
Magnolia wormskioldi Heer. Greenland.
Benzoin antiquum Heer. Greenland.
Daphnogene kanii Heer. Greenland.
Liquidambar europaeum Alex. Braun. Greenland.
Prunus scottii Heer. Greenland.
Ilex? reticulata Heer. Greenland.
Celastrus borealis Heer. Sakhalin.
Acer arcticum Heer. Greenland, Svalbard.
Acer inaequale Heer? Svalbard.
Rhamnus brevifolius Alex. Braun. Greenland.
Rhamnus gaudini Heer. Greenland.
Rhamnus rossmaessleri Unger. Greenland.
Zizyphus hyperboreus Heer. Greenland.
Paliurus colombi Heer. Greenland, Svalbard, interior of Siberia.
Vitis alaskana Cockerell. Greenland.
Vitis olriki Heer. Greenland.
Tilia malmgreni Heer. Canada, Grinnell Land, Svalbard.
Grewia crenata (Unger) Heer. Svalbard.
Pterospermites alternans Heer. Greenland.
Pterospermites spectabilis Heer. British America, Greenland.
Hedera macclurii Heer. Canada, Greenland, Svalbard, Sakhalin.
Cornus hyperborea Heer? Greenland, Svalbard.
Cornus orbifera Heer. Greenland, Svalbard.
Nyssa arctica Heer. Greenland, Svalbard.
Nyssidium ekmani Heer. Greenland, Svalbard.
Diospyros alaskana Schimper. Canada.
Diospyros anceps Heer. Interior of Siberia.
Diospyros brachysepala Alex. Braun. Greenland, interior of Siberia.
Viburnum nordenskiöldi Heer. Canada, Grinnell Land, Greenland, Sakhalin.
Viburnum schmidtianum Heer? Greenland, Sakhalin.
Viburnum whymperi Heer. Greenland, Svalbard.
Nordenskiöldia borealis Heer. Greenland, Svalbard.

The above-listed species represent about 52 percent of the previously described flora of Alaska. The identity of the Tertiary flora of Alaska with that of the Eocene (so-called Arctic Miocene) of the entire holarctic region cannot be questioned.

In connection with the Eocene deposits of the Canadian Provinces and the United States, the Fort Union formation includes the largest number of the Alaskan Tertiary species, 35 in all, as listed below. The asterisks (*) denote species that are regarded by the writer as characteristic or index fossils of the Fort Union formation.

*Onoclea sensibilis Linnaeus.
*Equisetum globulosum Lesquereux.
Ginkgo adiantoides (Unger) Heer.
Taxites olriki Heer.
Sequoia langsdorfii (Brongniart) Heer.
Taxodium occidentale Newberry.
Glyptostrobus europaeus (Brongniart) Unger.
Phragmites alaskana Heer.
Populus richardsoni Heer.
*Populus speciosa Ward.
*Populus amblyrhyncha Ward.
*Populus genetrix Newberry.
Populus glandulifera Heer.
Salix lavateri Alex. Braun.
Juglans woodiana Heer.
Juglans nigella Heer.
*Hicoria antiquora (Newberry) Knowlton.
*Corylus americana fossilis Newberry.
Corylus macquarrii (Forbes) Heer.
Betula prisca Ettingshausen.
Fagus antipofii Abich.
Quercus olafseni Heer.
*Protoficus inaequalis Newberry.
Laurus princeps Heer.
*Platanus nobilis Newberry.
Acer arcticum Heer.
*Sapindus affinis Newberry.
Sapindus angustifolius Lesquereux.
Paliurus colombi Heer.
Grewia crenata (Unger) Heer.
Diospyros brachysepala Alex. Braun.

*Viburnum antiquum (Newberry) Hollick.
*Viburnum newberryanum Ward.
Viburnum nordenskiöldi Heer.
Viburnum whymperi Heer.

The formations in which the next highest numbers of Alaskan Tertiary species have been recorded are the Lance (20), the Wilcox (15), and the Paskapoo (12).

The stratigraphic distribution of the 12 species above designated by asterisks as characteristic of the Fort Union is as follows:

	Wilcox	Lance	Fort Union	Paskapoo	Raton	Eocene (not differentiated)	Existing species
Onoclea sensibilis Linnaeus	----	×	×	×	----	----	----
Equisetum globulosum Lesquereux	----	----	×	----	----	----	----
Populus amblyrhyncha Ward	----	×	×	----	----	----	----
Populus genetrix Newberry	----	×	×	----	----	×	----
Populus speciosa Ward	----	×	×	×	----	×	----
Hicoria antiquora (Newberry) Knowlton	×	×	×	×	----	×	----
Corylus americana fossilis Newberry	----	----	×	×	----	----	?
Protoficus inaequalis Newberry	----	----	×	----	----	----	----
Platanus nobilis Newberry	----	×	×	----	----	----	----
Sapindus affinis Newberry	----	×	×	----	×	----	----
Viburnum antiquum (Newberry) Hollick	----	×	×	----	----	----	----
Viburnum newberryanum Ward	----	×	×	----	--	----	----
	1	9	12	4	1	3	----

In view of the facts above set forth the general similarity of the Alaska Tertiary flora to that of the Eocene in the States proper would appear to be demonstrated; but it may be objected that certain of the listed species also occur in strata more recent than the Eocene, that this fact has been ignored in the discussion of distribution and stratigraphy, and that these species might indicate a later than Eocene age for the flora. Inasmuch, however, as such species are relatively few, and as certain of the Eocene species apparently persisted throughout Tertiary time and are represented in our existing flora, it would be logical to infer that many species persisted into later Tertiary time before becoming extinct and would therefore be recognized as elements in Oligocene, Miocene, and Pliocene floras.

In this connection it is interesting to recall the words of Newberry [43] written more than half a century ago and subsequently supported by published descriptions, discussion, and illustration of the following species of Tertiary age:

Onoclea sensibilis fossilis Newberry [op. cit., pp. 8–10, pl. 23, fig. 3; pl. 24, figs. 1–5]. * * * After a laborious examination of all the genera of exotic ferns * * * I was led to turn my eyes nearer home, and found in *Onoclea* a striking and unexpected resemblance to it. * * * Varying as the living *Onoclea* does, in the size, outline, and nervation of the sterile frond, * * * it plainly includes all the characters of the fossils before us, and I therefore find it impossible to separate them.

Corylus americana fossilis Newberry [op. cit., p. 60, pl. 29, figs. 8–10]. Among the variety of specimens of the leaves of *C. americana* with which I have compared these fossils, there are some which, if fossilized, would form impressions absolutely undistinguishable from them, and I have therefore found it impossible to fix upon any characters by which they can be separated.

Corylus rostrata fossilis Newberry [op. cit., p. 63, pl. 32, figs. 1–3]. These leaves offer no characters by which they can be distinguished from those of the living "beaked hazelnut" [*C. rostrata* Aiton].

Alnus serrulata fossilis Newberry, n. sp. [op. cit., pp. 66–67, pl. 46, fig. 6]. It will be seen at a glance that it closely resembles the leaves of *A. serrulata*, and I have been unable to find any characters upon which to base a distinction. * * * We know that our living flora of North America is the progeny by direct descent of the Tertiary flora, and *the result of investigation will undoubtedly be to increase the number of species considered identical in the two floras.* [The italicizing is mine.—A. H.]

Incidentally it may here be remarked that certain of the Alaskan specimens included in the genus *Salix*, to which fossil specific names have been applied, might equally well be referred to existing species, so far as identifiable characters are concerned.

In regard to the apparent identity of a number of early species with those of later Tertiary age in the Old World it may be sufficient to quote, in closing, the words of Gardner,[44] published more than half a century ago, in the introduction to his Eocene flora of Great Britain:

The nearly unbroken sequence seen in the Eocene floras extends into the Miocene. There is no great break in passing from one to the other when we compare them over many latitudes, and but little change beyond that brought about by altered temperature and migration. * * * From middle Eocene to Miocene the heat imperceptibly diminished. Imperceptibly, too, the tropical members of the flora disappeared; that is to say, they migrated, for *most of their types, I think, actually survive at the present day, many but very slightly altered.* [The italicizing is mine.—A. H.] Then the subtropical members decreased, and the temperate forms, never quite absent, even in the middle Eocenes, preponderated. As decreasing temperature drove the tropical forms south, the more northern must have pressed closely upon them. The northern Eocene, or the temperate floras of that period, must have pushed, from their home in the far north, more and more south as climates chilled, and at last, in the Miocene time, occupied our latitudes. *The relative preponderance of these elements, I believe, will assist in determining the age of Tertiary deposits in Europe, more than any minute comparison of species.* [The italicizing is mine.—A. H.] * * * Arctic

[43] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, 1898.

[44] Gardner, J. S., and Ettingshausen, Constantin, A monograph of the British Eocene flora, vol. 1, pp. 7–8, May 1879.

fossil floras of temperate and therefore Miocene aspect are in all probability of Eocene age, and what has been recognized in them as a newer or Miocene facies is due to their having been first studied in Europe in latitudes which only became fitted for them in Miocene times. When stratigraphic evidence is absent or inconclusive, this unexpected persistence of plant types or species throughout the Tertiaries should be remembered, and the degrees of latitude in which they are found should be well considered before conclusions are published respecting their relative age.

GEOLOGY OF THE TERTIARY DEPOSITS OF ALASKA

By Philip S. Smith

INTRODUCTION

The time is not yet at hand when the various events in the Tertiary history of Alaska can be described with completeness and their progressive development told with certainty as an orderly sequential story. Bits of that history have been learned by geologists and others from observations in many parts of Alaska, and some fitting together of these fragments has been done for individual areas, but even in the best-known areas the gaps are in many ways more conspicuous and larger than the patterns produced by these records. It is therefore keenly recognized that much more information must be collected before an adequate sketch of the geology of this important and interesting time that will be reliable or satisfactory can be prepared. However, it is believed that even a summary of the present state of our knowledge or ignorance may be of service in furnishing a starting point from which to project additional inquiry and an incentive to others to carry the work further. At least an inventory of the available facts in one place will be useful to the geographer in his efforts to understand how some of the existing features have come into being and to the geologist in his efforts to reconstruct the past. It is therefore with full realization of the limitations of all kinds, or perhaps in spite of those limitations, that the writer has attempted in the following pages to set down the small part of the Tertiary history of Alaska that is known to him.

The land mass of Alaska in Tertiary time appears to have been essentially coextensive with the area occupied by the Territory today. At a few places—namely, in southern Alaska in the Lituya Bay and Katalla districts, on the Alaska Peninsula and the Pribilof Islands, in the Seward Peninsula region near Nome, and in extreme northern Alaska near the Arctic coast—deposits of Tertiary age that were evidently laid down under marine conditions have been found back of the present shore line. These deposits do not now extend far inland, and there is little or no evidence to indicate that they ever did extend inland much beyond their present position. Everywhere else the Tertiary deposits afford clear evidence that they were laid down under terrigenous conditions—that is, they were deposited as sediments in lakes or fresh-water ponds or in swamps and marshes on lowland areas, or were poured out as lavas on land surfaces, or were injected as intrusive igneous rocks into the older formations that presumably formed the land masses of that time.

In the following pages are given brief descriptions of the principal places where rocks of these different categories have been identified. It is beyond the scope of this section, however, to describe in detail each of the different occurrences, and the reader who wishes that information should consult the Geological Survey report that treats of the specific area in which he is interested. A selected list of the principal Survey reports covering the different districts in which Tertiary rocks are reported is given below. Correlation between the different districts or even between different parts of the same district cannot yet be made satisfactorily, so that in general it has been necessary to resort to a geographic rather than a geologic arrangement. However, a strictly geographic arrangement has not been followed, as it seemed better to describe first under each of the major classes of Tertiary rocks the areas in which that particular class was most extensively or completely developed and to follow successively with the description of those areas in which these rocks were less known, less extensive, or less characteristically developed.

The locations at which Tertiary deposits have been recognized are indicated on plate 1. The size and shape of the areas as represented have been conventionalized and generalized, as the scale of the map is inadequate to show them accurately and yet permit the localities to be readily found. As a rule, therefore, the individual symbols suggest that the Tertiary deposits are more extensive and continuous than is perhaps strictly justified by the facts. However, as an offset, no attempt has been made to indicate those places where Tertiary deposits are concealed under later deposits, and as only those tracts have been shown where the Tertiary has been mapped the actual extent is doubtless much greater than is indicated. Furthermore, although considerable amounts of the Tertiary rocks have been removed through erosion, no attempt has been made to show their original extent. The map should be read with these facts clearly in mind.

SELECTED LIST OF GEOLOGICAL SURVEY PUBLICATIONS ON THE TERTIARY DEPOSITS OF ALASKA

The following list is arranged geographically:

GENERAL

The geography and geology of Alaska, by A. H. Brooks. Professional Paper 45, 1906, 327 pp.

The Mesozoic stratigraphy of Alaska, by G. C. Martin. Bulletin 776, 1926, 493 pp.

Locality distribution of species in Alaska

Species, arranged taxonomically (not including those identified only generically)	Southeastern Alaska region							Yakutat-Copper River region						Matanuska-Cook Inlet region																	Alaska Peninsula region							Lower Yukon, Norton Sound region	Kobuk River, Northwestern Alaska	Tanana region						Yukon River region: Upper				Yukon River region: Central					
	Baranof Island (near Sitka)	Keku Island	Kootznahoo Inlet	Kuiu Island	Kupreanof Island	Whitney Island	Zarembo Island	Yakutat Bay	Danaku	Bering Lake	Bering River	Gakona Glacier	Berg Lake and other localities	Chickaloon River	Matanuska River, near Moose Creek	Kings River	Little Kings Creek	Eska Creek	Youngs Creek	Sheep Valley	Other localities	Port Graham	Kachemak Bay	Point Naskowhak	Yentna River (Cache Creek)	Old Tyonek	Ninilchik	Chinitna Bay	Kenai Peninsula (locality?)	Cook Inlet (locality?)	Cape Douglas	Kukak Bay	Aniakchak Bay, King Salmon Lake, and vicinity	Chignik Bay	Portage (Balboa) Bay	Herendeen Bay	Unga Island			California Creek	Sec. 10, T. 9 S., R. 6 W.	Lignite Creek	Coal Creek	Wells Creek	Other localities	American Creek	Bryant Creek	Mission Creek	Seventymile River, near Mogul Creek	Yukon River, north bank, opposite Hess Creek	Drew's or Miller's coal mine	Yukon River, south bank, 1.5-2 miles above Rampart	Yukon River, north bank, below rapids below Rampart	Yukon River, 35 miles below Tanana	Divide between Folger Creek and Nowitna River
Chondrites heeri Eichwald?						×																×																																
Onoclea sensibilis Linnaeus					×												×																																							
Dryopteris meyeri (Heer) Hollick, n. comb																																	×																						×
Hausmannia atwoodi Hollick, n. sp																																				×																				
Dennstaedtia blomstrandi (Heer) Hollick, n. comb																															×																								
Asplenium alaskanum Hollick, n. sp				×				×					×																																										
Pteris inequilateralis Hollick, n. sp														×																																										
Pteris oeningensis Unger?																																			×																					
Pteris pseudopennaeformis Lesquereux								×																																														
Pteris sitkensis Heer				×	×																																																			
Osmunda doroschkiana Goeppert				×																													×						×	×?																		
Osmunda dubiosa Hollick, n. sp																															×																								
Anthrophyopsis hamiltonensis Hollick, n. sp					×																																																	
Equisetum arcticum Heer																×				×																×			×												×	×				×				
Equisetum globulosum Lesquereux																																×					?																		
Ceratozamia wrightii Hollick					×																																																	
Dioön inopinus Hollick					×																																																	
Dioön praespinulosum Hollick					×																																																	
Ginkgo adiantoides (Unger) Heer	×																																					×			×																×
Ginkgo reniformis conformis Hollick, n. var.																												×																										
Taxites olriki Heer					×							×		×				×				×								×																	×											
Taxites microphyllus Heer																							×																																
Pinus macclurii Heer?																																																							×	
Pinites pannonicus (Unger) Goeppert																																					×																	
Pityoxylon inaequale Felix								?	×																																														
Pityoxylon macclurii (Heer) Kraus[1]																																																							
Picea harrimani Knowlton																																×																								
Sequoia brevifolia Heer					×																																									×										
Sequoia disticha Heer																																		×																						
Sequoia heerii Lesquereux																																×																								
Sequoia langsdorfii (Brongniart) Heer		×	×	×	×		×											×				×	×				×			×	×			×		×	×											×										
Sequoia spinosa Newberry																														×				×																					
Taxodium crassum Hollick, n. sp					×																												×																					
Taxodium dubium (Sternberg) Heer			×	×														×				×					×			×		×				×																			
Taxodium dubium longifolium Massalongo			×																																																			
Taxodium dubium normale Massalongo																							×																			×											
Taxodium occidentale Newberry					×											×																							×														
Taxodium tinajorum Heer				×	×																×	×			×		×				×																									
Glyptostrobus europaeus (Brongniart) Unger			×	×	×				×							×	×			×	×								×					×	×		×																				
Thuites ehrenswärdi Heer																																																					×			
Thuites (Chamaecyparis) alaskensis Lesquereux																																					×																	
Caulinia laevis (Goeppert) Goeppert																											×																												
Sagittaria pulchella Heer																											×																												
Arundo pseudogoepperti Berry?																×			×																				×																			
Phragmites alaskana Heer?																							×																					×											
Poacites tenue-striatus Heer																							×															×																	
Carex servata Heer																							×															×																	
Flabellaria florissanti Lesquereux																	×																																						
Flabellaria alaskana Hollick, n. sp					×																																																	
Smilax reticulata Heer																																																					×			
Piper septentrionalis Hollick, n. sp														×		×																					×																				
Piper convertabilis Hollick, n. sp																			×																	×		×																			
Piper concavum Hollick, n. sp					×						×																																										
Piper disputabilis Hollick, n. sp													×																																										
Piper chapini Hollick, n. sp																		×																																					
Populus arctica Heer																		×																×	×	×	×													×						×
Populus arctica var. b Heer																																		×																					
Populus richardsoni Heer																		×																		×																×				
Populus speciosa Ward?					×																																																	
Populus amblyrhyncha Ward			×															×																		×									×												
Populus flexuosa Hollick, n. sp			×																															×																							
Populus genetrix Newberry																																																						×			
Populus latior Alex. Braun																		×				×																												×									
Populus hookeri Heer																																																	×								
Populus glandulifera Heer					×																	×																														×			
Populus balsamoides Goeppert			×		×								×		×							×																								×									×			
Populus gaudini Fischer-Ooster																		×	×																																					
Populus congerminalis Hollick, n. sp																																×																								
Populus mutabilis Heer																		×																																					
Populus leucophylla Unger																							×																																	
Populus obscura Hollick, n. sp																																		×																					
Populus zaddachi Heer?																					×		×																×				×									×							
Salix alaskana Hollick, n. sp																								×																																
Salix angusta Alex. Braun																								×																							×										
Salix lavateri Alex. Braun																							×															×																	
Salix varians Goeppert																							×	×				×																													
Salix wimmeriana Goeppert																													×																											
Salix macrophylla Heer																							×																																	
Salix tenera Alex. Braun																								×													×																	
Salix grandifolia Weber																								×													×																	
Salix raeana Heer																								×							×						×																	
Salix libbeyi Lesquereux?																																					×																	
Salix abbreviata Goeppert																								×																																
Salix pilosula Goeppert																													×																											
Salix integra Goeppert?																													×																											
Salix minuta Knowlton																																					×																	
Comptonia cuspidata Lesquereux																																					×	×?																		
Comptonia praemissa Lesquereux																																			×																					
Myrica (Comptonia) vindobonensis (Ettingshausen) Heer																×													×																											
Myrica banksiaefolia Unger																							×																																
Myrica banksiaefolia curta Hollick, n. var																															×		×																								
Myrica (Dryandroides) lignitum (Unger) Saporta																															×		×																								
Myrica speciosa Unger																															×		×																								
Juglans acuminata Alex. Braun			×								×										×											×											×												
Juglans acuminata latifolia (Alex. Braun) Heer																																																				×				
Juglans strozziana Gaudin?			×																																																			
Juglans salicifolia Goeppert																								×																																
Juglans longiapiculata Hollick, n. sp					×																																																	
Juglans thermalis Lesquereux														×																																											
Juglans egregia Lesquereux					×																													×																					
Juglans crossii Knowlton																×																																									
Juglans juglandiformis (Sternberg) Giebel																×																																									
Juglans woodiana Heer																							×													×																			
Juglans nigella Heer			×		×												×				×								×																											
Juglans picroides Heer																							×													×								×												
Juglans valida Hollick, n. sp					×																																																	
Juglans (?) pseudopunctata Hollick, n. sp					×														×					×																															
Juglans townsendi Knowlton																																				×																				
Hicoria antiquora (Newberry) Knowlton																																		×																					
Hicoria magnifica Knowlton																																×																			×	×				
Pterocarya septentrionale Hollick, n. sp																×																																										
Engelhardtia ettingshauseni Berry																								×																																
Carpinus grandis Unger			×																				×	×			×							×																				
Carpinites truncatus Hollick, n. sp																																									×												
Corylus adumbrata Hollick, n. sp																								×			×																													
Corylus americana fossilis Newberry																								×														×																	
Corylus evidens Hollick, n. sp																																×																								
Corylus harrimani Knowlton																																×																								
Corylus kenaiana Hollick, n. sp																								×																																
Corylus macquarrii (Forbes) Heer		×		×																		×					×																												
Corylus macquarrii macrophylla Heer																							×																																	
Corylus ? palachei Knowlton																																×																								
Betula alaskana Lesquereux																																		×																					
Betula brongniartii Ettingshausen																																				×																				
Betula confusa lata Hollick, n. var																								×																																
Betula dubiosa Hollick, n. name																													×																											
Betula grandifolia Ettingshausen																							×																																	
Betula populoides Hollick, n. sp																																		×																					
Betula prisca Ettingshausen																							×	×				×																													
Alnus alaskana Newberry			×																									×																													
Alnus alnifolia (Goeppert) Hollick, n. comb				×																																																		×
Alnus corylina Knowlton and Cockerell																								×								×																								
Alnus grandiflora Newberry																														×																										
Alnus kefersteinii (Goeppert) Unger																							?					×						×																							
Fagus antipofii Abich																							×		×																														
Fagus deucalionis Unger																								×			×																													
Fagus feroniae Unger																							×																																	
Fagus alnitifolia Hollick, n. sp																								×																																
Castanea castaneaefolia (Unger) Knowlton			×	×													×				×																																			
Quercus alaskana Trelease?															×								×																																	
Quercus artocarpites Ettingshausen															×																				×																					
Quercus chamissoni Heer																							×																																	
Quercus conjunctiva Hollick, n. sp															×																																									
Quercus dallii Lesquereux																											×				×																										
Quercus etymodrys Unger																																											×													
Quercus furuhjelmi Heer			×																		×																																		
Quercus grönlandica Heer																				×			×								×																										
Quercus juglandina Heer?															×																																									
Quercus meriani Heer															×																																									
Quercus nevadensis Lesquereux																																																				×				
Quercus olafseni Heer																										×																													
Quercus oregoniana Knowlton																							×																																	
Quercus platania Heer																					×	×																																		
Quercus pseudocastanea Goeppert																							×			×																	×															
Quercus steenstrupiana Heer																								×																									×									
Dryophyllum aquilonium Hollick, n. sp															×																																									
Dryophyllum longipetiolatum Knowlton					×																																																	
Dryophyllum stanleyanum Dawson					×						×																																									×			
Ulmus braunii Heer																															×	×	×																								
Ulmus borealis Heer																								×																																
Ulmus carpinoides Goeppert				×																																																			
Ulmus diptera Steenstrup?											×																																												
Ulmus longifolia Unger																		×																																					
Ulmus plurinervia Unger																							×																																	
Ulmus pseudobraunii Hollick, n. sp														×																																										
Ulmus sorbifolia Goeppert					×																	×																																	

Stratigraphic position of the species elsewhere

Species, arranged taxonomically (not including those identified only generically)	United States (excluding Alaska): Southeastern and Gulf region (Eocene)			United States: Rocky Mountain region (Eocene)										United States: Pacific coast region (Eocene)				United States: Eastern and western United States (later Tertiary, not differentiated)							Canada (E=Eocene, M=Miocene)					Northern Hemisphere excluding North America (O=Oligocene, P=Pliocene)				
	Midway group	Wilcox group	Barnwell formation	Post-Laramie formations?	Lance formation (Tertiary?)	Fort Union formation	Raton formation	Denver formation	Dawson arkose	Evanston formation (Tertiary?)	Livingston formation (Eocene and Upper Cretaceous)	Hanna formation	Green River formation	Puget group	Clarno formation (Eocene and Oligocene)	Ione formation	Eocene?	Atlantic coast	Nevada	Colorado	Yellowstone National Park	Oregon	Washington	California	Northwest Territory	British Columbia	Alberta and Saskatchewan	Canada	Grinnell Land, Banks Land	Greenland	Iceland	Svalbard (Spitsbergen)	Europe (Middle and southern)	Asia (mostly northern)
Chondrites heeri Eichwald?																																			
Onoclea sensibilis Linnaeus						×	×																									E								E	
Dryopteris meyeri (Heer) Hollick, n. comb																																		E				E
Hausmannia atwoodi Hollick, n. sp																																			
Dennstaedtia blomstrandi (Heer) Hollick, n. comb							×																								E								
Asplenium alaskanum Hollick, n. sp																																			
Pteris inequilateralis Hollick, n. sp																																			
Pteris oeningensis Unger?																																		E			M	
Pteris pseudopennaeformis Lesquereux		×							×							×																					
Pteris sitkensis Heer																																			
Osmunda doroschkiana Goeppert																																		E				E
Osmunda dubiosa Hollick, n. sp																																			
Anthrophyopsis hamiltonensis Hollick, n. sp																																			
Equisetum arcticum Heer																													E		E			E		
Equisetum globulosum Lesquereux							×																													
Ceratozamia wrightii Hollick																																			
Dioön inopinus Hollick																																			
Dioön praespinulosum Hollick																																			
Ginkgo adiantoides (Unger) Heer						×	×																					O	E			E				E
Ginkgo reniformis conformis Hollick, n. var.																																			
Taxites olriki Heer							×																		E		E			E	E	E		
Taxites microphyllus Heer																																			
Pinus macclurii Heer?																															E	E				
Pinites pannonicus (Unger) Goeppert																																			M	
Pityoxylon inaequale Felix																																			
Pityoxylon macclurii (Heer) Kraus[1]																																E					
Picea harrimani Knowlton																																			
Sequoia brevifolia Heer																																		E		E	M	
Sequoia disticha Heer																																				E		
Sequoia heerii Lesquereux						×								?		×												O									
Sequoia langsdorfii (Brongniart) Heer						×	×					×				×						×		×			E		E							
Sequoia spinosa Newberry																																			
Taxodium crassum Hollick, n. sp																																			
Taxodium dubium (Sternberg) Heer		×			×									×	×			×				×				M	E			E		E	M	E
Taxodium dubium longifolium Massalongo																																			M	
Taxodium dubium normale Massalongo																																			M	
Taxodium occidentale Newberry						×	×																		E	M O E									
Taxodium tinajorum Heer																																		E		E		
Glyptostrobus europaeus (Brongniart) Unger		×			×	×													×		×				E	E	E			E		E	M	E
Thuites ehrenswärdi Heer																																E	E		E		E
Thuites (Chamaecyparis) alaskensis Lesquereux																																			
Caulinia laevis (Goeppert) Goeppert																																			?	
Sagittaria pulchella Heer																																			
Arundo pseudogoepperti Berry?			×																																?	
Phragmites alaskana Heer?							×																												?	
Poacites tenue-striatus Heer																																			
Carex servata Heer																																			
Flabellaria florissanti Lesquereux														×																					
Flabellaria alaskana Hollick, n. sp																																			
Smilax reticulata Heer																																			M	
Piper septentrionalis Hollick, n. sp																																			
Piper convertabilis Hollick, n. sp																																			
Piper concavum Hollick, n. sp																																			
Piper disputabilis Hollick, n. sp																																			
Piper chapini Hollick, n. sp																																			
Populus arctica Heer																											E		E		E	E		E		E
Populus arctica var. b Heer																																E				
Populus richardsoni Heer							?													?						E		E			E		E		E
Populus speciosa Ward?						×	×																				E									
Populus amblyrhyncha Ward						×	×																													
Populus flexuosa Hollick, n. sp																																			
Populus genetrix Newberry							×																				E									
Populus latior Alex. Braun				?		?													×								O							M	E
Populus hookeri Heer																											E									
Populus glandulifera Heer							×																											M	E
Populus balsamoides Goeppert							×													×				×				?						E	M		
Populus gaudini Fischer-Ooster							×														×						?				E			M	E
Populus congerminalis Hollick, n. sp																																			
Populus mutabilis Heer													×																		E					
Populus leucophylla Unger																																			M	
Populus obscura Hollick, n. sp																																			
Populus zaddachi Heer?																?						×	?		×		M O			E		E	E	M	E
Salix alaskana Hollick, n. sp																																			
Salix angusta Alex. Braun						×								×										×		?											M	
Salix lavateri Alex. Braun																								×	×											E			M	E
Salix varians Goeppert																								×	×		×		M				E		E	M	E
Salix wimmeriana Goeppert																																			M	
Salix macrophylla Heer																																			E	M	
Salix tenera Alex. Braun																																		E			M	
Salix grandifolia Weber																																			O	
Salix raeana Heer																		?				×			E		E			E		E		
Salix libbeyi Lesquereux?																						×													M	
Salix abbreviata Goeppert																																			M	
Salix pilosula Goeppert																																			
Salix integra Goeppert?					×																							?								M	
Salix minuta Knowlton																												?									
Comptonia cuspidata Lesquereux																																			
Comptonia praemissa Lesquereux																																			
Myrica (Comptonia) vindobonensis (Ettingshausen) Heer																																			M	
Myrica banksiaefolia Unger																																			M	
Myrica banksiaefolia curta Hollick, n. var																																			
Myrica (Dryandroides) lignitum (Unger) Saporta																			?													E			M, E?	E
Myrica speciosa Unger																																			M	
Juglans acuminata Alex. Braun								×								×			×							E	E	E			E			M	E
Juglans acuminata latifolia (Alex. Braun) Heer																																			M	
Juglans strozziana Gaudin?																																E			P?	
Juglans salicifolia Goeppert																																			M	
Juglans longiapiculata Hollick, n. sp																																			
Juglans thermalis Lesquereux									×																											
Juglans egregia Lesquereux																										×										
Juglans crossii Knowlton													×	×														?				E				
Juglans juglandiformis (Sternberg) Giebel																					×											E			M	
Juglans woodiana Heer							×																				E?									
Juglans nigella Heer							×	×																				E				E				E
Juglans picroides Heer																																			
Juglans valida Hollick, n. sp																																			
Juglans (?) pseudopunctata Hollick, n. sp																																			
Juglans townsendi Knowlton																																			
Hicoria antiquora (Newberry) Knowlton		×			×	×																					E	E							
Hicoria magnifica Knowlton																																			
Pterocarya septentrionale Hollick, n. sp																																			
Engelhardtia ettingshauseni Berry		×																																	
Carpinus grandis Unger															×					×		×		×						E?				E		E	M	E
Carpinites truncatus Hollick, n. sp																																			
Corylus adumbrata Hollick, n. sp																																			
Corylus americana fossilis Newberry						×	×												×								E	E							
Corylus evidens Hollick, n. sp																																			
Corylus harrimani Knowlton																																			
Corylus kenaiana Hollick, n. sp																																			
Corylus macquarrii (Forbes) Heer							×								×					?						×	×	×		×	×	×	×	M?, E	E
Corylus macquarrii macrophylla Heer																										×					×	×			
Corylus ? palachei Knowlton																																			
Betula alaskana Lesquereux																																			
Betula brongniartii Ettingshausen																														E	E			M	E
Betula confusa lata Hollick, n. var																																			
Betula dubiosa Hollick, n. name																										E	M						E	E	M	E
Betula grandifolia Ettingshausen																																			M	
Betula populoides Hollick, n. sp																																			
Betula prisca Ettingshausen							×																				E			E	E	E	E	M	E
Alnus alaskana Newberry																											E									
Alnus alnifolia (Goeppert) Hollick, n. comb																																			M	
Alnus corylina Knowlton and Cockerell																																			
Alnus grandiflora Newberry																																			
Alnus kefersteinii (Goeppert) Unger																							×										E	E	E	M, E	E
Fagus antipofii Abich							×																	?		O					E			M, E	E
Fagus deucalionis Unger																					?								?						E	E	E		
Fagus feroniae Unger																					×								O								M, E	
Fagus alnitifolia Hollick, n. sp																																			
Castanea castaneaefolia (Unger) Knowlton																							×		×					?		E				E
Quercus alaskana Trelease?																																			
Quercus artocarpites Ettingshausen																																			M ?	
Quercus chamissoni Heer																																			
Quercus conjunctiva Hollick, n. sp																																			
Quercus dallii Lesquereux																											E ?									
Quercus etymodrys Unger																																			M	
Quercus furuhjelmi Heer																																			
Quercus grönlandica Heer																																E		E	E	
Quercus juglandina Heer?																																E					
Quercus meriani Heer																																			P ?, M	
Quercus nevadensis Lesquereux																										×										
Quercus olafseni Heer							×					?															E					E	E			E
Quercus oregoniana Knowlton																×																				
Quercus platania Heer																																E		E	?	
Quercus pseudocastanea Goeppert																											E				E					
Quercus steenstrupiana Heer																										×						E					
Dryophyllum aquilonium Hollick, n. sp																																			
Dryophyllum longipetiolatum Knowlton																						×														
Dryophyllum stanleyanum Dawson																											O ?, E									
Ulmus braunii Heer																					×					E ?						E	M, E	E
Ulmus borealis Heer																														E	E					
Ulmus carpinoides Goeppert																																			M	
Ulmus diptera Steenstrup?																																	E		M	
Ulmus longifolia Unger																																			M	
Ulmus plurinervia Unger																							×										E			M	E
Ulmus pseudobraunii Hollick, n. sp																																			
Ulmus sorbifolia Goeppert																																			M	

[1] No locality given other than "Alaska."

Locality distribution of species in Alaska

Species, arranged taxonomically (not including those identified only generically)	Southeastern Alaska region							Yakutat-Copper River region						Matanuska-Cook Inlet region																	Alaska Peninsula region							Lower Yukon, Norton Sound region	Kobuk River, Northwestern Alaska	Tanana region						Yukon River region: Upper				Yukon River region: Central					
	Baranof Island (near Sitka)	Keku Island	Kootznahoo Inlet	Kuiu Island	Kupreanof Island	Whitney Island	Zarembo Island	Yakutat Bay	Danaáku	Bering Lake	Bering River	Gakona Glacier	Berg Lake and other localities	Chickaloon River	Matanuska River, near Moose Creek	Kings River	Little Kings Creek	Eska Creek	Youngs Creek	Sheep Valley	Other localities	Port Graham	Kachemak Bay	Point Naskowhak	Yentna River (Cache Creek)	Old Tyonek	Ninilchik	Chinitna Bay	Kenai Peninsula (locality?)	Cook Inlet (locality?)	Cape Douglas	Kukak Bay	Aniakchak Bay, King Salmon Lake, and vicinity	Chignik Bay	Portage (Balboa) Bay	Herendeen Bay	Unga Island			California Creek	Sec. 10, T. 9 S., R. 6 W.	Lignite Creek	Coal Creek	Wells Creek	Other localities	American Creek	Bryant Creek	Mission Creek	Seventymile River, near Mogul Creek	Yukon River, north bank, opposite Hes Creek	Drew's or Miller's coal mine	Yukon River, south bank, 1.5-2 miles above Rampart	Yukon River, north bank, below rapids below Rampart	Yukon River, 35 miles below Tanana	Divide between Folger Creek and Nowitna River
Planera aquaticiformis Hollick, n. sp													X																																										
Planera ungeri Ettingshausen				X																	X																																
Artocarpidium alaskanum Hollick, n. sp													X																																X										
Artocarpus ordinarius Hollick, n. sp																																																				X			
Ficus? alaskana Newberry			X																										X																	?		X	?	X			
Ficus dalli Cockerell																														X																									
Ficus menzeli Hollick, n. sp														X																																									
Ficus overbecki Hollick, n. sp																																										X													
Ficus stantoni Hollick, n. sp																																		X																					
Protoficus inaequalis Newberry ?																X																																							
Grevillea alaskana Hollick, n. sp																							X																																
Hakea alaskana Hollick, n. sp																		X																																					
Macclintockia chignikensis Hollick, n. sp																																		X																					
Coccolobis chapini Hollick, n. sp																		X																																					
Nelumbo protolutea Berry?																																																					X		
Magnolia inglefieldi Heer					X									X							X																																
Magnolia nordenskioldi Heer																																		X																					
Magnolia ovalis Lesquereux													X																																										
Magnolia wormskioldi Heer								X																																															
Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb													X																																										
Cinnamomum ficoides Hollick, n. sp																																	X																						
Persea spatiosa Hollick, n. sp													X																																										
Sassafras alaskanum Hollick, n. sp					X																																																		
Malapoenna carbonensis (Ward) Knowlton?					X																																																		
Malapoenna magnifica (Saporta) Hollick, n. comb					X								X																																										
Benzoin antiquum Heer																							X																																
Laurus californica Lesquereux					X																																																		
Laurus fürstenbergii Alex. Braun					X																																																		
Laurus hamiltonensis Hollick, n. sp					X																																																		
Laurus ocotaefolia Ettingshausen																		X																																					
Laurus princeps Heer															X								X																																
Laurus saliciformis Knowlton and Cockerell															X								X																																
Daphnogene kanii Heer											X																																												
Hydrangea alaskana Hollick																																	X																						
Hamamelis clarus Hollick, n. sp																																																	X						
Liquidambar europaeum Alex. Braun																						X																																	
Platanus aceroides latifolia Knowlton																																																				X			
Platanus nobilis Newberry																																						X																	
Platanus rectinervis Hollick, n. sp																																																				X			
Spiraea andersoni Heer																						X																																	
Spiraea weaveri Hollick, n. sp																							X																																
Rosa cetera Hollick, n. sp															X																																							
Rosa confirmata Hollick, n. sp																							X																																
Crataegus alaskensis Hollick, n. sp																															X																								
Crataegus cappsii Hollick, n. sp																																											X												
Crataegus yukonensis Hollick, n. sp																																																			X				
Prunus hartungi aequalis Hollick, n. var																							X																																
Prunus olympica Ettingshausen																							X																																
Prunus scottii Heer															X																																							
Prunus variabilis Newberry?																														X			X																						
Pithecolobium ceterum Hollick, n. sp																																																			X				
Acacia aquilonia Hollick, n. sp			X																																																				
Cassia glenni Berry?															X																																				X				
Cassia phaseolites Unger?															X																																							
Sophora multiformis Hollick, n. sp																																																			X				
Canavalia eocenica Berry										X																																												
Dolichos convexus Hollick, n. sp																		X																																					
Tetrapteris harpyiarum Unger								X																																															
Semecarpus alaskana Hollick, n. sp													X																																										
Semecarpus prindlei Hollick, n. sp																																															X								
Rhus frigida Knowlton																																				X																			
Ilex insignis Heer																						X										X										X													
Ilex? reticulata Heer															X																																							
Celastrus borealis Heer																						X																				X													
Celastrus comparabilis Hollick, n. sp								X																																										X				
Elaeodendron helveticum Heer																																					X																		
Acer arcticum Heer																		X																	X	X																			
Acer disputabilis Hollick, n. sp																																	X																						
Acer grahamensis Knowlton and Cockerell																						X																																	
Acer inaequale Heer?														X				X																																					
Acer trilobatum productum (Alex. Braun) Heer																																				?																X			
Acer trilobatum var. Knowlton																																X																				?			
Acer visibilis Hollick, n. sp																																																				X			
Aesculus arctica Knowlton																																X																							
Cupania comparabilis Hollick, n. sp																																X																							
Paullinia alaskana Hollick, n. sp																																																			X				
Sapindus affinis Newberry?																		X																																					
Sapindus angustifolius Lesquereux? (not Blume)																		X																																					
Sapindus basilicus (Unger) Unger					X																																																		
Koelreuteria eakini Hollick, n. sp																																																				X			
Rhamnus brevifolius Alex. Braun																							X																																
Rhamnus decheni Weber													X																																										
Rhamnus gaudini Heer															X								X																																
Rhamnus marginatus Lesquereux													X																																										
Rhamnus pseudogoldianus Hollick, n. sp			X										X																																										
Rhamnus rossmaessleri Unger					X																																																		
Zizyphus hyperboreus Heer																																	X																						
Zizyphus meigsii (Lesquereux) Berry ? (not Schimper)																																		X																					
Zizyphus townsendi Knowlton																																				?																			
Paliurus ceterus Hollick, n. sp																		X			X																																	
Paliurus colombi Heer																																	X		X	X																			
Vitis alaskana Cockerell			X																																																				
Vitis atwoodi Hollick, n. sp			X																																																				
Vitis heeriana Knowlton and Cockerell?																						X																				X									X				
Vitis olriki Heer					X																																																		
Cissus cissoides (Saporta) Hollick, n. comb																		X																																					
Cissus pterospermoides Hollick, n. sp																		X																																					
Elaeocarpus alaskensis Hollick, n. sp																							X																																
Tilia alaskana Heer																						X																																	
Tilia grewioides Hollick, n. sp			X																																																				
Tilia malmgreni Heer			X																																																				
Tilia notabilis Hollick, n. sp			X																																																				
Grewia crenata (Unger) Heer																																																				X			
Grewia orbiculata Hollick, n. sp																																																			X	X			
Grewia zizyphoides Hollick, n. sp																																		X																					
Grewiopsis alaskana Hollick, n. sp																		X																X																					
Grewiopsis congerminalis Hollick, n. sp																																		X															X						
Grewiopsis defectivus Hollick, n. sp					X																																																		
Grewiopsis grandiculus Hollick, n. sp																																		X																					
Grewiopsis frustratorius Hollick, n. sp					X																																																		
Apeibopsis? discolor (Lesquereux) Lesquereux																																	X																						
Abutilon eakini Hollick, n. sp																																				X																			
Hampea conditionalis Hollick, n. sp								X																									?																						
Pterospermites alaskana Knowlton																																X																							
Pterospermites alternans Heer																																																	X						
Pterospermites auriculaecordatus Hollick, n. sp															X																		X																					
Pterospermites conjunctivus Hollick, n. sp					X																													X																					
Pterospermites imparilis Hollick, n. sp															X																		X																					
Pterospermites magnifolia Knowlton																																X																							
Pterospermites spectabilis Heer																X																		X															X			X			
Dillenia alaskana Hollick, n. sp					X																													X																					
Dillenites ceterus Hollick, n. sp					X																																																		
Dillenites ellipticus Hollick, n. sp					X																																																		
Dillenites ellipticus ulmifolius Hollick, n. var					X																																																		
Dillenites microdentatus (Hollick) Berry					X																																																		
Saurauja alaskana Hollick, n. sp					X																																																		
Lepargyraea weaveri Hollick, n. sp																							X																																
Trapa borealis Heer																						X																																	
Hedera auriculata Heer																						X																																	
Hedera macclurii Heer																																				X					X														
Aralia delicatula Hollick, n. sp																																				X																			
Cornus büchii Heer													X																																										
Cornus hyperborea Heer?													X																																										
Cornus irregularis Hollick, n. sp													X																																										
Cornus orbifera Heer																														X																									
Nyssa arctica Heer																																					X																		
Nyssidium ekmani Heer			X																X																																	X			
Rhododendron crassum Hollick, n. sp													X																																										
Vaccinium alaskanum Knowlton																																	X																						
Vaccinium friesii Heer																						X																																	
Vaccinium hollicki Knowlton																														X																									
Diospyros alaskana Schimper																						X					X																												
Diospyros anceps Heer																							X							X																									
Diospyros brachysepala Alex. Braun																																																				X			
Diospyros stenosepala Heer																						X																																	
Ebenoxylon boreale Platen [1]																																																							
Mohrodendron inopinum Hollick, n. sp			X										X		X																																							
Fraxinus herendeenensis Knowlton																																				X																			
Fraxinus inordinata Hollick, n. sp															X																		X																					
Fraxinus johnstrupi Heer															X																																							
Fraxinus juglandina Saporta														X	X								X											X																					
Fraxinus lateralis Hollick, n. sp													X		X																																							
Fraxinus? pseudobliqua Hollick, n. sp					X																													X																					
Fraxinus yukonensis Hollick, n. sp															X																											X						X						
Viburnum aequale Hollick, n. sp																																				X																			
Viburnum antiquum (Newberry) Hollick																																															X								
Viburnum contortum Lesquereux																X																																							
Viburnum duriusculum Hollick, n. sp																																				X																			
Viburnum evexum Hollick, n. sp																																		X																					
Viburnum newberryanum Ward																		X																																					
Viburnum nordenskiöldi Heer																																		X						X		X													
Viburnum obliquum Hollick																		X																																					
Viburnum schmidtianum Heer?																																												X											
Viburnum whymperi Heer																																																X	X						
Nordenskiöldia borealis Heer																																			X																				
Antholithes castaneoides Hollick, n. sp															X																																							
Palaeanthus prindlei Hollick, n. sp																																															X								
Phyllites arctica Knowlton																																				X																			
Phyllites saundersi Knowlton																																X																							
Carpolithes auriformis Hollick, n. sp																																	X																						
Carpolithes elytraeformis Hollick, n. sp								X																																															

Stratigraphic position of the species elsewhere

Species	United States (excluding Alaska): Southeastern and Gulf region (Eocene)			Rocky Mountain region (Eocene)										Pacific coast region (Eocene)				Eastern and western United States (later Tertiary, not differentiated)							Canada (E=Eocene, M=Miocene)					Northern Hemisphere excluding North America (O=Oligocene, P=Pliocene)				
	Midway group	Wilcox group	Barnwell formation	Post-Laramie formations?	Lance formation (Tertiary?)	Fort Union formation	Raton formation	Denver formation	Dawson arkose	Evanston formation (Tertiary?)	Livingston formation (Eocene and Upper Cretaceous)	Hanna formation	Green River formation	Puget group	Clarno formation (Eocene and Oligocene)	Ione formation	Eocene?	Atlantic coast	Nevada	Colorado	Yellowstone National Park	Oregon	Washington	California	Northwest Territory	British Columbia	Alberta and Saskatchewan	Canada	Grinnell Land, Banks Land	Greenland	Iceland	Svalbard (Spitsbergen)	Europe (Middle and southern)	Asia (mostly northern)
Planera aquaticiformis Hollick, n. sp																																		
Planera ungeri Ettingshausen																		X		X		X	?							E	E		M	E
Artocarpidium alaskanum Hollick, n. sp																																		
Artocarpus ordinarius Hollick, n. sp																																		
Ficus? alaskana Newberry																																		
Ficus dalli Cockerell																																		
Ficus menzeli Hollick, n. sp																																		
Ficus overbecki Hollick, n. sp																																		
Ficus stantoni Hollick, n. sp																																		
Protoficus inaequalis Newberry ?						X																											
Grevillea alaskana Hollick, n. sp																																		
Hakea alaskana Hollick, n. sp																																		
Macclintockia chignikensis Hollick, n. sp																																		
Coccolobis chapini Hollick, n. sp																																		
Nelumbo protolutea Berry?		X																																
Magnolia inglefieldi Heer																	X				X							E				
Magnolia nordenskioldi Heer																									E					E		E		E
Magnolia ovalis Lesquereux		X																																
Magnolia wormskioldi Heer																														E			M	
Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb	X							?																									M, E	
Cinnamomum ficoides Hollick, n. sp																																		
Persea spatiosa Hollick, n. sp																																		
Sassafras alaskanum Hollick, n. sp																																		
Malapoenna carbonensis (Ward) Knowlton?												X																					
Malapoenna magnifica (Saporta) Hollick, n. comb																																	E	
Benzoin antiquum Heer																				?										E				
Laurus californica Lesquereux																	?				X			X											
Laurus fürstenbergii Alex. Braun																								X									M	
Laurus hamiltonensis Hollick, n. sp																																		
Laurus ocotaefolia Ettingshausen																																	M	
Laurus princeps Heer						?																	X									M	
Laurus saliciformis Knowlton and Cockerell																								X											
Daphnogene kanii Heer		?																												E			M?	
Hydrangea alaskana Hollick																																		
Hamamelis clarus Hollick, n. sp																																		
Liquidambar europaeum Alex. Braun						?									X		X					?							E			M, E	
Platanus aceroides latifolia Knowlton	X						X																												
Platanus nobilis Newberry					X	X																?					E							
Platanus rectinervis Hollick, n. sp																																		
Spiraea andersoni Heer																																		
Spiraea weaveri Hollick, n. sp																																		
Rosa cetera Hollick, n. sp																																		
Rosa confirmata Hollick, n. sp																																		
Crataegus alaskensis Hollick, n. sp																																		
Crataegus cappsii Hollick, n. sp																																		
Crataegus yukonensis Hollick, n. sp																																		
Prunus hartungi aequalis Hollick, n. var																																		
Prunus olympica Ettingshausen																																	M	
Prunus scottii Heer																														E				
Prunus variabilis Newberry?																																		
Pithecolobium ceterum Hollick, n. sp																																		
Acacia aquilonia Hollick, n. sp																																		
Cassia glenni Berry?		X																																
Cassia phaseolites Unger?																																	M	
Sophora multiformis Hollick, n. sp																																		
Canavalia eocenica Berry		X																																
Dolichos convexus Hollick, n. sp																																		
Tetrapteris harpyiarum Unger																																	M	
Semecarpus alaskana Hollick, n. sp																																		
Semecarpus prindlei Hollick, n. sp																																		
Rhus frigida Knowlton																																		
Ilex insignis Heer																																		
Ilex? reticulata Heer																														E				
Celastrus borealis Heer																																		E
Celastrus comparabilis Hollick, n. sp																																		
Elaeodendron helveticum Heer																																	M	
Acer arcticum Heer						X																	X						E		E		
Acer disputabilis Hollick, n. sp																																		
Acer grahamensis Knowlton and Cockerell																																		
Acer inaequale Heer?																																E	?	
Acer trilobatum productum (Alex. Braun) Heer				?				?																								M	
Acer trilobatum var. Knowlton																																		
Acer visibilis Hollick, n. sp																																		
Aesculus arctica Knowlton																																		
Cupania comparabilis Hollick, n. sp																																		
Paullinia alaskana Hollick, n. sp																																		
Sapindus affinis Newberry?					X	X	X																					E							
Sapindus angustifolius Lesquereux? (not Blume)		?				X														?		?												
Sapindus basilicus (Unger) Unger																																	E	
Koelreuteria eakini Hollick, n. sp																																		
Rhamnus brevifolius Alex. Braun																														E			M	
Rhamnus decheni Weber				X																													M	
Rhamnus gaudini Heer														X												E							
Rhamnus marginatus Lesquereux		X																																
Rhamnus pseudogoldianus Hollick, n. sp																																		
Rhamnus rossmaessleri Unger																														E			M, E	
Zizyphus hyperboreus Heer									?			?																		E				
Zizyphus meigsii (Lesquereux) Berry ? (not Schimper)		X					X																										
Zizyphus townsendi Knowlton																																		
Paliurus ceterus Hollick, n. sp																																		
Paliurus colombi Heer					X	X						X																		E		E		E
Vitis alaskana Cockerell																										E?				E				
Vitis atwoodi Hollick, n. sp																																		
Vitis heeriana Knowlton and Cockerell?																																		
Vitis olriki Heer										X															O				E				
Cissus cissoides (Saporta) Hollick, n. comb																																	E	
Cissus pterospermoides Hollick, n. sp																																		
Elaeocarpus alaskensis Hollick, n. sp																																		
Tilia alaskana Heer																																		
Tilia grewioides Hollick, n. sp																																		
Tilia malmgreni Heer																									E				E			E		
Tilia notabilis Hollick, n. sp																																		
Grewia crenata (Unger) Heer						X								X							X				MO	E					E		
Grewia orbiculata Hollick, n. sp																																		
Grewia zizyphoides Hollick, n. sp																																		
Grewiopsis alaskana Hollick, n. sp																																		
Grewiopsis congerminalis Hollick, n. sp																																		
Grewiopsis defectivus Hollick, n. sp																																		
Grewiopsis grandiculus Hollick, n. sp																																		
Grewiopsis frustratorius Hollick, n. sp																																		
Apeibopsis? discolor (Lesquereux) Lesquereux				X								X																					
Abutilon eakini Hollick, n. sp																																		
Hampea conditionalis Hollick, n. sp																																		
Pterospermites alaskana Knowlton																																		
Pterospermites alternans Heer																									?				E				
Pterospermites auriculaecordatus Hollick, n. sp																																		
Pterospermites conjunctivus Hollick, n. sp																																		
Pterospermites imparilis Hollick, n. sp																																		
Pterospermites magnifolia Knowlton																																		
Pterospermites spectabilis Heer																									E				E				
Dillenia alaskana Hollick, n. sp																																		
Dillenites ceterus Hollick, n. sp																																		
Dillenites ellipticus Hollick, n. sp																																		
Dillenites ellipticus ulmifolius Hollick, n. var																																		
Dillenites microdentatus (Hollick) Berry		X																																
Saurauja alaskana Hollick, n. sp																																		
Lepargyraea weaveri Hollick, n. sp																																		
Trapa borealis Heer																										E	?							
Hedera auriculata Heer																																		
Hedera macclurii Heer																									E				E		E		E
Aralia delicatula Hollick, n. sp																																		
Cornus büchii Heer																																	M	
Cornus hyperborea Heer?																	?													E		E		
Cornus irregularis Hollick, n. sp																																		
Cornus orbifera Heer																														E		E		
Nyssa arctica Heer																														E		E		
Nyssidium ekmani Heer																														E		E		
Rhododendron crassum Hollick, n. sp																																		
Vaccinium alaskanum Knowlton																																		
Vaccinium friesii Heer																																		
Vaccinium hollicki Knowlton																																	E?	
Diospyros alaskana Schimper										X				X						X	?			E							
Diospyros anceps Heer																																	M	E
Diospyros brachysepala Alex. Braun				?																													M	E
Diospyros stenosepala Heer																														E				
Ebenoxylon boreale Platen [1]																																		
Mohrodendron inopinum Hollick, n. sp																																		
Fraxinus herendeenensis Knowlton																																		
Fraxinus inordinata Hollick, n. sp																																		
Fraxinus johnstrupi Heer		E																											E				
Fraxinus juglandina Saporta																																	M	
Fraxinus lateralis Hollick, n. sp																																		
Fraxinus? pseudobliqua Hollick, n. sp																																		
Fraxinus yukonensis Hollick, n. sp																																		
Viburnum aequale Hollick, n. sp																																		
Viburnum antiquum (Newberry) Hollick																																		
Viburnum contortum Lesquereux				X	X	X	X																						?				
Viburnum duriusculum Hollick, n. sp																																		
Viburnum evexum Hollick, n. sp																																		
Viburnum newberryanum Ward					X	X																											
Viburnum nordenskiöldi Heer						X																		E				E		E		E
Viburnum obliquum Hollick																																		
Viburnum schmidtianum Heer?					X	X																	X						E		E		E
Viburnum whymperi Heer													X											E	E				E		E	?	
Nordenskiöldia borealis Heer																														E				
Antholithes castaneoides Hollick, n. sp																																		
Palaeanthus prindlei Hollick, n. sp																																		
Phyllites arctica Knowlton																																		
Phyllites saundersi Knowlton																																		
Carpolithes auriformis Hollick, n. sp																																		
Carpolithes elytraeformis Hollick, n. sp																																		

[1] No locality given other than "Alaska."

The Upper Cretaceous flora of Alaska, by Arthur Hollick, with a description of the Upper Cretaceous plant-bearing beds, by G. C. Martin. Professional Paper 159, 1930, 123 pp., 87 pls.

SOUTHEASTERN ALASKA

The Juneau gold belt, by A. C. Spencer, pp. 1–137, and A reconnaissance of Admiralty Island, by C. W. Wright, pp. 138–154. Bulletin 287, 1906, 161 pp.

Reconnaissance on the Pacific coast from Yakutat to Alsek River, by Eliot Blackwelder. In Bulletin 314, 1907, pp. 82–88.

The Ketchikan and Wrangell mining districts, by F. E. and C. W. Wright. Bulletin 347, 1908, 210 pp.

The Yakutat Bay region, Alaska, by R. S. Tarr and B. S. Butler. Professional Paper 64, 1909, 183 pp.

Geology and mineral deposits of southeastern Alaska, by A. F. Buddington and Theodore Chapin. Bulletin 800, 1929, 398 pp.

Notes on the geography and geology of Lituya Bay, Alaska, by J. B. Mertie, Jr. In Bulletin 836, 1931, pp. 117–135.

COPPER RIVER REGION

Geology of the central Copper River region, by W. C. Mendenhall. Professional Paper 41, 1905, 133 pp.

Geology and mineral resources of the Controller Bay region, by G. C. Martin. Bulletin 335, 1908, 141 pp.

Mineral resources of the Kotsina-Chitina region, by F. H. Moffit and A. G. Maddren. Bulletin 374, 1909, 103 pp.

Mineral resources of the Nabesna-White River district, by F. H. Moffit and Adolph Knopf, with a section on the Quaternary, by S. R. Capps. Bulletin 417, 1910, 64 pp.

Geology and mineral resources of the Nizina district, by F. H. Moffit and S. R. Capps. Bulletin 448, 1911, 111 pp.

Headwater regions of Gulkana and Susitna Rivers, with accounts of the Valdez Creek and Chistochina placer districts, by F. H. Moffit. Bulletin 498, 1912, 82 pp.

Mineral deposits of the Yakataga district, by A. G. Maddren. In Bulletin 592, 1914, pp. 119–153.

Geology and mineral resources of Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant. Bulletin 587, 1915, 243 pp.

The Nelchina-Susitna region, by Theodore Chapin. Bulletin 668, 1918, 67 pp.

The Upper Chitina Valley, by F. H. Moffit, with a description of the igneous rocks, by R. M. Overbeck. Bulletin 675, 1918, 82 pp.

The Kotsina-Kuskulana district, by F. H. Moffit and J. B. Mertie, Jr. Bulletin 745, 1923, 149 pp.

Notes on the geology of the upper Nizina River, by F. H. Moffit. In Bulletin 813, 1930, pp. 143–163.

The Slana district, upper Copper River region, by F. H. Moffit. In Bulletin 824, 1931, pp. 111–124.

COOK INLET AND SUSITNA REGION

Geologic reconnaissance in the Matanuska and Talkeetna basins, by Sidney Paige and Adolph Knopf. Bulletin 327, 1907, 71 pp.

The Mount McKinley region, by A. H. Brooks. Professional Paper 70, 1911, 234 pp.

A geologic reconnaissance of the Iliamna region, by G. C. Martin and F. J. Katz. Bulletin 485, 1912, 138 pp.

Geology and coal fields of the lower Matanuska Valley, by G. C. Martin and F. J. Katz. Bulletin 500, 1912, 98 pp.

The Yentna district, by S. R. Capps. Bulletin 534, 1913, 75 pp.

Geology and mineral resources of Kenai Peninsula, by G. C. Martin, B. L. Johnson, and U. S. Grant. Bulletin 587, 1915, 243 pp.

The Willow Creek district, by S. R. Capps. Bulletin 607, 1915, 86 pp.

The Broad Pass region, by F. H. Moffit and J. E. Pogue. Bulletin 608, 1915, 80 pp.

The Nelchina-Susitna region, by Theodore Chapin. Bulletin 668, 1918, 67 pp.

Geology and mineral resources of the region traversed by the Alaska Railroad, by S. R. Capps. In Bulletin 755, 1924, pp. 73–150.

Mining developments in the Matanuska coal fields, by Theodore Chapin. In Bulletin 714, 1921. (See also Bulletin 692–D, 1919; and Bulletin 712–E, 1920.)

An early Tertiary placer deposit in the Yentna district, by S. R. Capps. In Bulletin 773, 1925, pp. 53–61.

Mineral resources of the Kamishak Bay region, by K. F. Mather. In Bulletin 773, 1925, pp. 159–181.

The Iniskin-Chinitna Peninsula and the Snug Harbor district, Alaska, by F. H. Moffit. Bulletin 789, 1927, 71 pp.

Geology of the upper Matanuska Valley, Alaska, by S. R. Capps, with a section on the igneous rocks, by J. B. Mertie, Jr. Bulletin 791, 1927, 92 pp.

Geology of the Knik-Matanuska district, Alaska, by K. K. Landes. In Bulletin 792, 1927, pp. 51–72.

The Skwentna region, by S. R. Capps. In Bulletin 797, 1929, pp. 67–98.

The Mount Spurr region, by S. R. Capps. In Bulletin 810, 1930, pp. 141–172.

The Chakachamna-Stony region, by S. R. Capps. In Bulletin 813, 1930, pp. 97–123.

The Lake Clark-Mulchatna region, by S. R. Capps. In Bulletin 824, 1931, pp. 125–154.

SOUTHWESTERN ALASKA

Geology and mineral resources of parts of Alaska Peninsula, by W. W. Atwood. Bulletin 467, 1911, 137 pp.

A geologic reconnaissance of the Iliamna region, by G. C. Martin and F. J. Katz. Bulletin 485, 1912, 138 pp.

Mineral deposits of Kodiak and the neighboring islands, by G. C. Martin. In Bulletin 542, 1913, pp. 125–136.

The Lake Clark-central Kuskokwim region, by P. S. Smith. Bulletin 655, 1917, 162 pp.

The Cold Bay-Chignik district, by W. R. Smith and A. A. Baker. In Bulletin 755, 1924, pp. 151–218.

The Cold Bay-Katmai district, by W. R. Smith. In Bulletin 773, 1925, pp. 183–207.

Mineral resources of the Kamishak Bay region, by K. F. Mather. In Bulletin 773, 1925, pp. 159–181.

Geology and oil developments of the Cold Bay district, by W. R. Smith. In Bulletin 783, 1927, pp. 63–88.

Geology and mineral resources of the Aniakchak district, by R. S. Knappen. In Bulletin 797, 1928, pp. 161–223.

YUKON AND KUSKOKWIM BASINS

The Fortymile quadrangle, Yukon-Tanana region, by L. M. Prindle. Bulletin 375, 1909, 52 pp.

Mineral resources of the Nabesna-White River district, by F. H. Moffit, Adolph Knopf, and S. R. Capps. Bulletin 417, 1910, 64 pp.

The Bonnifield region, by S. R. Capps. Bulletin 501, 1912, 64 pp.

A geologic reconnaissance of a part of the Rampart quadrangle, by H. M. Eakin. Bulletin 535, 1913, 38 pp.

A geologic reconnaissance of the Fairbanks quadrangle, by L. M. Prindle, F. J. Katz, and P. S. Smith. Bulletin 525, 1913, 220 pp.

The Koyukuk-Chandalar region, by A. G. Maddren. Bulletin 532, 1913, 119 pp.

A geologic reconnaissance of the Circle quadrangle, by L. M. Prindle. Bulletin 538, 1913, 82 pp.

Gold placers of the lower Kuskokwim, with a note on copper in the Russian Mountains, by A. G. Maddren. In Bulletin 622, 1915, pp. 292–360.

Quicksilver deposits of the Kuskokwim region, by P. S. Smith and A. G. Maddren. In Bulletin 622, 1915, pp. 272–291.

The Chisana-White River district, by S. R. Capps. Bulletin 630, 1916, 130 pp.

The Yukon-Koyukuk region, by H. M. Eakin. Bulletin 631, 1916, 88 pp.

The Lake Clark-central Kuskokwim region, by P. S. Smith. Bulletin 655, 1918, 162 pp.

The Cosna-Nowitna region, by H. M. Eakin. Bulletin 667, 1918, 54 pp.

The Anvik-Andreafski region, by G. L. Harrington. Bulletin 683, 1918, 70 pp.

The Kantishna district, by S. R. Capps. Bulletin 687, 1919, 118 pp.

The Nenana coal field, Alaska, by G. C. Martin. Bulletin 664, 1919, 54 pp.

Mineral resources of the Goodnews Bay region, by G. L. Harrington. In Bulletin 714, 1921, pp. 207–288.

The Ruby-Kuskokwim region, by J. B. Mertie, Jr., and G. L. Harrington. Bulletin 754, 1924, 129 pp.

Geology and gold placers of the Chandalar district, by J. B. Mertie, Jr. In Bulletin 773, 1925, pp. 215–263.

The Nixon Fork country, by J. S. Brown. In Bulletin 783, 1927, pp. 97–144.

The Toklat-Tonzona River region, by S. R. Capps. In Bulletin 792, 1927, pp. 73–110.

The Chandalar-Sheenjek district, by J. B. Mertie, Jr. In Bulletin 810, 1930, pp. 87–139.

Geology of the Eagle-Circle district, by J. B. Mertie, Jr. Bulletin 816, 1930, 168 pp.

SEWARD PENINSULA

The Fairhaven gold placers, Seward Peninsula, by F. H. Moffit. Bulletin 247, 1905, 85 pp.

The gold placers of parts of Seward Peninsula, including the Nome, Council, Kougarok, Port Clarence, and Goodhope precincts, by A. J. Collier, F. L. Hess, P. S. Smith, and A. H. Brooks. Bulletin 328, 1908, 343 pp.

A geologic reconnaissance in southeastern Seward Peninsula and the Norton Bay-Nulato region, by P. S. Smith and H. M. Eakin. Bulletin 449, 1911, 146 pp.

Geology of the Nome and Grand Central quadrangles, by F. H. Moffit. Bulletin 533, 1913, 140 pp.

Pliocene and Pleistocene fossils from the Arctic coast of Alaska and the auriferous beaches of Nome, Norton Sound, by W. H. Dall. In Professional Paper 125, 1921, pp. 23–37.

NORTHERN ALASKA

A reconnaissance in northern Alaska in 1901, by F. C. Schrader, with notes by W. J. Peters. Professional Paper 20, 1904, 139 pp.

Geologic investigations along the Canada–Alaska boundary, by A. G. Maddren. In Bulletin 520, 1912, pp. 297–314.

The Noatak-Kobuk region, by P. S. Smith. Bulletin 536, 1913, 160 pp.

The Koyukuk-Chandalar region, by A. G. Maddren. Bulletin 532, 1913, 119 pp.

The Canning River region of northern Alaska, by E. de K. Leffingwell. Professional Paper 109, 1919, 251 pp.

Pliocene and Pleistocene fossils from the Arctic coast of Alaska and the auriferous beaches of Nome, Norton Sound, by W. H. Dall. In Professional Paper 125, 1921, pp. 23–37.

The Chandalar-Sheenjek district, by J. B. Mertie, Jr. In Bulletin 810, 1930, pp. 87–139.

Geography and geology of northwestern Alaska, by Philip S. Smith and J. B. Mertie, Jr. Bulletin 815, 1930, 351 pp.

MARINE DEPOSITS

There are four principal areas in which Tertiary deposits that were laid down under marine conditions have been studied. These are the Lituya Bay-Katalla region, on the southern coast of Alaska; the Alaska Peninsula region, in western Alaska; the Nome district, in the Seward Peninsula region of northwestern Alaska; and the coastal plain adjacent to the Arctic Ocean, in northern Alaska.

In the Lituya Bay-Katalla region the Tertiary rocks form a narrow belt extending more or less continuously from the vicinity of Cape Spencer to Katalla, a distance of more than 300 miles. Observations have been made at a number of points in this belt, but the most complete section that has been worked out is that in the Controller Bay field, near the western limit of the belt, described by Martin. In this area he recognized the following section north of Bering Lake:

	Feet
Tokun formation: Sandstones and shales with thin flaggy sandstones and scattered calcareous concretions; dominantly marine	2,500+
Kushtaka formation: Arkose with many coal beds and with some shale and sandstone, dominantly terrigenous	2,500±
Stillwater formation: Shale and sandstone; dominantly marine	1,000+
Base of section not recognized.	

In the same general region but south of Bering Lake Martin distinguished the Katalla formation, 6,500 feet thick, which, though he was unable to place it definitely with respect to the section north of the lake, he was inclined to believe underlies the Stillwater formation. The paleontologic and stratigraphic evidence for the correlation of these four formations is inconclusive and conflicting. In seems reasonably certain, however, that the entire sequence of four formations is post-Eocene in age, and that the Tokun formation is probably of Miocene age. The Stillwater and Kushtaka formations may be either Oligocene or Miocene. In this correlation it will be observed that the flora of the coal measures (Kushtaka formation) does not resemble the type Kenai flora, of upper Eocene age, but seems younger. On the other hand, it should be emphasized that the Kenai flora has been found only in the lower part of the Kenai formation, and that the age of the upper part of the Kenai formation has not been determined paleontologically.

That still younger members of the Tertiary occur in this belt is shown by the fact that a section in the vicinity of Lituya Bay, according to Mertie, is as follows:

Shale of unknown thickness.
A covered zone comprising perhaps the major part of these rocks.
Tuffaceous beds and conglomerate overlain by a dominantly sandstone sequence, the whole aggregating about 1,000 feet.
Shale.
Tuffaceous beds.

The rocks near the base of this section have been determined from the fossils they contain to be of upper Miocene age, and the shales near the top Pliocene. The upper Miocene and Pliocene members were also recognized by Maddren near Yakataga, where they consist of 1,000 to 1,500 feet of dominantly buff sandstones, which, in turn, are overlain by a great series of sandstones and shales with some conglomerate beds more than 2,000 feet thick. Considerable deformation and enormous thrust faulting have involved all the members up to and including the Pliocene.

Deposits of marine Tertiary sediments in the Alaska Peninsula province have been recognized especially in the tract of country between Herendeen and Balboa Bays, at Pavlof Bay, and on Unga Island. The lower of these deposits at Herendeen, Balboa, and Pavlof Bays consist of soft shales, sandstones, and grits and seem to be interlaminated with deposits of terrigenous origin, and doubtless the series was laid down under oscillating conditions of the strand line whereby the region was alternately under and above the sea. The marine invertebrate fossils represent at least 34 species and are identified as of Eocene age, a determination that agrees with that made from the study of the plant collections.

A section about 200 feet thick was measured by Dall in 1872 on Unga Island, where the series consisted largely of conglomerates with some shales and sandstones containing in places abundant marine fossils. These beds have also been recognized at other places in the same general region—for instance, on the shores of Balboa and Herendeen Bays and Port Moller. In many of these other places the conglomerate forms a less conspicuous part of the section, and the beds are in the main slightly consolidated sandstones and shales. At Port Moller these beds attain a thickness of at least 1,000 feet. In the type area the Unga conglomerate appears to rest conformably on the highest recognized Eocene stratum, but this is not believed to be the normal relation, as the beds usually show much less deformation than the Eocene deposits. The invertebrate fossils collected from these localities are considered to indicate that the beds from which they were obtained are Miocene.

In certain of the unconsolidated beds of the narrow coastal plain in the vicinity of Nome marine fossils have been collected which have been identified by Dall [45] as Pliocene. The apparent recency of these deposits has caused some doubt to be felt as to the correctness of the age determination based on these fossils, but as there is no direct evidence to support another age assignment, it has seemed necessary to accept the late Tertiary age of part of the beds. The paleontologic determination of the age is in a measure confirmed by the fact that the beds in which these fossils were found were identified on stratigraphic evidence as among the oldest of the coastal-plain sediments in that area. Although part of the coastal-plain deposits are thus correlated with the Tertiary, in the main they are regarded as of Quaternary age. In none of the sections were any marked unconformities recognized, though they disclose numerous oscillations whereby uplifts of 100 feet or so have produced strand lines that now stand either above or below the present sea level. The movement producing these oscillations was of a gentle regional type and did not cause marked breaks in sedimentation.

The identification of Pliocene members in the coastal-plain deposits is also of indirect interest as suggesting the probable extension of these rocks into other parts of western Alaska. Thus in many other parts of Seward Peninsula and adjacent parts of the Norton Sound region, as well as in more remote areas in the Bering Sea region and along the coast of northwestern Alaska, there are coastal plains that appear to be analogous to those at Nome and that therefore may also be in part of Pliocene age though they are regarded as composed dominantly of later marine sediments.

Tertiary rocks have been definitely identified on the Colville River, in northern Alaska, at only one point, though they probably have a rather wide distribution. The deposit is described by Schrader as unconsolidated and consisting of nearly horizontal stratified beds of fine gray slate-colored or ash-colored calcareous silts. These beds are separated by an apparent unconformity from the underlying beds, but the amount of discordance is believed to be slight. The Pliocene age of the fossils contained in these beds was determined by Dall. About 100 miles west of the Colville River locality, near the head of the Topagoruk River, a small collection of fossils was made from unconsolidated sands and silts. The fossils were provisionally identified as Pliocene. Near Collinson Point, 150 miles east of the Colville, Leffingwell recorded exposures of soft shales and sands that indicated a thickness of at least 200 feet

[45] Dall, W. H., Pliocene and Pleistocene fossils from the Arctic coast of Alaska and the auriferous beaches of Nome, Norton Sound, Alaska: U. S. Geol. Survey Prof. Paper 125, pp. 23–37, 1920.

of beds. A rich collection of fossils was obtained from these beds that Dall identified as Pliocene. He stated that they resembled the fauna from the Pliocene beaches at Nome and that they indicated a temperature similar to that of the present Aleutian Islands, and therefore were distinctly different from the Pleistocene faunas, which lived in a much colder climate.

There is therefore good reason to believe that the entire Arctic coast of northern Alaska is fringed by unconsolidated marine deposits that are in part of late Tertiary age. These can be distinguished from the later deposits with which they are associated only by more refined observations than have been possible in the course of exploratory surveys, and probably they have in large part been masked by burial under later deposits, so that they have not been separately mapped but have been grouped with the later deposits which seem to form by far the larger part of the coastal-plain sediments.

TERRIGENOUS DEPOSITS

Widespread throughout Alaska are sedimentary deposits that were laid down during the Tertiary period on the old land surfaces of that time in ponds and swamps and similar places where deposition was in progress. Doubtless many of the deposits then formed were later removed when geologic changes transformed those areas into sites of erosion. Enough have been preserved, however, to give some insight into the conditions under which they were formed and the later events that have left their imprint on them. The record that these beds afford makes it possible to reconstruct some of the general history of the region in which they occur. Although widely distributed through the Territory, these Tertiary deposits, for purposes of description, may be grouped into four major provinces, which in this report have been designated as the Matanuska-Cook Inlet, Alaska Peninsula, central Alaska Range, and Yukon regions. Each of these is described briefly in the following pages, and in addition, under the general heading "Miscellaneous localities", such notes are given as are available regarding some of the smaller or less known localities of Tertiary deposits.

MATANUSKA-COOK INLET REGION

Tertiary sedimentary rocks were first recognized in Alaska on Kenai Peninsula, which forms the eastern shore of Cook Inlet. Subsequent investigations have extended the area known to be occupied by the members of this group of rocks, so that now they are recognized at a great number of localities throughout the area immediately adjacent to Cook Inlet and for scores of miles inland along the course of its larger tributary streams such as the Susitna, Matanuska, and Yentna Rivers. The beds in Kenai Peninsula are described by Martin [46] in considerable detail, and from his report the following statements are rather literally abstracted. The only Tertiary rocks recognized have been called the Kenai formation, which consists mainly of partly indurated sands and clays in about equal volume, with a total thickness of about 2,000 feet. The rocks are in general sufficiently indurated to stand up, when undercut, in almost vertical cliffs, some of which are more than 100 feet high, though the beds are soft enough to be cut with a knife or pick. A few beds are more thoroughly indurated, but this condition is generally due to local cementation or consolidation. The formation contains also a few rather small and inconspicuous conglomerate layers and a great many beds of lignite. Measured sections show that coal in beds 3 to 7 feet thick forms 3 to 5 percent of the entire section. No beds of marine origin have been recognized at any point in the Tertiary sections on Kenai Peninsula.

The fossil flora that was collected from the beds was for a long time identified as †Arctic Miocene,[47] but as more complete knowledge of it was accumulated paleobotanists in general came to regard it as of Eocene age, and this is the current correlation. The flora is so distinctive and so at variance with that from any related group of rocks throughout the world that the name Kenai acquired significance not only as a formation name but also in a rather restricted time sense as well. For a while, almost all Alaskan deposits formed during the earlier part of the Tertiary period were assigned to the Kenai. This practice has now been discontinued, and the name Kenai has been restricted to its more usual formational sense and limited to beds directly connected with the Kenai beds in the type area.

Near the head of Cook Inlet, in the Matanuska region, the Tertiary rocks have been divided into the Chickaloon formation, the Eska conglomerate, and an unnamed assemblage of arkose, shale, and conglomerate. The stratigraphic position of this unnamed unit has not been determined with precision, but it probably includes basal beds as well as marginal beds equivalent to both of the other formations. The Chickaloon formation consists mainly of sandstones and shales carrying in its lower part many coal beds. Its thickness has not been determined accurately but appears to be at least 2,000 feet. Its flora is in general similar to that of the Kenai formation, and it is therefore assigned to the Eocene. Overlying the Chickaloon formation and apparently separated from it by a marked unconformity is the Eska conglomerate, which has a maximum thickness of about 3,000 feet. The few

[46] Martin, G. C., Geology and mineral resources of Kenai Peninsula, Alaska: U. S. Geol. Survey Bull. 587, pp. 67–88, 1915.

[47] A dagger (†) preceding a geologic name indicates that the name has been abandoned or rejected for use in classification in publications of the U. S. Geological Survey.

fossils that have been collected from this formation were not adequate to permit an unqualified determination of the age of the rocks in which they occur, but it is by no means unlikely that they are Miocene. Overlying the Eska conglomerate but separated from it by a strong unconformity are Tertiary lava flows and tuffs that are regarded as probably of Pliocene age. The beds up to and including the Eska conglomerate have been greatly deformed, and some intrusive dikes and sills cut the sedimentary series. So great has been the deformation in places that some of the beds stand vertical or are even overturned, and faults of both normal and thrust type have produced profound displacements in parts of the area. These dynamic movements have been of pronounced economic significance in their effect on the coal beds contained in the Chickaloon formation. In the areas of little or moderate deformation these coals are of low rank, but in the areas where deformation was greater they range into the bituminous coals, and in the areas where it was intense they approach anthracite in composition. The Tertiary beds in the Matanuska region appear to have been much further consolidated and to have suffered much greater dynamic stresses, lying as they do between the Chugach and Talkeetna Mountains, than any of the other members of the Tertiary in the Cook Inlet region. Capps has suggested that most of the beds in the Matanuska field were laid down in a rather small basin and that their original extent was only slightly greater than the area of their present outcrop. On the other hand, the Kenai beds in the main Cook Inlet lowland appear to have been deposited in a rather extensive lowland. The absence of much coarse detrital material in the beds of the Chickaloon formation in the Matanuska Valley shows that the adjacent land could not have had such strong relief as would give the streams flowing from it opportunity to deposit much coarse material in the basin.

ALASKA PENINSULA REGION

In the Alaska Peninsula, Tertiary beds have been recognized and examined at a number of places all the way from Cape Douglas, near Kamishak Bay, on the northeast, to Pavlof Bay, on the southwest. The lowest sedimentary beds throughout this tract appear to be comparable in general character with the typical Kenai formation, though underlying them in the Port Moller district are pyroclastic igneous rocks and basaltic flows of Tertiary age. Everywhere the sedimentary rocks consist of sandstone, shale, and some conglomerates, with numerous beds of lignite. All are slightly to moderately indurated. In thickness this group of rocks appears to range from 1,000 to 5,000 feet. In places the section shows notable departures from this type section. Thus in the Balboa-Herendeen Bay region marine beds containing invertebrate fossils alternate with terrigenous beds and probably represent deposition in an area near the shore that was subjected to oscillatory movements, which at times brought it above the sea and at times depressed it below the sea. In other places the upper portion of the sedimentary series merges with andesitic flows and related pyroclastic rocks.

Succeeding the Eocene rocks, especially in the western part of the Alaska Peninsula region, on Unga Island, and apparently separated from the Eocene beds at most places by an unconformity, are the marine beds of the Unga conglomerate which have already been described. These beds are much less deformed than the Eocene beds and are regarded as of Miocene age. At one locality on the west shore of Herendeen Bay there is a small tract of sediments, apparently representing terrigenous deposition, which appears to overlie beds that have normal Miocene characters. Fossils have been collected from this tract, and though they are unsatisfactory for specific determination they suggest a possible Pliocene age for the beds in which they occur. If this identification should be substantiated by more complete collections, the absence of a clearly marked break in the type of sedimentation would seem to indicate that there was no pronounced stratigraphic break between the Miocene and Pliocene in that region.

Altogether the history of the Alaska Peninsula region in Tertiary time shows an interesting series of events—volcanic episodes in the early Eocene, late Eocene, Miocene, and very late Pliocene occurring at intervals during the deposition of terrigenous sediments in the Eocene and possibly also in the Pliocene and marine incursion in the Miocene. Fairly strong mountain-building is recognized as having occurred at the end of the Eocene epoch, and broad regional movements at intervals subsequent to that time.

ALASKA RANGE

At least three distinct types of terrigenous deposits that were laid down during Tertiary time have been recognized in the area that now forms the central part of the great arc of the Alaska Range. These differ not only lithologically but also in their distribution and geologic age. Distinctive names have been given to these different units—the Cantwell formation, the coal-bearing series, and the Nenana gravel. Each is described separately in the following notes.

The Cantwell formation has been recognized at several points along the northern flanks of the Alaska Range, from the vicinity of Mystic Pass, at the head of the Tonzona River, eastward to Mount Deborah, at the head of the Yanert River. It is most conspicuously developed in the area that extends about 40 miles east and west of the Alaska Railroad in that part of its course which follows the narrow valley of the Nenana River north of Windy. The formation consists principally of coarse clastic sediments that range from beds of coarse conglomerate which contain boulders 6 inches or more in diameter through finer grits and sandstones into shales. Some volcanic rocks of rather acidic composition are associated with these sediments. The rocks are thoroughly indurated and in places even metamorphosed into stretched conglomerates and schists. No detailed measurements of the entire section of the Cantwell formation have been made, but in places its thickness is at least several thousand feet. The only paleontologic evidence as to the age of these rocks leads to the conclusion that they are Eocene. The evidence is unsatisfactory, however, as the fossils are neither abundant nor distinctive. The geologists who have studied these rocks most thoroughly believe that part of the Cantwell may be as old as the Upper Cretaceous, though in the absence of specific evidence to support this view they have been constrained to accept its Eocene age.

Along the northern flanks of the Alaska Range but in places folded into the minor basins within the range itself are sedimentary beds that have been more or less thoroughly consolidated and deformed. These beds are referred to as the coal-bearing formation, inasmuch as at many places they contain numerous coal beds, some of which are as much as 20 feet thick. The beds are in general sandstones, clays, and fine conglomerates. In their general appearance they resemble closely the Kenai formation of the Cook Inlet region, though the identification is not yet sure enough to allow complete correlation and adoption of a single name for the beds in these two areas. The coal-bearing rocks probably overlie unconformably the older rocks in their neighborhood, though nowhere has the direct contact of these beds with the Cantwell formation been observed. The greater induration of the Cantwell and the discordance of its structure in places where the two formations are not widely separated leads to the conclusion that there is an unconformity between them. The beds were evidently formed at a time when the area now occupied by the Alaska Range was a region of low relief and mature drainage. The termination of this deposition and the deformation of the beds was brought about by mountain-building forces which initiated the growth of the present Alaska Range. Since that uplift large tracts of the formation have been stripped off and removed through erosion, so that the beds are preserved now only in protected areas or where they have been folded down into basins below the level of the older rocks. The age of these coal-bearing rocks has been determined by the fossil leaves preserved in many of the beds. From this evidence it seems certain that the formation as a whole is Eocene and probably was formed rather late in that epoch.

The term Nenana gravel has been given by Capps to a thick series of unconsolidated or only loosely cemented material consisting for the most part of well-rounded coarse gravel and subordinate beds and lenses of sand. This formation is especially well developed in the northern slopes of the Alaska Range, both east and west of the Nenana River. In places it is as much as 2,000 feet thick and is interpreted as the outwash from the growing Alaska Range that had its beginning at the end of the period of deposition of the coal-bearing formation. According to Capps, this formation is in general conformable with the coal-bearing rocks, and doubtless in places there is no structural break between the two formations. The writer, however, is inclined to stress the fact that in some places there is a break between them, and therefore he would place these beds higher in the Tertiary and correlate them with late Miocene or possibly Pliocene deposits. The determination of the age of these deposits is based entirely on their areal distribution and geomorphic history, so that precise dating of their formation is not possible except to state that they are older than the Wisconsin glacial deposits and older than any glacial deposits that have been recognized in the region. The impossibility of distinguishing the Nenana gravel from later unconsolidated deposits except under favorable circumstances has probably led to the inclusion of both as a single unit in most areas, so that the extent of Nenana gravel as indicated on the maps is probably greatly understated. Moreover, its original areal extent has been much reduced through erosion and through burial under the great volume of glacial and postglacial outwash material. For all these reasons it seems probable that the area originally occupied by this formation was immensely greater than the area in which it is now recognized and indicated on plate 1.

YUKON BASIN

Sedimentary rocks of Tertiary age have been recognized in two principal areas in the Yukon Basin, and small isolated areas elsewhere show that these deposits were at one time much more widespread. The two principal areas may be referred to as the Tanana-Dall River district and the Woodchopper-Eagle district; the former lies about in the central part of the Yukon's course through Alaska, and the latter is farther east, adjacent to the international boundary.

The Tertiary deposits in the Tanana-Dall River district occur mostly as discontinuous patches of rather small extent, which are probably the remnants of a once widespread deposit of fresh-water origin. The beds consist of clay, shale, sandstone, conglomerate, and thin seams of lignite. They have been subjected to strong deformation, so that their dips range all the way from nearly flat to practically vertical, and in places extensive faulting has broken the series. Some fossils of fresh-water invertebrates have been found in these beds, but most of the fossils that have been obtained from them are leaves and fragments of plants. These plants have been identified as most closely related to Eocene species, and the formation as a whole has been regarded as more or less exactly equivalent to the Kenai beds of Cook Inlet.

In addition to these more consolidated and deformed Tertiary deposits, there are at a number of places less consolidated deposits that appear to be of much younger Tertiary age. Deposits of this sort have been especially studied in the vicinity of Minook Creek, where they form notable terraces whose upland surface stands nearly 1,000 feet above the present-day drainage lines. These deposits seem to mark former courses of the main stream in the region and are regarded as probably of Pliocene age, though in the absence of paleontologic evidence this age assignment is open to considerable uncertainty. Although they now stand high above the present main stream, the deposits have not suffered folding and distortion but instead appear to have been uplifted or warped more or less as a whole in their present position.

In the Woodchopper-Eagle district the Tertiary rocks have not been satisfactorily differentiated from those of Upper Cretaceous age, so that the rocks of the two systems are here treated as a unit, though doubtless more refined field work will result in making a separation. These rocks crop out in a belt from 1 to 15 miles wide for a distance of 85 miles west of the international boundary. They are dominantly sandstones and shales, with beds of conglomerate ranging from fine grits to coarse boulders and beds of lignite. The series as a whole seems to have more of the fine beds at the base and to become coarser toward the top. The beds are considerably folded and deformed, so that in places they dip at angles as great as 70°. As they have been much broken by faulting, measurements of their thickness are not reliable, but they indicate that the series has a minimum thickness of 3,000 feet. Altogether some 20 collections of fossils have been made from these rocks, and of these 8 are identified as having an Upper Cretaceous affinity, while the others appear to be Eocene. There are numerous means of reconciling these apparently discordant results, but in the absence of more detailed field observations and critical analysis of the paleobotanic evidence it seems that for the time being the only course open is to accept the interpretation that in this region the sedimentation continued without a break from Upper Cretaceous into Eocene time and that presumably the Tertiary beds were on the whole older than those occurring in the Tanana-Dall River district, which are believed to be of relatively late Eocene age.

In the Fortymile region, which lies not far south of the Woodchopper-Eagle district, are numerous high terraces and gravel deposits that appear to be not unlike some of the terrace deposits in the Tanana-Dall River district, whose Pliocene age has been suggested. There is no direct evidence that these deposits are not Quaternary, but, on the other hand, there is nothing that would preclude their being Tertiary. In view of the lack of evidence, it seems unwarranted to go further than to suggest the possibility that in part they mark old drainage lines which may have been occupied by streams during late Tertiary time.

MISCELLANEOUS LOCALITIES

There are throughout Alaska, in addition to the areas described above in detail, numerous places where Tertiary sedimentary rocks have been recognized, though most of these areas are of rather small extent and the sections they afford are incomplete or little known. They are of great significance, however, in proving that the conditions throughout most of the Territory in Tertiary time were similar to those that existed in the areas where deposits of this age are more extensive. Thus these scattered small deposits all point to the conclusion that throughout early Tertiary time deposition under terrigenous conditions was in progress over wide tracts of a region which in general had a low relief, without nearby highlands that yielded much coarse detritus to the areas in which were being deposited mud and sand and much vegetation that was subsequently to become lignite.

In southeastern Alaska none of the Tertiary sediments show any indications of including beds of marine origin. These sediments are most extensively developed in the Kupreanof-Admiralty Island region where they are closely associated and in places interbedded with effusive igneous rock and volcanic tuffs. The most complete section of the Eocene rocks is said by Buddington to be found on Kuiu Island, where the section was as follows:

	Feet
Conglomerates of lava cobbles with interbedded tuff and breccia, predominantly rhyolitic	1,000+
Rhyolitic breccia and tuff	500±
Sandstone with intercalated conglomerate near top	1,200±
Basal conglomerate with intercalated sandstone	450±
Unconformity.	

The fossils from the sedimentary members have all been identified as of Eocene age and comparable with those from some of the Kenai beds in the type locality. There is some uncertainty as to the age of the upper part of the sequence where volcanic rocks predominate, because in that part fossils are absent. It is possible, therefore, that the upper members may in reality belong to a later epoch of the Tertiary.

Little is known regarding the geology of Kodiak Island, but the cursory examinations that have been made there indicate that at several places, especially on its east coast, are deposits that have a striking resemblance to the beds not far to the north, in the typical area of Eocene rocks in Kenai Peninsula, or to the west, in the various areas of the Alaska Peninsula. Both terrigenous deposits of Eocene age and marine deposits of Miocene age have been identified by means of the fossils they contained. The earlier reports, which were based mainly on oral information, indicated a considerable development of coal-bearing rocks of supposed Tertiary age on the west coast of Kodiak Island. Some of these places have not been examined by geologists, but regarding most of those that have been examined in detail the early reports have proved erroneous, as their bedrock consists of rocks entirely unlike the Tertiary beds. This statement also holds true regarding the occurrence of Tertiary rocks on Afognak Island, which lies immediately north of Kodiak.

Tertiary sedimentary rocks that were laid down under land conditions have been identified in Seward Peninsula on the Sinuk River, in the western part of the peninsula; on the Kugruk River, in the northern part; and on the Koyuk River, in the southeastern part. Most of these tracts now have a very small extent, but doubtless in the past they were much larger and have been reduced through erosion. The beds are composed of sandstone and shale with some coaly layers, though in the locality on the Kugruk River the coal is very thick, probably being in the form of a lens. All the beds have been somewhat deformed, dips of 70° being not at all unusual. The paleontologic evidence as to the age of these rocks is not at all satisfactory but is believed to indicate that the beds are Eocene and probably in general correlative with beds of similar appearance and relations in other parts of Alaska.

In northwestern Alaska sedimentary rocks that were laid down under terrigenous conditions in Tertiary time have been recognized only in the valley of the Kobuk River. There they occur as discontinuous patches, none of which is more than a few miles in extent. These patches occur principally in the central portion of the valley between the Shungnak River on the east and Trinity Creek on the west. The rocks consist of conglomerate, soft-bedded sandstone, and shale, with some thin coal beds. The beds in places show dips as steep as 30° and the deformation has also given rise to some faulting. No reliable measurements of the total thickness of the formation have been made, but it must be at least 1,000 feet, as some of the individual layers of conglomerate are as much as 200 feet thick. A few small collections of fossils from these rocks and the similarity of their appearance to Tertiary rocks in other parts of Alaska have led to their being assigned to the upper Eocene. There is, however, still some question as to whether or not there was a structural break between the Eocene and the Upper Cretaceous in this part of Alaska. If there was not, the lower part of this series may belong in the Upper Cretaceous and the other members may form a continuous sequence into the Tertiary, as was suggested for part of the sequence in the Eagle-Woodchopper district of the upper Yukon Valley.

EFFUSIVE IGNEOUS ROCKS

Probably quite as extensive areally as the tracts that are occupied by water-laid deposits interpreted as of Tertiary age are those that are covered by volcanic deposits made up of lavas and tuffs formed during this period. These Tertiary volcanic rocks not only occupy extensive areas but are widely distributed throughout the Territory. In the past they appear to have been even more widespread than at present, because in the long period that has ensued since some of them were erupted they have evidently suffered extensive removal through erosion. How great this erosion was in places may be conjectured from the fact that many of the lava flows now occur as nearly horizontal cappings on the tops of mountains that have been deeply dissected by streams whose valley floors now stand thousands of feet below the base of the lavas. This condition is well illustrated in the mountains north of Chickaloon, in the Matanuska district of the Cook Inlet region, and north of McCarthy, in the Chitina district of the central Copper River region.

Field evidence clearly shows that these Tertiary lavas were not the result of a single great outpouring. Instead they represent extrusions from different openings at widely different times. Thus in the Alaska Peninsula region the volcanism appears to have begun early in the Tertiary period and to have continued intermittently down to the present day, many volcanoes being even now active or having been in eruption during historic time. In the Wrangell Mountains of the Copper River region there is another area that appears to have been a volcanic center throughout most of Tertiary time and to be still marked by active or dormant volcanoes. In Seward Peninsula and in the region east of Norton Sound are extensive lava flows that appear to have begun in the middle or later part of the Tertiary and to have continued at least to the Pleistocene.

Other places where extensive igneous rocks of Tertiary age have been reported are indicated on plate 1. Doubtless with more complete exploration of the unsurveyed areas, the present known distribution of these rocks would be extended, and if it were possible to determine their original extent the known area of many of the individual tracts would be still further increased. The lack of surveys and burial by later deposits have probably prevented the representation of the true extent of the Tertiary lavas, especially in the lower Yukon-Norton Sound district and in the area at the head of Kotzebue Sound east of the lower course of the Buckland River.

Owing to the impossibility of determining closely the age of lavas except where they are in association with rocks containing organic remains, whose age is known, and the absence of such favorable conditions in most of the areas where the Alaskan lavas occur, geologists have been able to make only generalized determinations of the age of the Tertiary lavas of Alaska in the course of most of the reconnaissance and exploratory surveys. It has therefore not proved feasible to show separately on the map the lavas that were formed during each of the recognized time subdivisions of the Tertiary. Instead they have all been treated as a unit, even though the incomplete records available show that at least lavas of Eocene, Miocene, and Pliocene age occur and might be discriminated if more detailed information were at hand.

The chemical composition of the Tertiary lavas of Alaska shows a wide range both areally and stratigraphically. In general it appears that the older lavas were more acidic than the later ones. This is true in the Nelchina-Susitna district of central Alaska, where what is considered to be the oldest Tertiary lava is rhyolite and the youngest is basalt. It is also true in the Alaska Peninsula, especially in the vicinity of Lake Iliamna, and in the Yukon region, especially in the Cosna-Nowitna district. This relation, however, is not universal, for Pogue reports that in the Broad Pass district the lowest Tertiary lava is basalt, and that those stratigraphically higher are acidic lavas. No progressive gradation of composition has been observed in the sequence of lavas in the different fields, so that chemical composition does not seem to be of itself a safe criterion to use indiscriminately in attempting to correlate different tracts.

In southeastern Alaska rhyolite breccia, tuff, and related volcanic rocks occur on Kuiu, Kupreanof, Zarembo, Etolin, Conclusion, and Gravina Islands. They are believed to be, at least in part, of Eocene age. Basalts and andesites are reported on Kuiu, Kupreanof, Zarembo, Castle, and Onslow Islands, forming in places deposits as much as 2,500 feet thick. The basalts appear to have been poured out mostly through fissures, but a few were evidently erupted from volcanic centers. Where it has been possible to determine relations, the basalts appear to overlie the Eocene sediments and to be younger than the more acidic Tertiary lavas. In fact, there is some evidence that indicates that they are unconformable on the Eocene sediments and therefore of Miocene or later age. This evidence, however, is not definite enough to be determinative, so that the possible lower limit must be regarded as Eocene. On Suemez Island, about 50 miles west of Ketchikan, are rhyolites, andesites, and basalts that in many ways resemble those already described. Buddington, however, has chosen to regard them as more probably to be correlated with rocks of similar composition on Graham Island, B. C., which have been assigned to a Pliocene age by MacKenzie.

In the Wrangell Mountains of the Copper River region are a series of rhyolitic, andesitic, and basaltic flows that appear to have had their beginning before the deformation of the early Tertiary plain that was developed by erosion in the region and to have continued later than the dissection which followed its uplift. It is the consensus of opinion, therefore, that the outpouring of these lavas must have begun in late Eocene time and have continued to the present.

In the Alaska Peninsula region the lavas of Tertiary age are dominantly andesites and basalts. The conditions in the Kamishak Bay district, which may be taken as more or less typical of the region as a whole, are summarized by Mather [48] as follows:

> Basaltic lava flows and tuffs of varied composition rest unconformably upon the eroded surface of the Naknek formation [this formation is of Upper Jurassic age, but in other places the lavas overlie sedimentary rocks of known Tertiary age]. Apparently this locality during Tertiary time was the site of great eruptive activity. Lavas welled up through vents and poured out on the surface. Explosive debris was hurled upward and contributed to the building of volcanic cones.

In the Anvik-Andreafski region the lavas appear in general to be typical of those of the lower Yukon and eastern Norton Sound provinces as a whole. Here Harrington has discriminated dacites and andesites which cut Cretaceous rocks and are overlain by basalts. The acidic rocks are correlated with the earlier part of the Tertiary, and the outpourings of basalt probably began in the later part of the Tertiary and extended intermittently into Quaternary time.

In eastern Seward Peninsula, especially in the range of hills between the Koyuk and Buckland Rivers, are extensive andesitic lava flows whose age has not been determined with certainty but which the writer feels may well be the equivalent of the earlier Tertiary effusives of other districts. This correlation, however, is so uncertain that it is offered as little more than a suggestion. Definitely identified Tertiary lavas are found at several places throughout Seward Peninsula and consist principally of unaltered basalts that have suffered practically no deformation. These flows took place at considerable intervals of time. It appears that the bulk of the lavas were extruded much later than the Eocene, some of them even overlying Pliocene and possibly Pleistocene sediments and retaining on their surfaces in places features that would lead to

[48] Mather, K. F., Mineral resources of the Kamishak Bay region, Alaska: U. S. Geol. Survey Bull. 773, p. 171, 1925.

placing the date of their outpourings in the very recent geologic past.

INTRUSIVE IGNEOUS ROCKS

All the effusive igneous rocks of Tertiary age reached the surface through vents of one kind or another and therefore in part of their passage from the deeper-seated regions were intrusive in character. In addition to these, however, intrusives have been recognized which have had no obvious connection with surface extrusives in their neighborhood. The largest tract occupied by rocks of this sort is in the central Yukon region, including parts of the Innoko-Iditarod district and extending northeastward into the Cosna-Nowitna and Hot Springs districts, northward into the Melozitna and Koyukuk districts, and southward into the region near Sleitmut, in the central Kuskokwim Valley. Another extensive tract in which Tertiary intrusive rocks have been distinguished is in the central section of the Alaska Range, in the vicinity of Broad Pass. Doubtless there are many other areas of Tertiary intrusive rocks in Alaska that have not been identified as such, owing in part to the great difficulty in most places of obtaining adequate field information for dating closely the known intrusive rocks and in part to the unexplored condition of some of the tracts in which these rocks may occur. In fact, it is the opinion of the writer that many of the igneous intrusives that are now vaguely referred to in the literature as "post-Jurassic" or as "late Mesozoic" may ultimately prove to be in part of Tertiary age, or that the igneous activity, which in places doubtless began in later Mesozoic time, may not have entirely stopped by the end of that era.

In the Innoko-Iditarod region, which has been studied with especial thoroughness, Mertie has identified and mapped several areas of intrusive rocks, notably quartz monzonite and rocks rich in sodium, such as soda granite, soda granite porphyry, oligoclase dacite, and oligoclase-quartz diorite porphyry. He states: [49]

> It is inferred from the geologic occurrence that all these acidic dikes of sodic nature are products of the Tertiary volcanism. * * * In any event, they are believed to be related to the quartz monzonites and the basic intrusives and extrusives and are therefore assigned to late Eocene or post-Eocene time.

In the vicinity of Broad Pass, in the central part of the Alaska Range, Pogue distinguished as Tertiary certain bodies of granite, quartz monzonite, and quartz diorite whose intrusion was accompanied or followed by injections of granite porphyry and by extrusions of acidic lava. The granitic rocks are exceedingly massive, and this suggests that they were intruded later than the last great deformation of the Alaska Range province, which occurred in the middle or later part of the Tertiary period. Pogue has suggested, however, that this criterion may not be valid, as the very massiveness of the granitic rocks may have protected them from yielding to the stresses that deformed less rigid rocks, so that some of them stand vertical or are even overturned.

[49] Mertie, J. B., Jr., and Harrington, G. L., The Ruby-Kuskokwim region, Alaska: U. S. Geol. Survey Bull. 754, p. 74, 1924.

SYSTEMATIC DESCRIPTIONS

Phylum THALLOPHYTA

Class ALGAE

Order RHODOPHYCEAE (RHODOMENIALES)

Family RHODOMELACEAE

Genus CHONDRITES Sternberg

Chondrites heeri Eichwald?

Plate 108, figure 1

Chondrites heeri Eichwald, Geognostisch-paleontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 111, pl. 4 [VI], fig. 1, St. Petersburg, 1871.

Chondrites sp. Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 21, pl. 10, fig. 5, 1869.

This well-defined alga was originally collected by Hjalmar Furuhjelm at "Katschekmak" or "Katschemak" [Kachemak] Bay, Kenai Peninsula, and subsequently specimens that apparently represent the same species were collected by A. F. Buddington on one of the islands of southeastern Alaska, several hundred miles from the original locality. At neither locality, however, has the geologic age of the rock that contains the specimen been satisfactorily determined. Heer stated that the Kachemak Bay specimen was found "in lapide erratico"—apparently drift or float material—and remarked: "Hinc specimen unicum determinationem speciei et formationis accuratum non permittet." Its inclusion as a specific element in the Tertiary flora of Alaska may therefore be regarded as tentative only, and in any event the species is of little value as an index fossil, for the reason that it so closely resembles several others of the genus as to be practically indistinguishable from them. It may be compared, for example, with *Chondrites targionii* (Brongniart) Sternberg,[50] which has been identified in rocks ranging in age from early Mesozoic to late Tertiary; and it is about equally difficult to distinguish from certain forms, found in Pleistocene deposits of Spitsbergen, referred by Heer [51] to the existing species *Fucus canaliculatus* Linnaeus.

[50] *Fucoides targionii* Brongniart, Histoire des végétaux fossiles, vol. 1, p. 56, pl. 4, figs. 2–6, 1828.

[51] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 88, pl. 15, figs. 67–75, 1870.

Localities: Northeasternmost tip of Whitney Island in Cleveland Passage, southeastern Alaska (original no. K–21); collected by A. F. Buddington in 1922 (lot 7566). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region.

Phylum PTERIDOPHYTA

Class FILICINEAE

Order FILICALES

Family POLYPODIACEAE

Genus ONOCLEA Linnaeus

Onoclea sensibilis Linnaeus

Plate 2, figures 2–4

Onoclea sensibilis Linnaeus, Species plantarum, vol. 2, p. 1062, 1753.

Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 39, 1868; Illustrations of Cretaceous and Tertiary plants, pl. 8, fig. 1; pl. 9, figs. 1–3, U. S. Geol. and Geog. Survey Terr., 1878 [Lesquereux ident.].

Heer, Die fossile Flora Grönlands, pt. 2; Flora fossilis arctica, vol. 7, p. 48, pl. 70, fig. 6, 1883.

Filicites? hebridicus Forbes, Geol. Soc. London Quart. Jour., vol. 7, pt. 1, p. 103, pl. 2, figs. 2a, 2b, 1851.

Woodwardites arcticus Heer [?], Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 86, pl. 1, figs. 16, 16b; pl. 45, fig. 2c; pl. 48, fig. 9, 1868.

Onoclea hebraidica (Forbes) Gardner and Ettingshausen, A monograph of the British Eocene flora, vol. 1, pt. 3, p. 68, pl. 13, figs. 5, 5a, 6, 6a, London, 1882 (incl. in Paleontogr. Soc. Pub., vol. 36, 1882).

Onoclea sensibilis arctica Heer, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 260, pl. 70, fig. 6, 1883.

Hollick, U. S. Geol. Survey Bull. 500, pp. 49, 51, 1912.

Onoclea sensibilis fossilis Newberry, U. S. Geol. Survey Mon. 35, p. 8, pl. 23, fig. 3; pl. 24, figs. 1–5, 1890.

The earliest description of this fern as a fossil was given by Forbes in 1851, based upon specimens from the Eocene of the Isle of Mull, Scotland. He regarded them as representing a new species, to which he gave the name *Filicites? hebridicus*. A few years later, in collections made by Hayden [52] in the upper Missouri River region, subsequently determined to be of Fort Union age, Newberry [53] identified certain specimens as specifically identical with *Filicites? hebridicus*, but referred them to the living species *Onoclea sensibilis* Linnaeus, with the following comment:

> Varying, as the living *Onoclea* does, in the size, outline, and nervation of the sterile frond—from 6 inches to 3 feet in height; from a finely reticulated to an open, dichotomous nervation: from a bipinnate frond with remote, obovate pinnules, to a pinnate form with wave-margined pinnae and broadly alate rachis—it plainly includes all the characters of the fossils before us, and I therefore find it impossible to separate them.

[52] Newberry, J. S., Boston Jour. Nat. Hist., vol. 7, p. 510, 1863.

[53] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, pp. 36–37, 39–41, 1868.

Subsequently [54] he also incidentally mentions having obtained specimens from Whatcom Lake, near Bellingham Bay, Washington; and specimens from southwestern Canada were identified by Dawson,[55] who gave "Porcupine Creek (longitude 106°), near the international boundary" as the locality where they were found.

In the meantime Heer [56] had described certain fragmentary fern remains from the Tertiary of Greenland under the name *Woodwardites arcticus* and, in his discussion of its apparent relationships, says: "Unter den tertiären Farrn ähnelt auch der *Filicites hebridicus* Forb. einigermassen unserer Pflanze, allein die Maschen sind anders gebildet." Subsequently [57] he figured a fragmentary but well-defined specimen of a fern from the same region and described it as specifically identical with the specimens from the Isle of Mull, the United States, and Canada. This specimen is described in the text on page 48 under the name "*Onoclea sensibilis* L.," but on page 260, in the description of plate 70, and in the legend at the bottom of the plate, the figure of the specimen is designated "*Onoclea sensibilis arctica*." Apparently it was his intention to indicate his belief in the specific identity of the fossil *Onoclea sensibilis* with his *Woodwardites arcticus*, but if so his discussion in this connection, on page 49, is not conclusive:

> Es sind mir früher aus Grönland nur kleine Fragmente dieses Farns zugekommen, die ich als *Woodwardites arcticus* * * * beschrieben habe * * * Der Rand der blattreste erschein fein gezahnt, während die Lappen der *Onoclea* ungezahnt sind. Vielleicht, dass diese kleinen Zähnchen zufällig sind und vom Gestein herrühren."

It may therefore be inferred that Heer was apparently in doubt in regard to the advisability of definitely uniting together, as one species, all the Greenland specimens, and for this reason the reference to *Woodwardites* in our synonymy is queried.

In this connection it may also be pertinent to note, however, that Gardner and Ettingshausen,[58] in discussing the possible specific identity of the American and Old World specimens of *Onoclea* with Heer's *Woodwardites*, quote a communication received from Saporta, in which he says: "Votre Fougère de Mull, *Filicites hebraidicus*, est effectivement identique avec

[54] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 10, 1898.

[55] Dawson, J. W., Note on the plants collected by Mr. G. M. Dawson from the lignite Tertiary deposits near the 49th parallel: Report on the geology and resources of the region in the vicinity of the 49th parallel, app. A, p. 328, British N. Am. Boundary Comm., 1875; Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 21, 1886.

[56] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 86, pl. 1, figs. 16, 16b; pl. 45, fig. 2c; pl. 48, fig. 9, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 462, pl. 40, fig. 6, 1869.

[57] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pp. 48, 260, pl. 70, fig. 6, 1883.

[58] Gardner, J. S., and Ettingshausen, Constantin von, A monograph of the British Eocene flora, vol. 1, pt. 3, pp. 69–70 (footnote), 1882.

le *Woodwardites arcticus* de Heer; il suffit pour s'en convaincre de comparer les figures du 'Flora fossilis arctica' avec les vôtres."

Onoclea sensibilis Linnaeus, as a living species, represents a monotypic genus which is confined to eastern Asia and eastern North America; but the discovery of its fossil ancestors in northern Europe, Greenland, Canada, Alaska, and the western United States proves that in the early part of the Tertiary period it had a wide geographic distribution that embraced the northern part of Europe as well as the northern and middle parts of the North American continent and probably included also, the intervening region in Asia.

Localities: Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 496); collected by C. W. Wright in 1904 (lot 7474) (pl. 2, figs. 2, 3). Matanuska coal field, Kings River, east bank, at Coal Camp, 7 miles above mouth, talus slope at base of cliff, Matanuska-Cook Inlet region; collected by F. J. Katz in 1910 (lot 5895) (pl. 2, fig. 4).

Genus DRYOPTERIS Adanson

Dryopteris meyeri (Heer) Hollick, n. comb.

Plate 109, figures 1–6

Aspidium meyeri Heer, Flora tertiaria Helvetiae, vol. 1, p. 36, pl. 11, figs. 2a–e, 2g–i, 2k–l, Winterthur, 1855.

The fragmentary specimens that I have ventured to refer to this species possess poorly defined venation and few sori. The veinlets are apparently all simple, and the sori are round, and these characters, combined with the shape and general appearance of the pinnules, strongly suggest the species originally described by Heer from the Miocene of Switzerland, under the name *Aspidium meyeri*. It has been recorded from several Tertiary localities in Europe and from Greenland and the island of Sakhalin, but it does not appear to have been recorded from America elsewhere than from Alaska.

Localities: Divide between Folger Creek and Nowi River, 19.15 miles N. 3.5° E. of North Butte of Twin Buttes, central Yukon River region (original no. 2); collected by J. B. Mertie, Jr., in 1915 (lot 7007) (pl. 109, fig. 1). Cliff 1 mile south of small bay on south shore of King Salmon Lake, Alaska Peninsula (original no. P–21); collected by W. R. Smith in 1922 (pl. 109, figs. 2, 3). Summit of mountain 1 mile southwest of forks of Pumicestone Creek, Alaska Peninsula (original no. P–23); collected by W. R. Smith in 1922 (pl. 109, fig. 4). Summit of mountain half a mile east of head of north branch of Russel Creek, Alaska Peninsula (original no. P–24); collected by W. R. Smith in 1922 (pl. 109, figs. 5, 6).

Genus HAUSMANNIA Dunker

Hausmannia atwoodi Hollick, n. sp.

Plate 6, figures 6–9

Frond flabelliform, about 10 centimeters in width across the middle by 8 centimeters or more from the base to the middle of the upper margin, with pitted or rugose surface; margin irregularly crenate-dentate; primary venation strong, flabellate-tripalmate, dichotomously 4 or 5 times forked or branched, the ultimate branches terminating in the marginal sinuses and merging into a vein which forms the margin and connected throughout the lamina of the frond by irregular cross venation, the spaces between the latter subdivided by a finer system of veins that enclose groups of the pits and rugosities (sori).

This is one of the most interesting of the many unexpected generic elements revealed in the Tertiary flora of Alaska. Under the genera *Hausmannia* Dunker,[59] *Protorhipis* Andrae,[60] and other genera now relegated to synonymy, about 20 species have been described; but these are all of Mesozoic age, extending from Upper Triassic [61] to Lower Cretaceous,[62] and our species is the first one recorded from any horizon of more recent age. When first examined its striking similarity to *Hausmannia forchhammeri* Bartholin,[63] an Old World Jurassic species, was at once noted; but inasmuch as our specimens were found associated in the same collection with dicotyledonous leaves of well-known Tertiary species its stratigraphic position could not be questioned.

The only other allied species previously recorded from the New World are *Hausmannia? californica* Fontaine,[64] from the Knoxville formation of California, and *Protorhipis fisheri* Knowlton,[65] from the Kootenai formation of Montana—both of Lower Cretaceous age; although Newberry [66] described certain plant remains from the Upper Cretaceous Raritan formation of New Jersey under the name *Hausmannia rigida*, which, however, has no apparent close relationship with the genus, as was discussed by Berry,[67] who renamed the species *Newberryana rigida*, giving to it a new generic name and remarking: "What its real nature is I am at a loss to say. It is probably a fern."

[59] Dunker, Wilhelm, Monographie der norddeutschen Wealdenbildung, p. 12, pl. 5, fig. 1; pl. 6, fig. 12, Braunschweig, 1846 (type, *H. dichotoma*).

[60] Andrae, K. J., Beiträge zur Kenntniss der fossilen Flora Siebenburgens und des Banates: K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 4, p. 35, pl. 8, fig. 1, 1855 (type, *P. buchi*).

[61] *Hausmannia integrifolia* (Nathorst) Richter = *Protorhipis integrifolia* Nathorst, Om floran i skånes Kolförande bildningar, I, Floran vid Bjuf, pt. 2: Sveriges geol. undersökning, ser. C, no. 33, p. 57, pl. 11, fig. 2. Stockholm, 1879.

[62] *Hausmannia cretacea* (Velenovsky) Richter = *Platycerium cretaceum* Velenovsky, Květena Českého Cenomanu: K. böhm. Gesell. Wiss. Abh., ser. 7, vol. 3, no. 3, pl. 5, fig. 16, 1889 = *Platyceriphyllum cretaceum* Velenovsky, idem, p. 29.

[63] Bartholin, C. T., Nogle i den bornholmske Juraformation forekommende Planteforsteninger, pts. 1 and 2: Bot. Tidsskr., vol. 18, p. 26, pl. 11, figs. 4–6; pl. 12, figs. 1, 2, 1892.

[64] Fontaine, W. M., Status of the Mesozoic floras of the United States, second paper: U. S. Geol. Survey Mon. 48, p. 238, pl. 65, fig. 47, 1905 [1906].

[65] Knowlton, F. H., Description of a collection of Kootanie plants from the Great Falls coal field of Montana: Smithsonian Misc. Coll., vol. 50, pt. 1, p. 114, pl. 12, figs. 3, 4, 1907.

[66] Newberry, J. S., The flora of the Amboy clays; U. S. Geol. Survey Mon. 26, p. 35, pl. 1, figs. 2, 3, 5, 1895.

[67] Berry, E. W., The flora of the Raritan formation: New Jersey Geol. Survey Bull. 3, p. 220, 1911.

An excellent discussion of the generic affiliations of *Hausmannia* and *Protorhipis*, with bibliographic references and citations, is included in Knowlton's article, pages 115–119; and those who may be further interested in the subject may consult the quarto monograph by Richter,[68] in which are descriptions and figures of nearly all the species known up to the date of its publication, with a very full bibliography. Also, in this connection, mention should be made of Moller's paper on the fossil flora of Bornholm, Denmark,[69] in which two new subspecies or varieties (*Hausmannia forchhammeri dentata*[70] and *H. forchhammeri laciniata*[71]) and one new species (*Hausmannia* (*Protorhipis*) *acutidens*[72]) are described and figured.

The surficial characters of the fertile frond are well exemplified in figure 9, plate 6, where the sori may be seen covering the entire surface of the specimen, forming polygonal, mostly quadrate groups. This feature of the genus, with figures of the sporangia in *Hausmannia forchhammeri dentata*, is described and discussed in a paper by Halle,[73] based on specimens in the State Museum of Natural History at Stockholm.

In regard to the botanical relationship of the genus *Hausmannia*, at least as represented by *H. atwoodi*, *H. forchhammeri*, *Protorhipis fisheri*, etc., there can be no doubt that it is a fern, and one so closely allied to the living genus *Dipteris* that they might be regarded as congeneric. The probability of their generic relationship has been discussed by several authors and was made the subject of a comprehensive paper by Seward and Dale.[74] Seward[75] had previously founded and defined the family Dipteridinae to include the living genus *Dipteris* and the fossil genera *Hausmannia* and *Protorhipis*.

The genus *Dipteris*, which includes four living species, is limited to tropical and subtropical regions in eastern and southeastern Asia and tropical Polynesia, and it is of great interest to know that the last American representative of the family was native in Alaska in the Tertiary period, and that the northern limit of the living species that resembles it most closely, *Dipteris conjugata* (Kaulfuss) Reinwardt, is the island of Formosa, thus adding further evidence in regard to the subtropical climate that must have prevailed in Alaska up to and during at least the early part of the Tertiary period.

The species is named in honor of the collector, W. W. Atwood of the United States Geological Survey.

Locality: Head of Herendeen Bay, east of Portage Valley, Alaska Peninsula (original no. 10); collected by W. W. Atwood in 1908 (lot 5180).

Genus DENNSTAEDTIA Bernhardi

Dennstaedtia blomstrandi (Heer) Hollick, n. comb.

Plate 2, figure 5

Sphenopteris (*Gymnogramme?*) *blomstrandi* Heer, Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 155, pl. 29, figs. 1a, b, c, d, e, 2a, b, 3, 4a, b, c, 9a, b, c, d, 1868.

Sphenopteris blomstrandi Heer, Nachträge zur miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 1, p. 12, pl. 1, figs. 3, 4a, 5, 1874.

These fragmentary remains are, apparently, specifically identical with similar remains described and figured by Heer under the name *Sphenopteris blomstrandi*, from the Tertiary of Spitsbergen and Greenland.

Knowlton,[76] in his discussion of *Dennstaedtia americana*, suggests that these two species are at least congeneric, and he definitely unites *Davallia* (*Stenoloma*) *tenuifolia* Swartz, as identified by Dawson[77] from the Eocene (Paskapoo) of British America, and *Asplenium tenerum* Lesquereux[78] (not *A. tenerum* Forster, 1786), from the Eocene (Fort Union) of North Dakota, under the new generic and specific combination *Dennstaedtia americana*. Subsequently,[79] in the synonymy of *D. americana*, he includes *Sphenopteris blomstrandi* Heer without discussion or comment in respect to its date of publication.

Comparison of the figures of all the species mentioned certainly indicates specific identity, and if they are to be so regarded Heer's specific name has precedence and they must all be grouped under the name here adopted for the specimens from Alaska.

Incidentally it is of interest to note that in both Alaska and Spitsbergen the species is associated with *Equisetum arcticum* Heer.

Locality: Cape Douglas, Alaska Peninsula (original no. 16); collected by R. W. Stone in 1904 (lot 3527).

[68] Richter, P. B., Beiträge zur Flora der unteren Kreide Quedlinburgs, pt. I, Die Gattung *Hausmannia* Dunker und einige seltenere Pflanzenreste, Leipzig, 1906.

[69] Moller, Hjalmar, Bidrag till Bornholms fossila flora—Pteridofyter: Lund Univ. Årssk., vol. 38, pt. 2, no. 5, 1902; Reg. Soc. Physiog. Lund Acta, vol. 13, no. 5, 1902.

[70] Idem (Årssk.), p. 49, pl. 4, figs. 15, 17; pl. 5, figs. 1, 2; pl. 6, fig. 27.

[71] Idem, p. 50, pl. 4, fig. 16; pl.5, fig. 4.

[72] Idem, p. 51, pl. 5, fig. 7.

[73] Halle, T. G., On the sporangia of some Mesozoic ferns: K. svenska vet.-akad. Arkiv botanik, vol. 17, no. 1, pp. 19–21, pl. 2, figs. 19–24, 1921.

[74] Seward, A. C., and Dale, Elizabeth, On the structure and affinities of *Dipteris*, with notes on the geological history of the Dipteridinae: Roy. Soc. London Philos. Trans., ser. B, vol. 194, pp. 487–513, pls. 47–49, 1901.

[75] Seward, A. C., La flore wéaldienne de Bernissart: Mus. roy. hist. nat. Belgique Mém., vol. 1, p. 17, 1900.

[76] Knowlton, F. H., Descriptions of fossil plants from the Mesozoic and Cenozoic of North America, I: Smithsonian Misc. Coll., vol. 52, pt. 4, no. 1884, pp. 492–495, pl. 63, fig. 4; pl. 64, figs. 3–5, 1910.

[77] Dawson, J. W., Note on the plants collected by Mr. G. M. Dawson from the lignite Tertiary deposits near the 49th parallel: Report on the geology and resources of the region in the vicinity of the 49th parallel, app. A, p. 329, pl. 16, figs. 1, 1a, 2, 2a, British N. Am. Boundary Comm., 1875; Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 21, pl. 1, figs. 1, 1a, 1b, 1886 [1887].

[78] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 221, pl. 46A, figs. 1, 1a, 2, 1883.

[79] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 230, 1919.

Genus ASPLENIUM Linnaeus

Asplenium alaskanum Hollick, n. sp.

Plate 3, figures 1, 1a, 1ax; plate 4, figures 1a, 1ax, 1b, 1bx, 2–6, 6a; plate 5, figures 3–5

Fronds large, once-pinnate, the sterile and fertile fronds apparently separate; main rachis prominently channeled or ridged; pinnae alternately arranged, subtending obtuse angles with the main rachis, the lower ones at right angles and reflexed, linear-oblong to linear-lanceolate, pinnatifid; sterile pinnae pinnatifid for about one third to one half their length, the divisions with rounded, upward-curved, blunt apices; fertile pinnae pinnatifid almost to the rachis, the divisions linear-lanceolate-falcate; venation pinnate throughout, consisting of a midvein in each of the divisions of the pinnae, with numerous simple, subparallel, upward-curving side veins; sori oblong-linear, crowded, one attached to each side vein, oblique to the midvein.

This fern was evidently large, and the sterile and fertile pinnae were apparently borne upon separate fronds. The two kinds of pinnae differ considerably in appearance, but their close association in the same layers and pieces of matrix indicates, beyond reasonable doubt, that both belong to the same species.

The sterile pinnae vary more or less in shape and size, according to the part of the frond to which they belong. Plate 3 represents the median part of a sterile frond, and an enlargement (figure 1ax) of a median portion of one of the pinnae (a) in the lower left-hand part of the specimen, showing the characters of the venation. Similar fragmentary pinnae are also represented by figure 2, plate 4, and figure 5, plate 5. Pinnae from median or proximal and from distal parts of fronds are represented by figures 1a and 1b, respectively, on plate 4, with enlargements (figures 1ax and 1bx) showing details of pinnatification and venation. Figure 1, plate 4, as a whole, includes two distinct fragments, which are probably not parts of one and the same frond, inasmuch as each is in a separate layer of the matrix, part 1a being superimposed upon part 1b. Other fragments of pinnae that belong to median-distal parts of sterile fronds are represented by figures 3 and 4, plate 4, and by figures 3 and 4, plate 5.

Fragments of fertile fronds are represented by figures 5 and 6, plate 4, and figure 6a shows the shape and arrangement of the sori in detail.

The simple pinnate venation in our specimens is not typical or characteristic of any one genus, and if only the sterile pinnae were available for comparison these might equally well be placed in the genus *Lastrea;* but the linear sori on the fertile pinnae are clearly asplenoid in character.

A specimen from the Eocene of Currant Creek, Oreg., that is practically indistinguishable from the sterile pinnae of our Alaskan specimens, was originally described by Newberry,[80] under the name *Lastrea* (*Goniopteris*) *knightiana*, but was subsequently figured and identified as *Lastrea* (*Goniopteris*) *fischeri* Heer?,[81] from the Miocene of Switzerland, which it resembles very closely; but specific or even generic identification is impossible without fertile pinnae for comparison. The same species was also identified by Lesquereux [82] and by Knowlton [83] from the Eocene and Miocene(?) of Oregon, but these identifications also were based entirely on sterile pinnae.

Another species in which the sterile fronds resemble the Alaska specimens is *Asplenium iddingsi* Knowlton,[84] from the Eocene of the Yellowstone National Park, but, if the fragment of a fertile pinna represented by Knowlton's figure 2 is correctly identified with the species, it is clearly different from ours.

Finally, attention may be called to the European species *Polypodites thelypteroides* Brongniart,[85] as described and figured by Watelet [86] from the Eocene of France, in which the shape of the pinnae and pinnules and the character of the venation are identical with those of our species; but the sori are round. Sterile pinnae in each would be indistinguishable one from the other.

Localities: Controller Bay region, 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 3, figs. 1, 1a, 1ax; pl. 5, fig. 5). Yakutat Bay, west shore, small creek at Dalton's coal outcrop (original no. 141); collected by R. S. Tarr in 1905 (lot 3879) (pl. 4, figs. 1a, 1ax, 1b, 1bx, 2–6, 6a). Port Camden Bay, Kuiu Island, Alexander Archipelago (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 5, figs. 3, 4).

Genus PTERIS Linnaeus

Pteris inequilateralis Hollick, n. sp.

Plate 5, figure 1

Size and shape of frond not known; pinnae inequilateral, deeply pinnatifid or with pinnules confluent at their bases; divisions or pinnules entire, opposite,

[80] Newberry, J. S., Brief descriptions of fossil plants, chiefly Tertiary, from western North America: U. S. Nat. Mus. Proc., vol. 5, p. 503, 1882 [1883]; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 10, pl. 48, fig. 6, 1898.

[81] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 34, pl. 9, figs. 3a–3e, Winterthur, 1855.

[82] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 239, pl. 50, figs. 1, 1a, 1883.

[83] Knowlton, F. H., U. S. Geol. Survey 20th Ann. Rept., pt. 3, p. 38, pl. 1, fig. 2, 1900.

[84] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 666, pl. 79, figs. 2, 3; pl. 80, figs. 9, 10, 1899.

[85] Brongniart, Adolphe, Tableau des genres de végétaux fossiles: Dictionnaire universel d'histoire naturelle, vol. 13, pp. 115, 164, 1849.

[86] Watelet, Adolphe, Description des plantes fossiles du bassin de Paris, p. 48, pl. 13, fig. 1, 1866.

about 2.5 centimeters in length on one side of the rachis and 1.5 centimeters on the opposite side, lanceolate-falcate in outline, blunt-acuminate; nervation pinnate, once-forked.

This fragment apparently represents a large fern with inequilateral pinnae such as are characteristic of several species in the genus *Pteris*. It has some resemblance to *Pteris inequalis* Heer,[87] from the Miocene of Switzerland, but is much larger and more conspicuously inequilateral. It may also be compared with *Pteris grönlandica* Heer,[88] from the Tertiary of Greenland, especially with his figure 1 on plate 107, from which it appears to differ merely in its somewhat more robust and slightly broader pinnules—differences such as might exist in individual pinnae on the same frond.

Locality: Controller Bay region, bed of creek flowing into head of Canyon Creek from Mount Chezem, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846).

Pteris oeningensis Unger?

Plate 9, figure 3

Pteris oeningensis Unger, Chloris protogaea, pt. 1, p. 124, pl. 37, figs. 6, 7, Leipzig, 1841.

The fragmentary specimen referred tentatively to this species has not been heretofore recorded from the New World, except by Heer [89] from the Tertiary of Greenland, and his figures of the Greenland specimens do not compare as closely with ours as certain figures by the same author [90] of specimens from the Tertiary of Switzerland.

Our specimen is also suggestive of *Pteris inaequalis* Heer,[91] but as only a portion of one side of the pinna is preserved intact it is impossible to determine whether or not the two sides were unequal. The resemblance of these two species, one with the other, was noted by Heer [92] in his description of the pinnules of *Pteris oeningensis*, in regard to which he remarks that "sie ähneln sehr denen der *Pt. inaequalis* Hr., die fiederchen sind aber beiderseits gleich."

Locality: Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178).

Pteris pseudopennaeformis Lesquereux

Plate 75, figure 1b

Pteris pseudopennaeformis Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 52, pl. 4, figs. 3, 4, 1878.

Our single fragmentary specimen appears, undoubtedly, to belong to this species as described and figured by Lesquereux from the Eocene of the western United States and by Hollick [93] and Berry [94] from the Eocene of Louisiana.

Whether or not the species is distinct from *Pteris pennaeformis* Heer [95] of the Old World has been discussed by nearly every author who has compared them. Lesquereux [96] originally regarded the specimens from the western United States as identical with Heer's species and remarked: "The species may differ somewhat from that of Europe, but, in the state of the specimens, the difference is not apparent"; and subsequently, in his report on the Tertiary flora, where he first used the new specific name, he said: "The fragments representing this species [*pseudopennaeformis*] * * * seem referable to the Miocene form [*pennaeformis*] described by Heer. * * * A comparison of specimens only could determine either identity or a specific difference between the European and American forms."

Berry, in his discussion of specimens from Louisiana, remarked that *P. pseudopennaeformis* is similar to *P. pennaeformis* "in a general way but is entirely distinct." If they are distinct, then *Pteris pseudopennaeformis* is a strictly American Eocene species, with a geographic distribution that includes Alaska, the western United States, and the Gulf States as far east as Mississippi.

Locality: Yakutat Bay, west shore, at Dalton's coal outcrops (original no. 141); collected by R. S. Tarr in 1905 (lot 3879).

Pteris sitkensis Heer

Plate 109, figure 8a

Pteris sitkensis Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 21, pl. 1, fig. 7a, 1869.
Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 112, St. Petersburg, 1871.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 212, 1894; Geol. Soc. America Bull., vol. 5, p. 577, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 877, 1896.

Our specimen is almost certainly referable to this species, although the marginal denticulations are so obscurely defined as to be discernible only in certain

[87] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 39, pl. 12, figs. 6a, b, c, Winterthur, 1855; vol. 3, p. 154, pl. 145, figs. 1–3, 1859.
[88] Heer, Oswald, Flora fossilis arctica, vol. 7, p. 49, pl. 70, figs. 1–5; pl. 107, fig. 1, 1883.
[89] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 87, pl. 45, figs. 8a, 8b, 1868; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 2, p. 9, pl. 3, figs. 1–4, 8b, 1880.
[90] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 39, pl. 12, figs. 5a–5l, Winterthur, 1855; vol. 3, p. 154, pl. 145, figs. 5, 6, 6b, 6c, 1859.
[91] Heer, Oswald, Naturf. Gesell. Zurich Mitt., vol. 8, p. 95, 1853; Flora tertiaria Helvetiae, vol. 1, p. 39, pl. 12, figs. 6a–6c, Winterthur, 1855; vol. 3, p. 154, pl. 145, figs. 1–3, 1859.
[92] Heer, Oswald, Flora fossilis arctica, vol. 6, p. 9, 1880.
[93] Hollick, Arthur, A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 279, pl. 32, fig. 1, 1899.
[94] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 168, pl. 9, fig. 6, 1916.
[95] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 38, pl. 12, figs. 1a–1d, Winterthur, 1855.
[96] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1870, p. 384, 1871; idem for 1871, p. 283, 1872.

places and by careful examination. Where the margins are not clearly defined it is difficult to distinguish between this species and *Pteris grönlandica* Heer [97] and other allied species.

The type specimen described and figured by Heer was collected by Hjalmar Furuhjelm on Kuiu Island, Alexander Archipelago, in the same region as that in which our specimen was obtained. It has also been found in the Tertiary of Greenland [98] and in the Mackenzie River region of Canada [99]

Locality: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565).

Family OSMUNDACEAE

Genus OSMUNDA Linnaeus

Osmunda doroschkiana Goeppert [1]

Plate 2, figure 1a; plate 109, figure 71

Osmunda doroschkiana Goeppert, Schlesische Gesell. vaterl. Culture 39te Jahresber., Abt. Naturwiss. u. Med., Abh., p. 203, 1861.

Osmunda doroshiana Goeppert, Acad. imp. sci. St.-Pétersbourg Bull., vol. 3, p. 457, 1861.

Osmunda doroschiniana Goeppert. Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 112, pl. 4 [" Pl. VI " on plate], figs. 2, 3, St. Petersburg, 1871.

This species represents one of the first fossil plants described from Alaska. It is probably the fern provisionally identified by Grewingk [2] as the Paleozoic species *Neuropteris acutifolia* Brongniart, from Unga Island, the same locality in which the specimens were collected by Doroschin upon which Goeppert based the species *Osmunda doroschkiana*—a locality in which only Tertiary plants have been found. The exact locality, as given by Goeppert, is " das westliche Ufer der Saharoschen Bucht " (= Zachareffskaia or Zachary Bay).

There seems to be little doubt that this species is known under several different names. As one example in this connection may be cited *Osmunda strozzii* Gaudin,[3] from the Miocene of Italy, which appears to be specifically identical with it; and Heer [4] suggests its possible identity with *Osmunda heerii* Gaudin, from the Miocene of the Old World and the Eocene of Greenland.

Specimens referred to *Osmunda torellii* (Heer) Heer [5] by Lesquereux,[6] collected by W. H. Dall at Coal Harbor, Unga Island, are undoubtedly identical with *Osmunda doroschkiana;* but whether or not Lesquereux's reference of the specimens to Heer's species was justified may, perhaps, be regarded as an open question.

Localities: Head of Herendeen Bay, east of Portage Valley, Alaska Peninsula (original no. 10); collected by W. W. Atwood in 1908 (lot 5180) (pl. 2, fig. 1a). Port Camden, about 3 miles southwest of Corn Island, Kuiu Island, southeastern Alaska (original no. 271); collected by A. F. Buddington in 1922 (lot 7580) (pl. 109, fig. 7). Unga Island, Alaska Peninsula.

Osmunda dubiosa Hollick, n. sp.

Plate 5, figure 2

Size and shape of frond not known; pinnae deeply pinnatifid; divisions lingulate, 1.2 by about 8 centimeters, obtuse, entire, alternately arranged, the midveins subtending obtuse, almost right angles with the rachis; venation pinnate; veins once-forked.

This is a very small fragment upon which to base a specific description, but the general characters are well defined and are probably sufficient to identify the species in the event of a more complete specimen being brought to light.

Localities: Cape Douglas, Alaska Peninsula, cape west of cabin (original no. 5); collected by R. W. Stone in 1904 (lot 3526). Unga Island (?), Alaska Peninsula.

FILICALES of uncertain relationship

Genus PECOPTERIS Brongniart

Pecopteris sp. Heer

Pecopteris sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 66, 1868.

This generic determination is probably erroneous, as *Pecopteris* is a Paleozoic genus, and the locality is one in which only Tertiary plants have been collected. The probability is that the specimen was afterward

[97] Heer, Oswald, Die fossile Flora Grönlands, pt. 2; Flora fossilis arctica, vol. 7, p. 49, pl. 70, figs. 1–5; pl. 107, fig. 1, 1883.

[98] Heer, Oswald, Nachträge zur Miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 3, p. 6, pl. 1, fig. 6a (fig. 9 on plate), 1874.

[99] Dawson, J. W., On fossil plants from the Mackenzie and Bow Rivers: Roy. Soc. Canada Trans., vol. 7, sec. 5, p. 70, pl. 10, fig. 1, 1889.

[1] By referring to the synonymy it may be seen that the specific name is spelled in three different ways. The original spelling of the name by Goeppert, in 1861 (op. cit. (Schlesische Gesell.), p. 201), was in accordance with its reference to " Obrist-Lieutenant v. Doroschkin ", but he subsequently modified it so as to conform to his new rendition of Doroschin's name as " Oberst-Lieutenant Hr. v. Doroschin " (op. cit. (Acad. imp.), p. 455), and in 1871 Eichwald still further modified it, probably merely on etymologic grounds, and referred to Doroschin as " Bergingenieur Staatsrath Peter Doroschin " (op. cit., preface, p. i).

[2] Grewingk, C. C. A., Beitrag zur Kenntniss der orographischen und geognostischen Beschaffenheit der Nordwest Küste Amerikas mit den anliegenden Inseln: Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, pp. 170, 364, 1850.

[3] Gaudin, C. T., Contributions à la flore fossile italienne, Mém. 6: Soc. helvétique sci. nat. Nouv. mém., vol. 20, pt. 3, p. 9, pl. 1, figs. 1–4, 1862.

[4] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 88, pl. 1, figs. 6–11; pl. 8, fig. 15b, 1868.

[5] Heer, Oswald, Uebersicht der Miocenen Flora der arctischen Zone: Flora fossilis arctica, vol. 3, no. 4, p. 14, 1874; Miocene Flora der Insel Sachalin: Idem, vol. 5, no. 3, p. 19, pl. 1, figs. 4, 4b, 1878; = *Hemitelites torelli* (Heer) Heer, Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 462, pl. 40, figs. 1–5a; pl. 55, fig. 2, 1869; = *Pecopteris torellii* Heer, Miocene Flora von Nordgrönland: Idem, vol. 1, p. 88, pl. 1, figs. 15, 15b, 15c, 1868; Die tertiäre Flora von Grönland: Idem, vol. 7, p. 53, pl. 66, fig. 5b; pl. 102, figs. 1, 2b, 3, 5, 1883.

[6] Lesquereux, Leo, Contributions to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, p. 444, pl. 6, figs. 3–6, 1882 [1883].

included in some one or another of the Tertiary species described from the region, as it does not appear to have been subsequently mentioned by Heer.

Collected by Hjalmar Furuhjelm on Keku Island, southeastern Alaska.

Genus ANTHROPHYOPSIS Nathorst

Anthrophyopsis hamiltonensis Hollick, n. sp.

Plate 6, figures 1–5

Frond or leaflet lingulate-lanceolate, unsymmetrical, about 12 centimeters in maximum length by about 4 centimeters in maximum width, broadest below the middle, somewhat constricted and curving above to a rounded apex, curved and tapering below to an inequilateral, narrow, cuneate base that is prolonged into a short footstalk; margin entire; venation elongated flabellate; veins all of equal rank, mostly simple for a short distance from the base, forking and more or less acutely reticulated above.

It is with some hesitation that these specimens are referred to the genus *Anthrophyopsis*,[7] originally so named by Nathorst in order to indicate its supposed relationship to the living fern genus *Antrophyum*[8] but subsequently[9] transferred by him to the fossil cycadean genus *Ctenis*, for the reason that the matter of their correct ordinal relationship must be regarded as an open question. It appears to be probable, however, that the Alaskan Tertiary specimens are congeneric with the Old World Triassic species included under *Anthrophyopsis* and later under *Ctenis*, although these generic names may not indicate their correct taxonomic relationships. In connection with any discussion of plant remains of this general type or appearance attention should also be called to *Canna eocenica* Berry,[10] from the Tertiary (Eocene) of the southern United States. The general surficial resemblance between the figures of this species and those of our Alaskan specimens referred to the genus *Anthrophyopsis* is certainly close enough to warrant careful comparison. Generic identity between them appears to be possible.

Localities: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 3652) (pl. 6, figs. 1, 2). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 1392) (pl. 6, figs. 3–5).

---

[7] *Anthrophyopsis* Nathorst, Floran vid Bjuf, pt. 1: Sveriges geol. undersökning, ser. C, no. 27, p. 43, Stockholm, 1878. Type, *A. nilssoni*, pl. 7, fig. 5; pl. 8, fig. 6; Floran vid Hoganas och Helsingborg: Idem, no. 29, p. 16, pl. 1, fig. 10; pl. 2, fig. 1, 1878; Floran vid Bjuf, pt. 2: Idem, no. 33, p. 58, pl. 11, figs. 5, 5a, 7, 1879.

[8] The incorrect spelling of the generic name *Anthrophyopsis* was probably due to inadvertence on the part of Nathorst. It is, however, correctly spelled *Antrophyopsis* in his explanation of plate 7.

[9] Nathorst, A. G., Floran vid Bjuf, pt. 3: Sveriges geol. undersökning ser. C, no. 85, p. 88, Stockholm, 1886.

[10] Berry, E. W., The lower Eocene floras of southeastern North America: U.S. Geol. Survey Prof. Paper 91, p. 181, pl. 15, figs. 7, 8, 1916.

Class EQUISETINAE

Order EQUISETALES

Family EQUISETACEAE

Genus EQUISETUM Linnaeus

Equisetum arcticum Heer

Plate 7, figures 1–9; plate 8, figures 1–10; plate 114, figure 3b

Equisetum arcticum Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 23, no. 6, p. 150, 1866; Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 156, pl. 29, figs. 8a–8d, 9e, f; Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 31, pl. 1, figs. 1–6e, 7–15; pl. 2, figs. 1–3c, 4, 1870; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 57, 1877; Die Miocene Flora des Grinnell-Landes: Idem, vol. 5, no. 1, p. 19, pl. 1, fig. 1a, 1878.

Abundant remains of Equisetae occur in collections from widely separated localities in Alaska, and whether or not they should all be included in a single species may perhaps be questioned. The same problem has confronted other authors who have had occasion to study this and closely similar species, and, for the most part, specific rank has been accorded on very slight differences in surficial characters and frequently on very fragmentary specimens or even on a single fragment.

Our specimens include the characteristic hollow, jointed, grooved, and ridged stems, either sheathed or naked at the nodes, and rhizomes with rootlets and tubercles attached. (See pl. 7, fig. 9, and pl. 8, figs. 8–10.) Cross sections of the stems and nodal diaphragms are also represented in several of the specimens. (See pl. 7, figs. 1–3a.) In no specimen are any organs of fructification preserved, and in only one (pl. 7, fig. 8) was any indication of leaves detected. The internodes vary in length according to the part of the stem that is preserved in any particular specimen—the shorter ones, apparently, representing the lower parts. (See pl. 7, fig. 8, and pl. 8, fig. 3.) The ridges are closely spaced, and certain of the specimens show indications of as many as 25 to the circumference of the stem. The sheaths are often obscurely defined and in some specimens are apparently lacking. They are about 1 centimeter in length and terminate above in narrow, appressed, sharp teeth, which in certain specimens appear as if bristle-tipped.

Our specimens agree in their essential characters with those depicted in Heer's figures of *Equisetum arcticum*, especially with those figured on plate 1 in volume 2 of Flora fossilis arctica. It is a characteristic element in the Eocene flora of Spitsbergen and Grinnell Land, and its occurrence also in Alaska indicates a wide geographic distribution in the Arctic regions.

In any critical study of the species comparisons should be made with *Equisetum braunii* (Unger)

Heer,[11] *E. limosellum* Heer,[12] *E. limoselloides* Heer,[13] and *Physagenia parlatorii* Heer,[14] from the Miocene of Switzerland; *E. limosum?* Linnaeus as identified by Lesquereux [15] and *E. wyomingense* Lesquereux,[16] from the Eocene of Wyoming; *E. haguei* Knowlton,[17] *E. canaliculatum* Knowlton,[18] and *E. deciduum* Knowlton,[19] from the Miocene of the Yellowstone National Park; and *E. florissantense* Cockerell,[20] from the Miocene of Colorado, which the author states is related to *E. canaliculatum*. In his discussion of *Equisetum haguei* Knowlton remarked that "among living species this seems to approach closely to *E. limosum* L.; more closely, in fact, than does the specimen referred to *E. limosum* by Lesquereux"; and similarity of characters between all of the species mentioned and other living ones might readily be noted by comparing certain of the fossil remains with coordinate fragments of existing plants. The Tertiary species evidently persisted, with but little change in form and appearance, to the present day.

Localities: American Creek, 100 yards below crossing of Eagle-Valdez trail, upper Yukon River region (original no. 2 AC 40); collected by A. J. Collier in 1902 (lot 2966) (pl. 7, figs. 1–3). Bryant Creek, upper Yukon River region (original no. 3 AP 350); collected by L. M. Prindle in 1903 (lot 3229) (pl. 7, fig. 4). Yukon River, north bank, at Drew's mine, central Yukon River region (original no. 3 AH 9a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246) (pl. 7, figs. 5–9). Matanuska River, 4,200 feet down from Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 8, fig. 1). Matanuska coal field, south of pond on top of mountain, between Kings River and Youngs Creek, Matanuska-Cook Inlet region; collected by G. C. Martin and F. J. Katz in 1910 (lot 5898) (pl. 8, figs. 2–6). Anchorage Bay, Chignik Bay, Alaska Peninsula, talus slopes on mountain about 1 mile southeast of Pacific Packing & Navigation Co.'s cannery (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 8, fig. 7). Cape Douglas, Alaska Peninsula, east coast of back bay, between cabin and neck of cape (original no. 11); collected by R. W. Stone in 1904 (lot 3547) (pl. 8, figs. 8–10).

[11] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 44, pl. 14, figs. 8a–8d, Winterthur, 1855; vol. 3, p. 157, pl. 145, figs. 28, 29, 1859.

[12] Idem, vol. 1, p. 44, pl. 14, fig. 9, 1855; vol. 3, p. 157, pl. 145, figs. 20–26 (var. b), 27a, b, 30a, b, 1859; Flora fossilis Helvetiae, p. 169; pl. 69, figs. 8a, b, 9–16, Zürich, 1877.

[13] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 157, pl. 145, fig. 31, Winterthur, 1859.

[14] Idem, vol. 1, p. 109, pl. 42, figs. 2–17, 1855; vol. 3, p. 158, pl. 145, figs. 17, 18, 1859, = *Equisetum parlatorii* (Heer) Schimper, Traité de paléontologie végétale, vol. 1, p. 261, pl. 7, figs. 12–13, Paris, 1869.

[15] Lesquereux, Leo, The fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 299, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 69, pl. 6, fig. 5, 1878, = *E. lesquereuxii* Knowlton, A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 94, 1898.

[16] Lesquereux, Leo, The Lignitic formation and its fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1873, p. 409, 1874; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 69, pl. 6, figs. 8–11, 1878. Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 15, pl. 65, fig. 8, 1898.

[17] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, ch. 14, p. 674, pl. 81, figs. 3, 4, 1899.

[18] Idem, p. 675, pl. 81, figs. 6, 7.

[19] Idem, p. 676, pl. 81, fig. 5.

[20] Cockerell, T. D. A., *Equisetum* in the Florissant Miocene: Torreya, vol. 15, p. 266, fig. 1, 1915.

Equisetum globulosum Lesquereux

Equisetum globulosum Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 444, pl. 6, figs. 1, 2, 1882 [1883].

This species, as originally described and figured by Lesquereux, was based on specimens collected by W. H. Dall in Alaska in 1880; but the exact locality was not given. Knowlton,[21] however, gives Unga Island as Dall's locality.

Fragmentary specimens from Kukak Bay, collected by DeAlton Saunders in 1899, were identified but not figured by Knowlton,[22] who says: "They are a little smaller but otherwise do not differ essentially from the typical form."

The species was also recorded by Lesquereux [23] from the Fort Union formation of North Dakota; and specimens described and figured by Newberry [24] as "*Equisetum* sp.?", probably also from the same formation and locality, are undoubtedly specifically identical with *E. globulosum*.

It appears to be quite probable that all the remains that have been referred to this species are merely imperfect or shrunken specimens of *Equisetum arcticum* Heer, the species last described.

Phylum SPERMATOPHYTA

Class GYMNOSPERMAE

Order CYCADALES

Family CYCADACEAE

Genus CERATOZAMIA Brongniart

Ceratozamia wrightii Hollick

Plate 12, figure 6

Ceratozamia wrightii Hollick, Torrey Bot. Club Bull., vol. 59, no. 4, p. 169, pl. 1, 1932.

This specimen is the only fossil representative of the genus thus far described from the New World, but a Tertiary (Miocene) species from Switzerland (*Ceratozamia hofmani* Ettingshausen),[25] based upon a single parallel-veined leaf or leaflet, was described and figured in 1888, and a somewhat similar but more fragmentary specimen, from the Tertiary (Oligocene) of Italy (*Ceratozamites vicetinus* Meschinelli),[26] was described and figured in 1889. The relationship of each

[21] Knowlton, F. H., Report on the fossil plants collected in Alaska in 1895: U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 877, 1896.

[22] Knowlton, F. H., Fossil plants from Kukak Bay: Alaska, vol. 4, p. 149, Harriman Alaska Expedition, 1904.

[23] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 222, pl. 48, fig. 3, 1883.

[24] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 16, pl. 22, figs. 3, 4, 1898.

[25] Ettingshausen, Constantin von, Über das Vorkommen einer Cycadee in der fossilen Flora von Leoben in Steiermark: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 96, pt. 1, p. 80, 1887; Die fossile Flora von Leoben in Steiermark, pt. 1: Idem, Denkschr., vol. 54, p. 272 (12), pl. 3, figs. 10 (10a, 10b), 1888.

[26] Meschinelli, Luigi, Studio sulla flora fossile di Monte Piano: Soc. veneto-trentina sci. nat. Atti, vol. 10, fasc. 2, p. 276 (9), pl. 6, figs. 1, 2, 1889.

of these species to the Cycadaceae has, however, been questioned by certain European paleobotanists, and hence any discussion here, in connection with their probable taxonomic relationships, would be of little value or interest.

In our existing flora the genus *Ceratozamia* (with 6 recognized species), is confined to Mexico, and the limit of its range northward is about latitude 25°. It is distinctly a tropical or subtropical genus; hence the discovery of our fossil species in rocks of Tertiary age in Alaska, at about latitude 57°, may be regarded as presumptive evidence that tropical or subtropical climatic conditions prevailed there at that time. It is also interesting and significant that, so far as any definite records show, the genus was confined to the western American or Pacific region during the Tertiary period, as are the existing species of the genus, indicating that, even as far back as the early part of Tertiary time, milder climatic conditions prevailed in southeastern Alaska than in equivalent latitudes in the continental interior and eastward.

The specific name is given in honor of C. W. Wright, of the United States Geological Survey, by whom the specimen was collected.

Locality: Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 496); collected by C. W. Wright in 1904 (lot 7474).

Genus DIOÖN Miguel, 1846 (=DION Lindley, 1843)

Dioön inopinus Hollick

Plate 9, figure 4a; plate 10, figure 2a

Dioön inopinus Hollick, Torrey Bot. Club Bull., vol. 59, no. 4, p. 170, pl. 3, 1932.

These two specimens, although fragments only, indicate that the leaves, in their entirety were apparently comparable in size with most of the existing species of the genus. I infer that figure 4a, plate 9, represents a median part, and figure 2a, plate 10, a proximal part of a leaf.

The leaflets, so far as discernible, are entire; but a single well-defined denticle, on the upper margin of the lower third leaflet on the left-hand side of figure 4a, may indicate that the margins of certain of the leaflets were denticulate distad.

This species and the one next described represent the first fossil species of the genus *Dioön* thus far recorded from any American locality; although several species were described under the genus *Dioönites*, from Mesozoic strata, among which may be mentioned *Dioönites borealis* Dawson,[27] from the Cretaceous of the Northwest Territory, which we may regard as an ancestral relative of the two species of *Dioön* now under consideration, from the nearby coastal region of Alaska.

[27] Dawson, J. W., On the Mesozoic floras of the Rocky Mountain region of Canada: Roy. Soc. Canada Trans., vol. 1, sec. 4, p. 24, pl. 3, fig. 37, 1882 [1883]; vol. 3, p. 6, pl. 1, fig. 2, 1885 [1886].

It is also of interest to note, as was discussed in connection with the genus *Ceratozamia*, that the last representatives of the genus *Dioön* to survive in the northern part of North America were apparently limited to the Pacific coast region. At least no specimens that might be referred to the genus have been recorded from any locality in the interior or in the eastern part of the continent.

In our existing flora the genus *Dioön*, represented by four species, is confined to Mexico, where its northern limit of distribution is about latitude 32°. Its range is practically identical with that of *Ceratozamia*, and the two genera were evidently contemporaneous elements in the Tertiary flora of Alaska at about latitude 57°. They have migrated southward a distance of about 25° since that time, but otherwise their regional distribution has apparently not changed.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Dioön praespinulosum Hollick

Plate 10, figure 1a; plate 11, figures 1a, 2–5; plate 110, a

Dioön praespinulosum Hollick, Torrey Bot. Club Bull., vol. 59, no. 4, p. 171, pl. 4, figs. 1, 2, 1932.

This species is closely similar in its general surficial appearance to the existing Mexican species *Dioön spinulosum* Dyer. They are so strikingly alike, in fact, that dismembered parts of certain selected leaflets of *D. spinulosum* might be matched almost exactly with the figures of the fossil specimens.

Figure 1a, plate 10, shows the basal portion of a leaf; figure 5, plate 11, shows an apical portion; figures 1a, 2–4, plate 11, show intermediate portions. The leaves were evidently much smaller than those of *Dioön inopinus* Hollick, the species last described, and the leaflets more crowded. The two species occur together in the same collection.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 10, fig. 1a; pl. 11, figs. 1a, 2, 3). Idem (original no. III, lot 4392) (pl. 11, figs. 4, 5). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 110, a).

Order GINKGOALES

Class GINKGOACEAE

Genus GINKGO Linnaeus

Ginkgo adiantoides (Unger) Heer

Plate 117, figures 1, 2

Ginkgo adiantoides (Unger) Heer, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 21, pl. 2, figs. 7–10, 1878; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 57, pl. 87, figs. 9–12, 1883.

Lesquereux, U. S. Nat. Mus. Proc., vol. 10, p. 35, 1887.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, no. 998, p. 215, 1894; Geol. Soc. America Bull., vol. 5, p. 579, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 879, 1896.

This species was identified by Lesquereux in a collection made in the vicinity of Sitka by E. W. Nelson (U. S. Nat. Mus. no. 2300; lot 210) and by Knowlton among specimens collected at Herendeen Bay by C. H. Townsend (lot 539). These were fragmentary specimens, and the descriptions were not accompanied by illustrations. Our specimens, also, are fragmentary, but their specific identity can hardly be doubted.

Locality: Divide between Folger Creek and Nowitna River, 19.15 miles N. 35° E. of north butte of Twin Buttes, central Yukon region (original no. 2); collected by J. B. Mertie in 1915 (lot 7007).

Ginkgo reniformis conformis Hollick, n. var.

Plate 12, figure 1

This variety differs from the species, *Ginkgo reniformis* Heer,[28] from the Tertiary of Siberia, merely in its finer, more crowded venation. In this and other essential characters it is so closely similar to *Ginkgo adiantoides* (Unger) Heer [29] that but for its broadly cordate instead of cuneate base there would be no question in regard to its specific identity. In other words, our specimen possesses the shape of *Ginkgo reniformis* with the venation of *G. adiantoides*. The former species was not again mentioned by Heer, nor does it appear to have been recognized by any subsequent author, and its validity as a species may perhaps be questioned, and the specimens referred to it be included under *G. adiantoides*, in which event the Alaskan specimen would be included in the same category. The specimen was, in fact, identified and listed under the specific name *adiantoides* by Knowlton,[30] in his preliminary identifications of species included in the Chinitna Bay collection.

Locality: Chinitna Bay, north side near entrance, Alaska Peninsula (original no. 922c); collected by T. W. Stanton and G. C. and Lawrence Martin in 1904 (lot 3505).

Order CONIFERALES

Family TAXACEAE

Genus TAXITES Brongniart

Taxites olriki Heer

Plate 16, figs. 2, 6–8; plate 48, figure 4b

Taxites olriki Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 275, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 95, pl. 1, figs. 21–23, 24c; pl. 45, figs. 1a, b, c, 1868; Flora fossilis alaskana: Idem, vol. 2, no. 2, p. 23, pl. 1, fig. 8, pl. 2, fig. 5b, 1869.

This is a relatively well-defined species as compared with other Tertiary coniferous species referred to the genera *Sequoia*, *Taxodium*, and *Glyptostrobus*, and the identification of our specimens from Alaska may be regarded as reasonably satisfactory. It is a characteristic element in the Tertiary floras of Greenland and Spitsbergen and, in addition to Heer's figures of the type specimens (Flora fossilis arctica, vol. 1) and the specimens from Alaska (idem, vol. 2), he gives other excellent illustrations of the species.[31]

A fine specimen was described and figured by Dawson [32] from the Eocene of Canada, which may be compared, especially, with our figure 8 on plate 16. Lesquereux [33] referred to the species, provisionally, a narrow-leaved specimen from the Miocene of California; and Knowlton [34] described and figured specimens from the Eocene of the Yellowstone National Park that may be compared with our figures 6 and 7 on plate 16.

The Alaskan specimens described by Heer (Flora fossilis arctica, vol. 2) were collected by Hjalmar Furuhjelm at "English Bay" [Port Graham], Kenai Peninsula, and they include both narrow- and broad-leaved forms. His figure 8 is practically identical in its characters with our figure 6 on plate 16.

Localities: Fairbanks district, Tanana region (original no. 31); collected by L. M. Prindle and H. B. Blair in 1906 (lot 7476) (pl. 16, fig. 2). O'Brien coal claim, three-quarters of a mile south of Matanuska River, 14 miles above mouth of Chickaloon River, Matanuska-Cook Inlet region; collected by G. A. Parks in 1911 (lot 6289) (pl. 16, fig. 6). Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 3652) (pl. 16, fig. 7). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 16, fig. 8). Copper Basin, half a mile east of Gakona Glacier, Yakutat-Copper River region (original no. 1948); collected by W. C. Mendenhall in 1902 (lot 3021) pl. 48, fig. 4b).

Taxites microphyllus Heer

Taxites microphyllus Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 24, pl. 1, figs. 9, 9b, 1869.

This species, represented by a single small fragment collected at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, by Hjalmar Furuhjelm, was not subsequently mentioned by Heer and does not appear to have been recognized in any subsequent col-

[28] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes, pt. 4, Tertiäre Pflanzen vom Tschirimyi-felsen an der Lena: Flora fossilis arctica, vol. 5, no. 2, p. 32, pl. 8, figs. 24, 25a, 1878.

[29] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 21, pl. 2, figs. 7–10, 1878; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 57, pl. 87, figs. 9–12, 1883, = *Salisburia adiantoides* Unger, Synopsis plantarum fossilium, p. 211, Leipzig, 1845.

[30] Knowlton, F. H., in Martin, G. C., and Katz, F. J., A geologic reconnaissance of the Iliamna region, Alaska: U. S. Geol. Survey Bull. 485, p. 78, 1912.

[31] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 465, pl. 55, fig. 7a, b, 1869; Nachträge zur miocenen Flora Grönlands: Idem, vol. 3, no. 1, p. 15, pl. 1, fig. 10, 1874; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 64, pl. 16, fig. 8b, 1876.

[32] Dawson, J. W., On the fossil plants of the Laramie formation of Canada: Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 23, pl. 1, fig. 5, 1886.

[33] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 240, pl. 50, figs. 6, 6a, 1883.

[34] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 680, pl. 82, figs. 1, 3, 4, 1899.

lections elsewhere. It is of doubtful specific validity and bears a very close surficial resemblance to certain of the small leafy twigs referred to *Sequoia langsdorfii*, depicted in this paper in figures 1–6, plate 15.

Family PINACEAE

Genus PINUS Linnaeus

Pinus macclurii Heer?

Pinus macclurii Heer, Schweiz. naturf. Gesell. Verh., vol. 51, p. 140, 1867.

Pinus (*Abies*) *macclurii* Heer, Flora fossilis arctica, vol. 1, p. 134, pl. 20, figs. 16–18 (cones); pl. 35, fig. 1, pl. 36, figs. 1–5 (wood), 1868.

Pinus macclurii Heer?, Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 195, 1898.

A provisional identification of this species was made by F. H. Knowlton based upon specimens collected by J. E. Spurr in 1896 on the Yukon River 35 miles below Tanana, in the central Yukon region, in regard to which he said: "There are several finely preserved cones that appear to be the same as Heer's *Pinus macclurii.*"

This is a species known only from the Eocene of the Arctic regions.

Pinus sp. Heer

Pinus sp. Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 23, pl. 1, fig. 11, 1869.

Pinus sp. Heer?, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

Heer's description and figure represent a fragmentary disintegrated cone, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. It is probably the same specimen as that previously listed as *Pinus* spec., which is credited to the same collector and locality.

Pinus? (leaves)

Pinus? (leaves), Knowlton, Alaska, vol. 4, p. 151, pl. 23, fig. 2, Harriman Alaska Expedition, 1904.

This specimen (U. S. Nat. Mus. no. 30073) collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899, consists of an aggregation of what are apparently detached pine needles. It possesses little diagnostic value.

Pinus? (scales)

Pinus? (scales), Knowlton, Alaska, vol. 4, p. 151, pl. 24, fig. 1, Harriman Alaska Expedition, 1904.

This specimen (U. S. Nat. Mus. no. 30074) consists of a number of what are apparently well-defined scales of pine cones. It was collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders, in 1899.

Genus PINITES (Witham) Lindley and Hutton

Pinites pannonicus (Unger) Goeppert

Pinites pannonicus (Unger) Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abh., p. 203, 1861.

Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 23, 1869.

Peuce pannonica Unger, Chloris protogaea, pt. 1, p. 37, Leipzig, 1841.

This species is represented by a specimen of fossil wood, collected on Unga Island, south of Alaska Peninsula, by Lt. Peter Doroschin. It is described but not figured. According to Heer the species is identical with *Pinites protolarix* Goeppert,[35] from the Tertiary of Europe.

Pinites sp. Goeppert

Pinites sp. Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abh., p. 203, 1861.

The specimen upon which this generic identification was based is merely mentioned by Goeppert as "a Tertiary species of fossil bituminous wood (*Pinites*)," collected by Lt. Peter Doroschin at Korovin Bay, Atha [Atka] Island, one of the Andreanof group of the Aleutian Islands.

Pinites sp. Goeppert

Pinites sp. Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abh., p. 203, 1861.

This specimen, collected by Lt. Peter Doroschin on the west shore of Cook Inlet, is merely described by Goeppert as a "petrified twig of *Pinites.*" The exact locality where it was found is ill defined, and the geologic horizon in which it belongs is uncertain; hence its inclusion in the Tertiary flora must be regarded as tentative only.

Genus PITYOXYLON Kraus

Pityoxylon inaequale Felix

Pityoxylon inaequale Felix, Deutsch. geol. Gesell. Zeitschr., vol. 38, p. 483, pl. 12, fig. 3, 1886.

This species is based upon a specimen of fossil wood from "the talus of a basalt mountain south of Danaáku [probably Danaaka, or Silver Lake, in the Yakutat-Copper River region], Alaska," collected by Arthur and Aurel Krause sometime during the years 1881 and 1882. The exact locality and the geologic horizon to which the specimen should be referred are uncertain, and it is admitted into the Tertiary flora of Alaska with reservation.

Pityoxylon macclurii (Heer) Kraus

Pityoxylon macclurii (Heer) Kraus, in Schimper, Traité de paléontologie végétale, vol. 2, p. 379, pl. 79, Paris, 1870.

Pityoxylon macclurii Kraus (Cramer sp.), Platen, Naturf. Gesell. Leipzig Sitzungsber., vol. 34, p. 146, 1907 [1908].

Pinus macclurii Heer (?), Cramer, in Heer, Fossile Hölzer des Bankslandes: Flora fossilis arctica, vol. 1, p. 170, pl. 35, fig. 1; pl. 36, figs. 1–5, 1868.

---

[35] Goeppert, H. R., Ueber die Verbreitung der fossilen Gewächse in der Steinkohlenformation: Schlesische Gesell. vaterl. Kultur Uebers. Arb. u. Verh., p. 77, 1840; Ueber die neulichst im Basalttuff des hohen Seebachkopfes bei Siegen entdeckten bituminösen und versteinerten Hölzer: Archiv Mineralogie, Geognosie, etc., vol. 14, p. 186 (description), p. 189 (name), pl. 11, figs. 1–6, 1840.

A specimen of this species was described by Paul Platen under the chapter heading "Hölzer aus Alaska;" but without any reference to either locality or collector. It may, however, be regarded as belonging in the Tertiary flora, as it is apparently identical with *Pinus macclurii*, originally described from the Tertiary of Greenland.

Genus PICEA Link

Picea harrimani Knowlton

Picea harrimani Knowlton, Alaska, vol. 4, p. 150, pl. 22, figs. 3, 4, Harriman Alaska Expedition, 1904.

This species is based upon cones collected in 1899 by De Alton Saunders at Kukak Bay, Alaska Peninsula (U. S. Nat. Mus. nos. 30070, 30071). In the discussion of the species, Knowlton remarked:

> It was at first supposed that these were cones of a *Pinus* allied to *P. strobus* L., but after further consideration it appears more probable that they belong to the genus *Picea*. In a general way, they are similar to *P. sitchensis* Carr., the Alaska spruce, but are narrower and longer than is usual in this species.

Picea (branches)

Picea (branches), Knowlton, Alaska, vol. 4, p. 151, pl. 24, fig. 3; pl. 25, figs. 3, 4, Harriman Alaska Expedition, 1904.

This generic identification was based upon specimens of leafy twigs (U. S. Nat. Mus. nos. 30075, 30079) collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899. They are probably referable to *P. harrimani*, cones of which were found at the same locality.

Picea? (seed)

Picea? (seed), Knowlton, Alaska, vol. 4, p. 151, pl. 33, fig. 1, Harriman Alaska Expedition, 1904.

In his discussion of this specimen (U. S. Nat. Mus. no. 30090), Knowlton said:

> It is practically impossible to distinguish this seed from that of a *Pinus*, but since cones and branches of *Picea* are abundant, and only a few questionable leaves of *Pinus* are present, it seems logical to refer it to the former.

Collected by De Alton Saunders in 1899 at Kukak Bay, Alaska Peninsula.

Genus ABIES Hill

Abies sp. Grewingk

Abies sp. Grewingk, Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, p. 364, 1850.

This generic identification was based upon material collected by Grewingk on Kadjak [Kodiak] Island, Alaska Peninsula, and presumably of Tertiary age.

Genus SEQUOIA Endlicher

Sequoia brevifolia Heer

Plate 15, figure 8; plate 78, figure 6b

Sequoia brevifolia Heer, Flora fossilis arctica, vol. 1, p. 93, pl. 2, figs. 23, 23b, 1868; Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 37, pl. 4, figs. 2, 2b, 3, 3b, 1870; Nachträge zur Miocenen Flora Grönlands: Idem, vol. 3, no. 1, p. 5, pl. 2, figs. 7, 8, 1874.

This species is exceedingly difficult to differentiate satisfactorily from certain of the short-leaved forms of *Sequoia langsdorfii*, such as are depicted in figures 1–6 on plate 9; and Heer [36] remarks that it may be merely a variety of that species. Our specimen is more robust than any of Heer's figures of *S. brevifolia*, but it agrees in its essential characters and is certainly different from the more common typical *S. langsdorfii*, such as the specimens depicted in figure 4, plate 10, and figure 1, plate 13.

Specimens referred to *S. brevifolia* were described and figured by Heer [37] from the Tertiary of the Baltic provinces of Germany, as well as from the Arctic regions; by Caspary [38] from the Tertiary amber of East Prussia; by Lesquereux[39] from the Upper Cretaceous (Montana formation) of Wyoming; and by Knowlton [40] from the same horizon and region. Knowlton, in his discussion of the specimens previously referred to the species, expressed doubt as to their specific distinction from *S. langsdorfii*, but finally concluded that "it appears best to keep them separate." Subsequently,[41] however, he tentatively referred the specimens from Wyoming to a new species, under the name *Sequoia obovata?*, and included in it specimens from the Upper Cretaceous (Fruitland formation) of New Mexico. Still later [42] he definitely established the new species and added to it another specimen, from the Upper Cretaceous (Vermejo formation) of Colorado, with the following remarks: [43]

> This fine species, to which I have ventured to give a new name, has long been known in this country under the name *Sequoia brevifolia* Heer. * * * Heer rightly states that his *S. brevifolia* appears to be most closely related to *S langsdorfii*. * * * It must be confessed that it is not easy to draw a satisfactory line between the American specimens and Heer's. * * * On carefully comparing these with the American material it appears that the Greenland form has the leaves more scattered, more obtuse, and little if any enlarged in the middle. In view of these facts, and in view of the marked difference in geologic position, it would seem improbable that the Greenland and American specimens are identical, and the latter have consequently been given a new name.

---

[36] Heer, Oswald, op. cit., vol. 1, p. 93.

[37] Heer, Oswald, Miocene baltische Flora, p. 21, pl. 3, figs. 10, 10b; pl. 9, fig. 5c, 1869.

[38] Caspary, Robert, K. preuss. geol. Landesanstalt Abh., neue Folge, no. 4, p. 139, pl. 25, figs. 112–112f, 1907.

[39] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 78. pl. 61, figs. 25, 25a, 26, 27, 27a, 1878.

[40] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 27, pl. 4, figs. 1–4, 1900.

[41] Knowlton, F. H., Flora of the Fruitland and Kirtland formations: U. S. Geol. Survey Prof. Paper 98, p. 333, 1916.

[42] 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. 250, pl. 30, fig. 7, 1917 [1918].

[43] Idem, pp. 250–251.

Whether or not this separation into two distinct species is justified must remain largely a matter of individual opinion. In any event, however, the geologic position of our specimen from Alaska would naturally cause it to be regarded as most closely allied to those from Greenland, and hence the original specific name is here applied to it.

Localities: Bryant Creek, upper Yukon River region (original no. 3AP 350); collected by L. M. Prindle in 1903 (lot 3229) (pl. 15, fig. 8). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, lowest of three horizons (original no. III); collected by W. W. Atwood in 1907 (lot 4392) (pl. 78, fig. 6b).

Sequoia disticha Heer

Plate 15, figure 7

Sequoia disticha Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 63, pl. 12, fig. 2a; pl. 13, figs. 9–11, 1876.

This species is difficult to distinguish from the short-leaved forms of *Sequoia langsdorfii* Heer, as depicted in his plate 13 and in figure 1, plate 15, of this paper. The similarity was discussed by Heer, and it appears to be probable that the distinctive characters are hardly of specific value. So far as I have been able to ascertain Heer did not again mention the species, and it is doubtful if it should be regarded otherwise than as one of the many varietal forms of *Sequoia langsdorfii*.

Locality: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523).

Sequoia heerii Lesquereux

Sequoia heerii Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 290, 1872; U. S. Geol. Survey Terr. Rept., vol. 7, p. 77, pl. 7, figs. 11, 11a, 12, 13, 1878.
Knowlton, Alaska, vol. 4, p. 152, Harriman Alaska Expedition, 1904.

In Knowlton's descriptions of fossil plants collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899, under this species he said: "The collection contains a single globular cone that is not to be distinguished from this species." Reference is evidently intended to Lesquereux's figure 13. No mention, however, is made of the presence of any foliage, which resembles very closely that of certain specimens with small leaflets, referred to *Sequoia langsdorfii*, such as are depicted in this paper in figures 2–4, plate 15, as may be seen by comparison with Lesquereux's figures 11, 12 of *S. heerii*.

Sequoia langsdorfii (Brongniart) Heer

Plate 9, figures 1a, 2, 4b; plate 10, figures 2b, 3a; plate 12, figures 2–5; plate 13, figures 1, 4a; plate 14; plate 15, figures 1–5, 6; plate 32, figure 1b; plate 33, figure 1c; plate 86, figure 2b; plate 108, figure 2; plate 110, b

Sequoia langsdorfii (Brongniart) Heer, Flora tertiaria Helvetiae, vol. 1, p. 54, pl. 20, figs. 2a–2c; pl. 21, figs. 4a–4g, 1855; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 23, pl. 1, figs. 10, 10b, 1869.
Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., pp. 202, 203, 1861.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 213, 1894; Geol. Soc. America Bull., vol. 5, p. 578, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 878, 1896.
Taxites langsdorfii Brongniart, Dict. sci. nat., vol. 57, p. 111 (108), Paris, 1828.

This widely distributed and abundant species, in one or another of its several forms or varieties, is represented in several Alaskan collections of Tertiary plants, ranging from southeastern Alaska to the Alaska Peninsula, and it was one of the first species recognized in the early studies of the fossil flora of Alaska, by Goeppert,[44] Heer,[45] and Knowlton.[46]

A great diversity of forms have been included in the species, to some of which varietal names have been given. Figures 1a and 2 on plate 9 are apparently referable to var. *acuta* Heer;[47] figures 3–5 on plate 12 appear to be equivalent to var. *angustifolia* Heer,[48] and figure 1 on plate 13 may be compared with var. *striata* Heer.[49] Surficially certain specimens are hardly to be distinguished from specimens of *Taxodium tinajorum* Heer and *T. dubium* (Sternberg) Heer.

The difficulty of differentiating the species was recognized by Heer[50] in his discussion of *Sequoia langsdorfii*, where he remarks that "die beblätterten Zweige sehen dem *Taxodium dubium* tauschend ähnlich und können leicht damit verwechselt werden."

Comparison should also be made with *Taxites rosthorni* Unger,[51] from the Tertiary of Europe. Unger notes the close similarity to "*Taxites langsdorfii*."

A fragment in connection with which the specific identity may be questioned is depicted in our figure 4a on plate 13, where it is closely associated with similar twigs that are apparently referable to species of *Taxodium*.

A specimen that includes a number of small twigs with short leaves is shown in plate 14, and others in figures 1–5 in plate 15. The difference in size between the smallest of these and the large specimens shown

[44] Goeppert, H. R., op. cit., p. 202 (west shore of Cook Inlet, "Landzunge Taketschek oder Osipnago" [locality not identified]); p. 203 (Unga Island, west shore of "Saharoschen Bucht" [Zachareffskaia or Zachary Bay]).

[45] Heer, Oswald, op. cit. (Flora fossilis alaskana), p. 23 (east shore of Cook Inlet, "Sinus Anglorum" [English Bay or Port Graham] and Ninilchik; "Insula Kuju" [Kuiu Island], "Archipelagus Indianorum" [Alexander Archipelago]).

[46] Knowlton, F. H., op. cit. (U. S. Nat. Mus. Proc.), p. 213 (Herendeen Bay; op. cit. (U. S. Geol. Survey 17th Ann. Rept.), p. 878 ("Cape Douglas ash beds, and Chignik Bay mine," Alaska Peninsula).

[47] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 61, pl. 12, figs. 6, 7; pl. 14, fig. 1, 1876.

[48] Idem, p. 61, pl. 12, figs. 3b, c, 8b, 9; pl. 13, figs. 1–3, 8.

[49] Idem, p. 60, pl. 12, figs. 3a, 5a, 8a; pl. 13, fig. 7.

[50] Heer, Oswald. Flora tertiaria Helvetiae, vol. 1, p. 54, Winterthur, 1855.

[51] Unger, Franz, Chloris protogaea, p. 83, pl. 21, figs. 4–6, Leipzig. 1847.

in plates 12 and 13 might seem to preclude the probability that they could all belong to the same species; but every possible intermediate gradation in size may be found in the collections, and any attempt at differentiation would merely result in adding to the already lengthy list of overlapping varietal names.

Localities: West side of Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 9, fig. 1a; pl. 13, fig. 4a). Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 9, fig. 2; pl. 12, figs. 4, 5). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 9, fig. 4b; pl. 10, fig. 2b; pl. 14). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 10, fig. 3a; pl. 13, fig. 1; pl. 15, figs. 4, 5; pl. 33, fig. 1c). Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186) (pl. 12, fig. 2). West side of Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 962); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3524) (pl. 12, fig. 3). Bryant Creek, upper Yukon River region (original no. 3AP350); collected by L. M. Prindle in 1903 (lot 3229) (pl. 15, fig. 1). Cape Douglas, Alaska Peninsula, east coast of back bay, between cabin and neck of cape (original no. 11); collected by R. W. Stone in 1904 (lot 3547) (pl. 15, figs. 2, 3). Cape Douglas, Alaska Peninsula, middle one of three small coves on east side of cape; collected by R. W. Stone in 1904 (lot 5939) (pl. 32, fig. 1b). Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298) (pl. 15, fig. 6). Zarembo Island, southeastern Alaska (original no. W16); collected by A. F. Buddington in 1921 (lot 7518) (pl. 108, fig. 2). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 110, b). Ninilchik, Matanuska-Cook Inlet region. West shore of Cook Inlet, Matanuska-Cook Inlet region. Keku Island, southeastern Alaska. Unga Island, Alaska Peninsula region.

Sequoia spinosa Newberry

Sequoia spinosa Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 504, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 21, pl. 53, figs. 4, 5, 1898.

All that we know of this species, so far as any published records are concerned, is included in the illustrated description by Newberry, based upon specimens collected by Captain Howard, U. S. N.[52] at Cook Inlet. The specimens figured include fragments of leafy twigs (op. cit., fig. 4; U. S. Nat. Mus. no. 7119) and a cone (op. cit., fig. 5; U. S. Nat. Mus. no. 7121).

[52] This was Capt. W. A. Howard, of the U. S. Revenue Cutter Service, according to a communication received from Capt. Commandant E. P. Bertholf, of that service, dated February 17, 1912. The communication also includes the following additional information: "Shortly after the cession of Alaska to the United States in 1867 the revenue cutter *Lincoln,* under command of Capt. J. W. White, * * * was dispatched to Alaska for the purpose of obtaining information relating thereto, and Capt. W. A. Howard was in general charge of the expedition."

Sequoia (cone)

Sequoia (cone), Knowlton, Alaska, vol. 4, p. 152, pl. 22, fig. 1, Harriman Alaska Expedition, 1904.

In his discussion of this specimen Knowlton said:

The long, thick, apparently naked peduncle is the same as that in *Sequoia heerii,* and this may belong to that species, but I am not certain from the section through the middle of the cone as to the shape of the scales, and it seems best to consider it as different, at least for the present.

The specimen (U. S. Nat. Mus. no. 30068) was collected by De Alton Saunders in 1899, at Kukak Bay, Alaska Peninsula.

Genus TAXODIUM L. C. Richard

Taxodium crassum Hollick, n. sp.

Plate 16, figure 9; plate 64, figure 4b

Leafy twigs with crowded, distichously arranged oblong to linear oblong-lanceolate, blunt-tipped leaflets that make angles of about 45° with the supporting twig.

This specimen is clearly a *Taxodium,* as indicated by the method of attachment of the leaflets. The leaflets are crowded and relatively broad for their length, approximating 1.5 millimeters in width. The lower ones are oblong and about 5 millimeters in length, the upper ones about 10 millimeters in length and linear oblong-lanceolate, all with rounded or blunt apices.

In general appearance this species is very suggestive of certain specimens from the Eocene of the Isle of Wight, England, described and figured by Gardner[53] and referred to *Podocarpus elegans* (De la Harpe);[54] but definite identification would be impossible without having the actual specimens for critical examination and comparison.

Localities: West side of Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 962); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3524) (pl. 16, fig. 9) Kupreanof Island, Hamilton Bay, southeastern Alaska, collected by C. W. Wright in 1904 (lot 7474).

Taxodium dubium (Sternberg) Heer

Plate 16, figure 5; plate 51, figure 5a

Taxodium dubium (Sternberg) Heer, Naturf. Gesell. Zurich Mitt., vol. 3, p. 92, 1853; Flora tertiaria Helvetiae, vol. 1, p. 49, pl. 16, fig. 19; pl. 17, figs. 5–15; pl. 21, fig. 3, Winterthur, 1855; K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., pp. 202, 203, 204, 1861.

[53] Gardner, J. S., A monograph of the British Eocene flora, vol. 2, Gymnospermae, p. 50, pl. 8, figs. 1–16, London, 1883.

[54] = *Cupressites elegans,* De la Harpe, Philippe, and Salter, J. W., Notes on the Eocene flora of Alum Bay, in Bristow, H. W., Geology of the Isle of Wight: Geol. Survey Great Britain Mem., Expl. sheet 10, p. 111, pl. 5, fig. 3, 1862.

Phyllites dubius Sternberg, Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, pt. 3, p. 39, pl. 36, fig. 3, Leipzig, 1823.
Taxodium distichum miocenum Heer, Miocene baltische Flora, p. 18, pl. 2, figs. 1–5, 6a, b, c, d, 7a, 8, 9, 9b, 10, 10b, 11a, b, 12–16, 17a, b, c, 18a, b, 19–25, 25b, 26; pl. 3, figs. 6, 7, Königsberg, 1869; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 21, pl. 1, fig. 6; pl. 3, fig. 11c; pl. 4, figs. 5b, c, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 214, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 7, p. 878, 1896; Alaska, vol. 4, p. 152, Harriman Alaska Expedition, 1904.
Newberry, U. S. Geol. Survey Mon. 35, p. 22, pl. 52, fig. 2 (excl. pl. 51, fig. 3 in part; pl. 52, figs. 3 and 4 in part; pl. 55, fig. 5 in part), 1898.

Under the names *Taxodium dubium* and *Taxodium distichum miocenum* a considerable diversity of leaf forms have been described and figured from time to time by various authors, some of which appear to be hardly referable to the species. The type of the species, *Phyllites dubius* Sternberg, has narrow, pointed leaves, similar to those of our specimens depicted in figure 5 on plate 16, whereas specimens of very different appearance, with short, occasionally spatulate, rounded or blunt-tipped leaves, have also been referred to the species. Examples of the latter form, from the Tertiary of Cook Inlet, Alaska, were described and figured by Newberry [55] under the name *Taxodium distichum miocenum* and are discussed in this paper on page 51, under *Glyptostrobus europaeus*. Newberry also figured a specimen of average, normal characters, from the same locality.[56]

Specimens collected by Lt. Peter Doroschin were listed by Goeppert [57] from the following localities in Alaska: West shore of Cook Inlet; near the village of Ninilchik, on the west shore of Kenai Peninsula [Matanuska-Cook Inlet region]; on "landzunge Taketschek oder Osipnago" [locality not identified], Alaska Peninsula; "nähe der Katmäschen" [near Mount Katmai?], Alaska Peninsula; southwest coast of Nukhalilek Bay [locality not identified], on the east shore of Alaska Peninsula; and Hudsnoi [Admiralty?] Island.

The specimens described and figured by Heer [58] include those collected by Doroschin at Ninilchik and others collected by Hjalmar Furuhjelm at English Bay [Port Graham], Kenai Peninsula, and Indian [Alexander] Archipelago, near Sitka. Heer's specimens from Port Graham and Alexander Archipelago (pl. 1, fig. 6; pl. 4, figs. 5b, c) are identical with ours, but the one from Ninilchik (pl. 3, fig. 11c) is comparable with our specimen depicted in figure 1 on plate 16, which is referred to the variety *normale*. Knowlton [59] also listed specimens collected by C. H. Townsend at Herendeen Bay, Alaska Peninsula; by W. H. Dall at the Sepphagen mine and De Groff tunnel, Kootznahoo Inlet, Admiralty Island; and by De Alton Saunders at Kukak Bay, Alaska Peninsula.

In one or another of its forms the species may be found included in Tertiary floras throughout the Eurasian and North American continents and Australasia, although a number of the identifications are probably erroneous, as many specimens are very difficult to distinguish from certain forms of *Sequoia langsdorfii* (Brongniart) Heer, with which it is often found associated. Toward the end of the Tertiary period it appears to have passed into the living species *Taxodium distichum* and *T. ascendens*, the only surviving representatives of the genus, which are now confined to a relatively small area in the southeastern and southern United States and northeastern Mexico.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 16, fig. 5). Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 51, fig. 5a). Cook Inlet, no definite locality, Matanuska-Cook Inlet region. Kuiu Island, southeastern Alaska.

Taxodium dubium longifolium Massalongo

Plate 16, figure 4

Taxodium dubium longifolium Massalongo, in Massalongo and Scarabelli, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 150, pl. 6, fig. 7; pl. 40, fig. 3, Imola, 1859.

This specimen apparently represents what Massalongo regarded as a long, narrow-leaved form or variety of *Taxodium dubium*, based upon material from the Tertiary of Sinigaglia, Italy, similar to *Taxodium angustifolium* Heer,[60] from the Tertiary of Spitsbergen. Whether or not it should be given specific rank is largely a matter of individual opinion, but it is at least sufficiently distinct in general appearance to warrant a varietal designation.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

[55] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 22, pl. 51, fig. 3 in part (U. S. Nat. Mus. no. 7107); pl. 52, figs. 2, 3 (U. S. Nat. Mus. no. 7110), fig. 4 in part (U. S. Nat. Mus. no. 7109), 1898. In the text on page 22 the locality for the Alaskan specimens of *Taxodium* is erroneously given as "Birch Bay, Washington."

[56] Idem, pl. 52, fig. 2 (U. S. Nat. Mus. no. 7118).

[57] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., pp. 202, 203, 204, 1861.

[58] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 21, pl. 1, fig. 6; pl. 3, fig. 11c; pl. 4, figs. 5b, c, 1869.

[59] Knowlton, F. H., A review of the fossil flora of Alaska: U. S. Nat. Mus. Proc., vol. 17, p. 214, 1894; Report on the fossil plants collected in Alaska in 1895; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 878, 1896; Fossil plants from Kukak Bay: Alaska, vol. 4, p. 152, Harriman Alaska Expedition, 1904.

[60] Heer, Oswald, Die fossile Flora der Polarländer: Flora fossilis arctica, vol. 1, p. 156, pl. 30, figs. 1a, 2, 1868.

Taxodium dubium normale Massalongo

Plate 13, figure 4b; plate 16, figure 1

Taxodium dubium normale Massalongo, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 150, pl. 5, fig. 11; pl. 6, figs. 1, 5, 10; pl. 40, fig. 4, Imola, 1859.

Our specimens appear to be identical with the variety of *Taxodium dubium* from the Tertiary of Sinigaglia, Italy, to which Massalongo gave the above name, and our figure 1, on plate 16, may be especially compared with the specimen depicted in his figure 1, plate 6, with which its identity can hardly be doubted.

The variety differs but little from the species to which it is referred, except in size, and yet it possesses certain distinctive characters that may be discerned better than they can be described, when comparison is made with figures of specimens typical of the species as originally defined.

Certain of the specimens from Grinnell Land, described and figured by Heer [61] as *Taxodium distichum miocenum*, and others from Greenland described and figured by the same author,[62] appear to be referable to this variety, although Heer did not recognize any varietal distinction and merely remarked on the variability in the size of the leaves.

Localities: West side of Kachemak Bay, Kenai Peninsula, at entrance to Troublesome Gulch, Matanuska-Cook Inlet region (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 13, fig. 4b). Fairbanks district, Tanana region (original no. 31); collected by L. M. Prindle and H. B. Blair in 1906 (lot 7476) (pl. 16, fig. 1).

Taxodium occidentale Newberry

Plate 16, figure 3; plate 109, figures 9, 10

Taxodium occidentale Newberry, Boston Jour. Nat. Hist., vol. 7, p. 576, 1863; Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 45, 1868. Illustrations of Cretaceous and Tertiary plants, pl. 11, figs. 1–3, U. S. Geol. and Geog. Survey Terr., 1878; U. S. Geol. Survey Mon. 35, p. 23, pl. 26, figs. 1–3; pl. 55, fig. 5 in part, 1898.
Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

These fragments of a broad-leaved *Taxodium* appear to be identical with the specimens from the Fort Union formation of Montana to which Newberry gave the above specific name. The species does not appear to have been heretofore figured except by Newberry, although it is recorded by Knowlton [63] from the Lance formation at localities in North Dakota, South Dakota, Montana, and Wyoming, and by Penhallow [64] from Tertiary localities in British Columbia.

Attention should be called, however, to a certain figure of *Taxites olriki* Heer [65] from the Eocene of Greenland, which is practically indistinguishable from *Taxodium occidentale* Newberry. It was recognized by Heer as a peculiar form, and he referred to it as "eine eigenthümliche Varietat" of his *Taxodium olriki.*

Localities: Matanuska coal field, Matanuska-Cook Inlet region, Kings River, east bank, at coal camp 7 miles above mouth; collected by F. J. Katz in 1910 (lot 5895) (pl. 16, fig. 3). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 109, fig. 9). Nenana coal field, Tanana region, California Creek, 0.47 mile S. 42° W. of northeast corner of sec. 15, T. 98, R. 6 W. (original no. 2); collected by G. C. Martin and R. M. Overbeck in 1916 (lot 7261) (pl. 109, fig. 10).

Taxodium tinajorum Heer

Plate 10, figure 4; plate 13, figures 2, 3, 4c, 5, 6; plate 18, figure 5b

Taxodium tinajorum Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 22, pl. 1, figs. 1–5a, b, 1869.
Eichwald, Geognostisch-palaeontologische Bemerkungen über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 116, pl. 4 [VI], fig. 4, St. Petersburg, 1871.
Knowlton, Alaska, vol. 4, p. 152, Harriman Alaska Expedition, 1904.

Specimens that appear to be referable to this species are included in several of the collections from Alaska, but they are exceedingly difficult to distinguish from certain forms of *Sequoia langsdorfii* (Brongniart) Heer, as may be seen by comparison with specimens referred to that species depicted in figures 3a and 4 on plate 10 and figure 1 on plate 13 of this paper.

The type specimens of the species were collected by Hjalmar Furuhjelm at "English Bay" [Port Graham], Kenai Peninsula, and other specimens were identified by Heer [66] from the Tertiary of Spitsbergen and Siberia.

The specimen described and figured by Eichwald was regarded by the author as a variety and is designated "*Taxodium tinajorum* Heer var." and described as follows: "Die hier von mir abgebildete Art unterscheidet sich etwas von der typischen Form durch schmälere Nadeln, die viel weiter von einander abstehen und mit einem deutlichen Mittelnerven versehen sind." The specimen upon which this description was based was collected by Peter Doroschin at "Dorfe

[61] Heer, Oswald, Die Miocene Flora des Grinnell-Landes: Flora fossilis arctica, vol. 5, no. 1, p. 23, pl. 2, figs. 3, 9, 1878.

[62] Heer, Oswald, Die tertiäre Flora von Grönland: Idem, vol. 7, p. 60, pl. 88, fig. 2b, 1883.

[63] Knowlton, F. H., The stratigraphic relations and paleontology of the "Hell Creek beds", "*Ceratops* beds", and equivalents, and their reference to the Fort Union formation: Washington Acad. Sci. Proc., vol. 11, pp. 189, 195, 202, 203, 211, 214, 1909; Further data on the stratigraphic position of the Lance formation ("*Ceratops* beds"): Jour. Geology, vol. 19, p. 369, 1911.

[64] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, 1908.

[65] Heer, Oswald, Nachträge zur Miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 1, p. 16, pl. 1, fig. 9, 1874.

[66] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 57, pl. 25, fig. 14, 1876; Beiträge sur fossilen Flora Sibiriens und des Amurlandes—IV, Tertiäre Pflanzen vom Tschirimyifelsen an der Lena: Idem, vol. 5, no. 2, pt. 33, pl. 8, figs. 30a, 38, 1878.

Niniltschick" [village of Ninilchik], on the west shore of Kenai Peninsula.

Knowlton remarked, in connection with material collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, that "there are several specimens that seem to belong to this species, although it is difficult to separate them in all cases from the former species" [*Taxodium distichum miocenum* Heer = *Taxodium dubium* (Sternberg) Heer]. The resemblance to certain forms of this species is as close as their mutual resemblance to certain forms of *Sequoia langsdorfii*, and the specific determinations of a number of figured specimens of these three species should be recognized merely as expressions of opinion based upon what may be regarded as the weight of evidence in one direction or another.

Localities: Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 10, fig. 4). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. IV); collected by W. W. Atwood in 1907 (lot 4391) (pl. 13, fig. 2; pl. 18, fig. 5b). Kachemak Bay, Kenai Peninsula, near entrance to Fritz Creek, Matanuska-Cook Inlet region (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131) (pl. 13, fig. 3). Kachemak Bay, Kenai Peninsula, at entrance to Troublesome Gulch, Matanuska-Cook Inlet region (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 13, fig. 4c). North side near entrance to Chinitna Bay, Matanuska-Cook Inlet region (original no. 922c); collected by T. W. Stanton and G. C. and Lawrence Martin in 1904 (lot 3505) (pl. 13, fig. 5). Cook Inlet, west shore, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. I); collected by C. A. Weaver in 1906 (lot 4130) (pl. 13, fig. 6).

Taxodium sp. Grewingk

Taxodium sp. Grewingk, Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, pp. 114, 364, 1850.

The generic name only is given by Grewingk to specimens from two localities—Tschugatsk [Kenai] Peninsula [Matanuska-Cook Inlet region] and Unalaska Island [Alaska Peninsula]. It is probable, however, that they are referable to *Taxodium dubium* in one or another of its varieties or forms.

Taxodium sp. Heer

Taxodium sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

Under the above generic designation Heer listed a specimen collected by Hjalmar Furuhjelm at English Bay [Port Graham], Kenai Peninsula, in the Matanuska-Cook Inlet region. He does not subsequently refer to it, however, and it cannot be definitely identified; but it may be the specimen to which he referred in the following words:[67] "In ramulis nonnullis folia sunt valde approximata * * *, in aliis in eodem lapide (tab. I, fig. 6) distantia."

[67] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 22, 1869.

Genus GLYPTOSTROBUS Endlicher

Glyptostrobus europaeus (Brongniart) Unger

Plate 10, figure 3b; plate 17, figures 1–6; plate 18, figures 1–5a; plate 19, figures 1, 2; plate 104, fig. 7b; plate 109, figure 11

Glyptostrobus europaeus (Brongniart) Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 5, p. 435, 1850.

Glyptostrobus europaeus (Brongniart) Heer, Flora tertiaria Helvetiae, vol. 1, p. 51, pl. 19, figs. 1–6; pl. 20, figs. 1a–f, Winterthur, 1855; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 22, pl. 1, figs. 7b–f; pl. 3, figs. 10, 10b, 11a, b, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 214, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 879, 1896.

Taxodium europaeum Brongniart, Annales sci. nat., Botanique, vol. 30, p. 175, 1833.

Glyptostrobus ungeri Heer?, Gartenflora, vol. 2, p. 292, pl. 65, fig. 2, 1853; Flora tertiaria Helvetiae, vol. 1, p. 52, pl. 18, figs. 1–17; pl. 21, figs. 1a–1e, Winterthur, 1855.

Glyptostrobus europaeus ungeri Heer?, Flora tertiaria Helvetiae, vol. 3, p. 159, pl. 146, figs. 13, 14, Winterthur, 1859.

Under the names *Glyptostrobus europaeus*, *G. ungeri*, and *G. europaeus ungeri*, a wide diversity of forms are included that are impossible to differentiate satisfactorily into distinct species or varieties; and leafy twigs that differ greatly from one another in surficial characters are found either attached or so closely associated that their specific identity cannot be doubted. Probably certain of the remains that from time to time have been included under one or another of the above names, represent erroneous identifications, but evidence is ample that a heterophyllous conifer similar to the living *Glyptostrobus heterophyllus* Endlicher, of eastern Asia, was an abundant element in the Tertiary floras of the Old and New Worlds, which is most commonly known, in one or another of its forms, under the name *Glyptostrobus europaeus*. The question of the specific or varietal status of *Glyptostrobus ungeri*, as distinct from *G. europaeus*, was discussed at some length by Velenovsky,[68] in connection with specimens from the Tertiary of Bohemia, and his conclusion is that—

> Es ist deswegen unmöglich (wenigstens in unserem Fundorte) *Glyptostrobus ungeri* als eine Art oder Varietät zu unterscheiden, obzwar sich auch hier eine Menge von beblätterten einjährigen Zweigen vorfindet, welch also sämmtlich nur zum *Glyptostrobus europaeus* angehören.

Nearly every author who has studied these forms has also expressed more or less uncertainty in regard to the affiliations or identity of certain specimens, and it must be admitted that the large amount of new material collected in Alaska has resulted in increasing rather than in decreasing the difficulty of satisfactorily delimiting or expanding the specific definition, and of

[68] Velenovsky, Josef, Die Flora aus den ausgebrannten tertiären Letten von Vrsovic bei Laun: K. böhm. Gesell. Wiss. Abh., ser. 6, vol. 11 (Math.-naturwiss. Cl., no. 1), p. 15, pl. 1, figs. 21–26, 1881.

differentiating certain of the forms from species in other genera. The leafy twigs shown in figures 1, 2, 5, and 6, plate 17, are difficult to distinguish from similar remains that have been referred to *Taxodium dubium*, and there is little doubt, for example, that if the leafy twig depicted in figure 1, above mentioned, was found by itself, or associated with remains of undoubted *Taxodium dubium*, it would be referred to that species. Specimens from Cook Inlet, Alaska (see p. 49) that are undoubtedly specifically identical with the specimen represented by the figure last mentioned were described and figured by Newberry [69] as *Taxodium distichum miocenum* Heer (=*T. dubium* (Sternberg) Heer), and if Newberry's identification is correct then we must relegate to that species the analogous forms that are included in this paper under *Glyptostrobus europaeus*. A similar leafy twig from the Tertiary of Bohemia that is apparently specifically identical with our figure 1 was depicted by Velenovsky [70] and described as *Taxodium dubium;* and Laurent [71] described and figured a similar twig from the Tertiary of France, referred it provisionally to *Taxodium dubium*, discussed its close resemblance to *Glyptostrobus europaeus*, and ended with the remark: "Comme nous avons toujours observé ces rameaux detachés, l'étude des échantillons de Menat n'apporte aucune preuve pour décider de cette question. On ne peut que poser les données du problème."

Certain of the most delicate of our twigs, such as are shown in the figures on plate 18, are very suggestive of specimens that have been referred to the genus *Widdringtonia*, especially *W. helvetica* Heer,[72] and critical examination is necessary in order to recognize any characters that might serve to differentiate the two species.

Under the name *Glyptostrobus ungeri?* Heer an excellent representation of the species, based upon specimens from the Tertiary beds of Florissant, Colo., was depicted by Lesquereux,[73] in which the growing twigs, with relatively broad leaves, are shown attached to the older branchlets with scalelike and aciculate leaves.

In one or another of its forms this species is one of the most abundant elements in the Tertiary coniferous flora of Alaska. It is represented in at least twelve of our collections, distributed between Alaska Peninsula and southeastern Alaska, and it was one of the first species recognized in the earlier collections made in the region, as follows:

"Kuju" [Kuiu] Island, "Indian" [Alexander] Archipelago. Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 22, pl. 1, figs. 7b–f, 1869. Collected by Peter Doroschin in 1861.

"Neniltschik" [Ninilchik], east shore of Cook Inlet. Idem, pl. 3, figs. 10, 10b, 11a, b. Collected by Hjalmar Furuhjelm in 1866.

Herendeen Bay, Alaska Peninsula. Knowlton, F. H., A review of the fossil flora of Alaska, with descriptions of new species: U. S. Nat. Mus. Proc., vol. 17, p. 214, 1894. Collected by C. H. Townsend in 1890.

De Groff tunnel, Admiralty Island, Kootznahoo Lagoon. Knowlton, F. H., U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 879, 1896. Collected by W. H. Dall and others in 1895.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 10, fig. 3b). O'Brien coal claim, three-quarters of a mile south of Matanuska River, 14 miles above mouth of Chickaloon River, Matanuska-Cook Inlet region; collected by G. A. Parks in 1911 (lot 6289) (pl. 16, fig. 6b). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4382) (pl. 17, figs. 1, 2; pl. 104, fig. 7b). Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298) (pl. 17, fig. 3; pl. 18, fig. 1). Matanuska River 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 17, figs. 4–6). Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 141); collected by R. S. Tarr in 1905 (lot 3879) (pl. 18, figs. 2, 3). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 18, fig. 4). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. IV); collected by W. W. Atwood in 1907 (lot 4391) (pl. 18, fig. 5a). South of pond on top of mountain between Kings River and Youngs Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by G. C. Martin and F. J. Katz in 1910 (lot 5898) (pl. 19, figs. 1, 2). Cliff 1 mile south of small bay on south shore of King Salmon Lake, Alaska Peninsula (original no. P. 21); collected by W. R. Smith in 1922 (pl. 109, fig. 11).

Genus WIDDRINGTONIA Endlicher

Widdringtonia sp. Heer

Widdringtonia sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 66, 1868.

The specimen referred to this genus by Heer was collected by Hjalmar Furuhjelm on "Keku Island," southeastern Alaska. The genus was not subsequently mentioned by Heer in his Flora fossilis alaskana,[74] but it is possible that a specimen there referred to *Glyptostrobus europaeus* [75] and credited to Kuju [Kuiu] Island may represent what was originally identified as a species of *Widdringtonia*, similar to *W. helvetica* Heer.[76] Certain specimens of the two

[69] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 22, pl. 51, fig. 3 in part; pl. 52, figs. 3 in part, 4 in part, 1898.

[70] Velenovsky, Josef, Die Flora aus den ausgebrannten tertiären Letten von Vrsovic bei Laun: K. böhm. Gesell. Wiss. Abh., ser. 6, vol. 11 (Math.-naturwiss. Cl., no. 1), p. 14, pl. 1, fig. 27, 1881.

[71] Laurent Louis, Flore fossile des schistes de Menat (Puy-de-Dôme): Mus. hist. nat. Marseille Annales, vol. 14, p. 69, pl. 5, fig. 6, 1912.

[72] Heer, Oswald, Gartenflora, vol. 2, p. 292, pl. 65, fig. 3, 1853; Flora tertiaria Helvetiae, vol. 1, p. 48, pl. 16, figs. 2–17, 1855.

[73] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 139, pl. 22, figs. 1–6a, 1883.

[74] Heer, Oswald, Flora fossilis arctica, vol. 2, no. 2, 1869.

[75] Idem, p. 22, pl. 1, fig. 7b, d.

[76] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 48, pl. 16, fig. 3, Winterthur, 1855.

genera are difficult to differentiate, and in his discussion of the species last mentioned Heer remarked that "die jungen Zweige sehen denen des *Glyptostrobus ungeri* sehr ähnlich und sind nur mit Mühe zu unterscheiden."

Attention may also be called to the similarity in general surficial appearance between *Widdringtonia* and *Juniperites baccifera* Unger,[77] from the Tertiary of Europe, and to note that Unger [78] discussed *Taxodium europaeum* Brongniart (=*Glyptostrobus europaeus* (Brongniart) Heer and *G. ungeri* Heer) in that connection.

Genus THUITES Sternberg

Thuites ehrenswärdi Heer

Plate 20, figure 9

Thuites ehrenswärdi Heer, Bibliothèque universelle, vol. 34, p. 535, Lausanne, 1869; Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 36, pl. 2, figs. 25, 25b, 26b, 1870; Die Miocene Flora des Grinnell-Landes: Idem, vol. 5, no. 1, p. 22, pl. 2, fig. 10c, 1878; Miocene Flora der Insel Sachalin: Idem, vol. 5, no. 3, p. 23, pl. 1, figs. 12, 12b, 12d, 13, 13b, 14, 1878.

This little conifer appears to be identical with Heer's species from the Tertiary of Spitsbergen, Grinnell Land, and the island of Sakhalin; and Palibin [79] has described and figured what appear to be fragmentary remains of the species from the Tertiary of Siberia.

Heer was in some doubt as to the correctness of the generic reference to *Thuites*, suggesting its possible affinity with *Chamaecyparis*, and giving to the Spitsbergen specimen the name *Thuites* (*Chamaecyparis?*) *ehrenswaerdi;* but subsequently the second generic appellation was dropped. It should also be noted that the identity of the specimen from Grinnell Land is questioned by Heer, and this specimen may perhaps be disregarded.

A species which is exceedingly difficult to differentiate from *Thuites ehrenswärdi* and which may not be ignored in making comparisons is *Biota borealis* Heer,[80] from the Tertiary of Greenland; and it is significant that Heer originally identified this species as *Thujopsis europaeus* Saporta.[81]

In any event, however individual opinion may differ in regard to the validity of these species, the identity of our specimen with one or the other of the Arctic forms can not be doubted.

[77] Unger, Franz, Chloris protogaea, p. 80, pl. 21, figs. 1–3, Leipzig, 1847.

[78] Idem, p. 81.

[79] Palibin, J. von, Pflanzenreste vom Sichota-Alin Gebirge: Russ. k. mineral. Gesell. Verh., ser. 2, vol. 42, Lief. 1, p. 42, pl. 2, figs. 2, 3, 1904.

[80] Heer, Oswald, Nachträge zur Miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 3, p. 7, pl. 1, figs. 13a, b, 14, 15a, 16–23, 23b, 24–26, 26b, 27–29, 1874; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 1, no. 2, p. 9, pl. 3, figs. 5, 5b, 1880.

[81] Heer, Oswald, Miocene Fora von Nordgrönland: Idem, vol. 1, p. 90, pl. 50, figs. 11a, 11b, 11c, 1868.

There also appears to be but little doubt that *Thuites* sp. Knowlton,[82] from the Tertiary of Oregon, is to be classed in the same specific category.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

Thuites (Chamaecyparis) alaskensis Lesquereux

Thuites (*Chamaecyparis*) *alaskensis* Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 445, pl. 6, figs. 7–9, 1882 [1883].

Locality: Coal Harbor, Unga Island, Alaska Peninsula; collected by W. H. Dall in 1880 (U. S. Nat. Mus. no. 1376).

Coniferous wood

Coniferous wood, Grewingk, Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, p. 364, 1850.

Grewingk mentioned the occurrence of fossil coniferous wood on Unga Island, south of Alaska Peninsula—apparently similar material to that to which he had previously referred (p. 170) as "bituminöses Holz."

Class ANGIOSPERMAE

Subclass MONOCOTYLEDONAE

Order PANDANALES

Family SPARGANIACEAE

Genus SPARGANIUM Linnaeus

Sparganium sp. Heer

Sparganium sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 66, 1868.

This generic identification, based upon a specimen collected by Hjalmar Furuhjelm at the Ninilchik River, Kenai Peninsula, in the Matanuska-Cook Inlet region, was not subsequently mentioned by Heer in his Flora fossilis alaskana [83] and he probably decided it to be erroneous and referred the specimen to some other monocotyledonous genus, without reference to the original identification.

Order NAIADALES

Family NAIADACEAE

Genus CAULINIA Wildenow

Caulinia laevis (Goeppert) Goeppert

Caulinia laevis (Goeppert) Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt., Naturwiss. u. Med., Abh., p. 202, 1861.

Caulinites laevis Goeppert, Palaeontographica, vol. 2, p. 263 [7], pl. 33 [1], fig. 1, 1852.

The Alaskan specimen described by Goeppert in 1861 under the above name was collected by Lt. Peter Doroschin at Ninilchik, on the west side of Kenai

[82] Knowlton, F. H., Fossil flora of the John Day Basin: U. S. Geol. Survey Bull. 204, p. 26, pl. 1, fig. 3, 1902.

[83] Heer, Oswald, Flora fossilis arctica, vol. 2, no. 2, 1869.

Peninsula in the Matanuska-Cook Inlet region. Goeppert apparently described it as a new species, under the genus *Caulinia*, although he had previously, in 1852, described similar fossil plant remains from the Miocene of North Germany under the name *Caulinites*, using the same specific name for each. Whether or not it was his intention to regard them as specifically identical I have not been able to determine definitely but have assumed that such was the case.

The generic name *Caulinia* has been applied to at least four totally different genera of living plants, in the Naiadaceae, Leguminosae, Algae, and Haloragidaceae; the genus *Caulinites* Brongniart [84] was established to include fossil plant stems or rhizomes assumed to be allied to *Caulinia* of the Naiadaceae. Goeppert accepted this as the taxonomic status of *Caulinites laevis* in 1852, but later he was apparently in doubt in regard to it, and in his discussion of *Caulinia laevis* in 1861 he compared the Alaskan and European specimens and said " Gehört vielleicht zu *Phragmites oeningensis* Heer ",[85] a species whose relationship to the grasses can hardly be questioned. The probability is that *Caulinia laevis* may be included, with other similar remains of rhizomes, culms, and leaves, in one or another of the comprehensive grass or sedge genera *Culmites*, *Phragmites*, *Arundo*, *Cyperites*, etc., and probably with either *Phragmites alaskana* Heer (see p. 55) or with *Arundo pseudogoepperti* Berry (see opposite column); but as long as the generic name *Caulinia* is retained it may be kept in its proper systematic position in the Naiadales.

Order ALISMALES

Family ALISMACEAE

Genus SAGITTARIA Linnaeus

Sagittaria pulchella Heer

Sagittaria pulchella Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 25, pl. 1, fig. 15, 1869.

This species, founded upon fragmentary remains of what are apparently leaves of a monocotyledonous plant, was collected by Hjalmar Furuhjelm at Ninilchik, Kenai Peninsula, in the Matanuska-Cook Inlet region. It has not been identified in any of the collections subsequently made in Alaska.

Sagittaria sp. Lesquereux

Sagittaria sp. Lesquereux, U. S. Nat. Mus. Proc., vol. 10, p. 37, 1887.

This generic identification, without description or illustration, was based, according to Lesquereux, on a specimen (lot 210, U. S. Nat. Mus. no. 2310) collected by E. W. Nelson at Sitka; but Knowlton [86] remarked as follows in regard to it: "I am informed by Mr. Nelson that he never visited Sitka and did not bring back any fossil plants from Alaska. This throws doubt on the specimens so recorded, and their locality and collector remain unknown."

Order POALES (GRAMINALES)

Family POACEAE

Genus ARUNDO Linnaeus

Arundo pseudogoepperti Berry?

Plate 19, figures 3–8; plate 20, figures 1–8; plate 22, figure 4

Arundo pseudogoepperti Berry, U. S. Geol. Survey Prof. Paper 84, p. 134, pl. 24, fig. 7, 1914.

After considerable hesitation I have decided to include all our specimens represented in part by leaves and in part by culms, rhizomes, and scales or glumes in a single species, inasmuch as all but two of the specimens were collected at the same locality and, apparently, from the same layers of matrix.

The species to which they are provisionally referred was founded by Berry upon leaf fragments from the Eocene of Georgia that are indistinguishable from similar fragments represented by figures 5–8, plate 19; but whether or not this species should be regarded as distinct from *Arundo* (*Donax*) *goepperti* (Münster) Heer,[87] an Old World Miocene species, is a question upon which individual opinions may well differ. Berry referred to specimens from the Eocene of Wyoming, provisionally identified by Lesquereux [88] as *Arundo goepperti?*, and remarked:

> These fragments agree fairly well with the European material, but when it is considered that remains of this kind have little to distinguish them specifically, and that these American forms are so far removed geographically from the type forms and occur at a horizon invariably of considerably greater age, the propriety of considering them distinct is obvious. A number of fragments * * * are referred to this species [*A. pseudogoepperti*]. * * * The most that can be said of their botanic relationship is that they represent large marsh grasses analogous, if not intimately related, to the modern genus *Arundo*, to which they are referred as a matter of convenience and long standing usage rather than because of any very definite proof of their relationship.

In agreement with this course of reasoning I have placed the Alaskan material, provisionally, under *Arundo pseudogoepperti*, pending the possible discov-

---

[84] Brongniart, Adolphe, Prodrome d'une histoire des végétaux fossiles, p. 115, 1828; Dict. sci. nat., vol. 57, p. 118, Paris, 1828.

[85] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 64, pl. 22, figs. 5a–5c; pl. 24, figs. 1–10b; pl. 27, figs. 2b, 2b*; pl. 29, fig. 8e, Winterthur, 1855.

[86] Knowlton, F. H., A review of the fossil flora of Alaska: U. S. Nat. Mus. Proc., vol. 17, p. 210, 1894 (footnote).

[87] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 62, pl. 22, figs. 3a, 3b; pl. 23, figs. 1–11, Winterthur, 1855, = *Culmites goepperti* Münster, Georg, Beiträge zur Petrefactenkunde, no. 5, p. 103, pl. 3, figs. 1–3; pl. 4, figs. 1–3, Bayreuth, 1842.

[88] Lesquereux, Leo, An enumeration with descriptions of some Tertiary fossil plants: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, suppl., p. 5, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 86, pl. 8, figs. 3–5, 1878.

ery of more complete material and additional facts of occurrence and distribution, such as may enable a thorough revision to be made of this and other allied genera of fossil monocotyledons.

Leaf fragments considerably narrower than those previously mentioned are shown in figures 3 and 4, plate 19, which may be compared with the figures of specimens from the Eocene of Montana referred to *Phragmites alaskana* Heer by Lesquereux;[89] and doubtless had our specimens not been found closely associated with the broader-leaved fragments they would have been placed under a distinct specific name.

Fragmentary remains with somewhat coarses nervation are shown in our figures 2 and 3, plate 20, which are suggestive of similar material described by various authors as species of *Cyperus*, *Cyperites*, *Typha*, *Iris*, etc. Figure 1, plate 20, apparently represents a culm with well-defined nodes, such as those of *Arundo goepperti* and *Phragmites oeningensis*, as depicted by Heer,[90] and *Arundo reperta* Lesquereux[91] from the Eocene of Wyoming. Figure 3, plate 22, apparently represents a cast of the interior of a culm.

What is apparently a young branch of a rhizome is shown in figure 7, plate 20, which may be compared with *Caulinites digitatus* Watelet,[92] from the Eocene of France, and with similar remains of *Arundo goepperti* as depicted by Heer;[93] and incidentally it is of interest to note that the type of this species, as recognized by Heer, is *Culmites goepperti* Münster,[94] represented entirely by the remains of rhizomes with attached roots.

Roots with fine rootlets attached are represented in figures 4–6, plate 20, which appear to be identical in character with similar remains from the Miocene of Switzerland, referred by Heer[95] to *Phragmites oeningensis* Alex. Braun, and to others from the Miocene of Germany, so referred by Ludwig,[96] and to a specimen of similar character from the Upper Cretaceous of Colorado, referred by Lesquereux[97] to the same species.

[89] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 90, pl. 8, figs. 10–12a, 1878.

[90] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, pl. 23, fig. 2; pl. 24, figs. 1, 2.

[91] Lesquereux, Leo, New species of Tertiary fossil plants briefly described: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1874, p. 311, 1876; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 87, pl. 8, figs. 6–8, 1878.

[92] Watelet, Adolphe, Description des plantes fossiles du bassin de Paris, p. 81, pl. 19, figs. 5–8, Paris, 1866.

[93] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, pl. 23, figs. 8–10, 1855.

[94] Münster, Georg, Beiträge zur Petrefactenkunde, no. 5, p. 103, pl. 3, figs. 1–3; pl. 4, figs. 1–3, Bayreuth, 1842.

[95] Heer, Oswald, Flora tertiaria Helvetiae, vol. 1, p. 64, pl. 22, figs. 5b–e, 1855.

[96] Ludwig, Rudolph, Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-Formation: Palaeontographica, vol. 8, p. 80, pl. 18, figs. 2c, 2d, 1859.

[97] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 90, pl. 8, fig. 2, 1878.

A specimen that appears to represent a large glume or scale is shown in figure 8, plate 20; but it is included in the species without comment or discussion as to its probable nature or affiliation.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 19, figs. 3–8; pl. 20, figs. 2–8). West side of Herendeen Bay, Alaska Peninsula, north of location 19 (original no. 20); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5183) (pl. 20, fig. 1). Matanuska River 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 22, fig. 4).

Genus PHRAGMITES Trinius

Phragmites alaskana Heer?

Plate 109, figure 12

Phragmites alaskana Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 24, pl. 1, figs. 12, 12b, 1869.

This species was based upon a single fragment of a parallel-veined, grasslike leaf, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. It is probably the identical specimen which was originally identified merely as *Phragmites* sp. Heer,[98] as in each instance the collector and the locality are the same. In his discussion of the species Heer referred to its resemblance to *P. oeningensis* Alex. Braun, and said: "*Phragmit. oeningensi* proxima et forte nonnisi varietas." The latter is an Old World Miocene species, and it is open to question whether the Alaska specimens should be regarded as specifically identical with it or as representing a distinct species.

Somewhat similar fragments from the Eocene of Montana were described and figured by Lesquereux[99] and by Ward[1] and were referred to the species; but with the exception of Lesquereux's figure 12 the reference hardly appears to be justified. However, the specific and generic status of most of the fragmentary remains that have from time to time been referred to the genera *Phragmites*, *Arundo*, *Cyperites*, *Iris*, etc., is more or less problematic, and the more the descriptions and figures are studied the more evident it becomes that the group of plant remains to which they belong requires critical study and thorough revision.

Localities: Nenana coal field, Tanana region, Coal Creek just west of Healy Coal Corporation's mine (original no. 23AC7); collected by S. R. Capps in 1923 (lot 7622) (pl. 109, fig. 12). Port Graham, Matanuska-Cook Inlet region.

[98] Heer, Oswald, Utdrag ur ett bref af Prof. Oswald Heer rörande fossila vexter från Nordvestra Amerika: K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

[99] Lesquereux, Leo, The fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 296, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 90, pl. 8, figs. 10–12a, 1878.

[1] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 550, pl. 32, figs. 1–3, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 17, pl. 3, figs. 1–3, 1887.

Phragmites sp. Heer

Phragmites sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

This generic determination probably refers to the same specimen to which Heer [2] subsequently gave the name *Phragmites alaskana*. In each instance the collector and locality are identical. (See p. 55.)

Genus POACITES Brongniart

Poacites tenue-striatus Heer

Poacites tenue-striatus Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 24, pl. 1, figs. 14, 14b, 14c, 1869.
Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 114, pl. 4 [vi], fig. 7, St. Petersburg, 1871.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 216, 1894.

The specimen described and figured by Heer was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. The specimen figured by Eichwald only remotely resembles Heer's figure and may not be properly referable to it. Eichwald did not give any exact locality for his specimen, but merely stated that it occurs "in einem harten bräunlichen Sandstein auf Alaska." The species was also listed by Knowlton as having been collected by C. H. Townsend in 1890, at Herendeen Bay, Alaska Peninsula.

Poacites sp. Heer

Poacites sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 63, 1868.

This generic reference, based on a specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was not subsequently mentioned by Heer in his Flora fossilis alaskana,[3] and possibly he may have decided to include it in his *Poacites tenue-striatus*, the species last described, from the same locality.

Impressions suggestive of Gramineae

Impressions suggestive of Gramineae, Grewingk, Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, p. 170, 1850.

Grewingk recorded fossil plant remains identified as above, from Unga Island, south of Alaska Peninsula, and presumably from Tertiary strata. The record is included in this paper with reservation; but it is probable that the remains were identical with some one or another of the fragments of monocotyledonous plants that were subsequently found elsewhere in Tertiary areas of Alaska and identified in the genera *Arundo*, *Phragmites*, *Poacites*, etc.

[2] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 24, pl. 1, figs. 12, 12b, 1869.
[3] Heer, Oswald, Flora fossilis arctica, vol. 2, no. 2, 1869.

Family CYPERACEAE

Genus CAREX Linnaeus

Carex servata Heer

Carex servata Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 24, pl. 1, figs. 13a–13d, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 216, 1894.

The original specimen upon which the species was based by Heer was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region; Knowlton subsequently identified the same species in C. H. Townsend's collection from Herendeen Bay, Alaska Peninsula.

Carex (leaves) Lesquereux

Leaves of *Carex*, Lesquereux, U. S. Nat. Mus. Proc., vol. 10, p. 36, 1887.
Knowlton, idem, vol. 17, p. 216, 1894.

This generic identification was based upon fossil leaf remains (lot 210, U. S. Nat. Mus. no. 2309) recorded as collected by E. W. Nelson at Sitka; but the locality and collector were questioned by Knowlton, who further remarked: "It is possible that this may be the *C. servata* of Heer [the species last mentioned], but as it is neither figured nor described I have retained it as probably separate."

Order ARECALES (PALMALES)

Family ARECACEAE

Genus FLABELLARIA Sternberg, 1822 (not Cavanilles, 1790, nor Defrance, 1820)[4]

Flabellaria florissanti Lesquereux

Plate 21

Flabellaria florissanti Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 144, pl. 24, figs. 1, 2, 2a, 1883.
Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

This specimen represents the upper surface of a fan palm leaf that agrees in essential characters with the species to which it is referred; but it might almost equally well be referred to *Sabal? eocenica* (Lesquereux) Knowlton [5] or to *Sabal inquirenda* Knowl-

[4] The generic name *Flabellaria* Sternberg, 1822, is antedated by *Flabellaria* Cavanilles, 1790, a modern monotypic African genus of the Malpighiaceae (see Monadelphiae classis dissertationes matriti, ex typographia regia, 1790, no. 9, Nona dissertatio botanica, De *Barnsteria, Tripteride, Tetrapteride, Molina* et *Flabellaria*, p. 436), and also by *Flabellaria* Defrance, 1820, which belongs to invertebrate zoology. Under the recognized rules of nomenclature, a different generic name will have to be adopted eventually for the several species of fossil palms that have been included in or referred to it; but this may best be accomplished in a special contribution in which all the recorded species of fossil fan palms may be listed and discussed under approved generic names.
[5] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 557, 1919, = *Flabellaria eocenica* Lesquereux, Leo, Enumeration and description of fossil plants from the western Tertiary formations: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 391, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 111, pl. 13, figs. 1–3, 1878.

ton.[6] These three species possess so many characters in common that specific differences between them are difficult to recognize, and they all three occur in Eocene strata, in a region included within the boundaries of Wyoming, Colorado, and New Mexico. Berry [7] described and figured specimens from the Tertiary (Eocene) of Mississippi and Arkansas, which he identified as *Sabalites grayanus* (Lesquereux) Lesquereux (=*Sabal grayana* Lesquereux), and regarded these as synonymous with *Flabellaria eocenica* Lesquereux. It may also be compared with *Flabellaria lamanonis* (Brongniart) Brongniart,[8] from the Eocene of France, with which it is evidently very closely allied, if not specifically identical.

As far as I am aware the specimen upon which this species is based and those that represent the species next described are the only remains of fan palms thus far discovered in the boreal regions of the North American continent, although two species, *Flabellaria grönlandica* and *F. johnstrupi*, from the Tertiary of Greenland, were described and figured by Heer.[9] It may be remarked, however, that the status of *F. johnstrupi* as a fossil plant has been questioned, and Potonié,[10] under the chapter heading " Vermeintliche pflanzliche Fossilen " remarked:

> Die von Wasser und Winderzeugten Wellenfurchen [ripple marks], * * * sind öfter als Pflanzenabdrücke untergebracht worden. Die von Heer (Fl. foss. arct., VII, 1883, Taf. 104–106) abgebildeten und als *Flabellaria johnstrupi* beschriebenen Gebilde * * * scheinen ebenfals Ähnliches zu sein.

Species have also been described from Tertiary and to some extent from Cretaceous strata at several localities in the United States and British Columbia.

One living species, *Sabal palmetto*, extends as far north as North Carolina; at least five species in the genera *Thrinax*, *Coccothrinax*, and *Serenoa* occur in Florida; one species, *Sabal mexicana*, extends into southern Texas; and one, *Washingtonia filamentosa*, into southern California. They represent a tropical and subtropical group of plants, like the sago palms or cycads, and the mutual association of species of these two groups in the Tertiary flora of Alaska is conclusive evidence of the climatic conditions that must have prevailed there at the time when they were elements in the living flora of that region.

Incidentally it may be remarked that if fragmentary leaves of the above-mentioned living species, similar to the fragmentary remains of fossil species, represented the only available material for study, it is doubtful if any more satisfactory specific or generic identifications could be made than with the fossil species.

Locality: Little Kings Creek 0.6 mile northwest of Kings River, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5896).

Flabellaria alaskana Hollick, n. sp.

Plate 22, figures 2a, 3; plate 111; plate 112

Leaves of relatively small size, with a median dimension of about 4.5 to 5 decimeters and a lateral width of about 6 to 7.5 decimeters, cleft to about a third of the distance from the outer margin to the base of the leaf; rays apparently about 50, crowded, compressed, apparently carinate, spreading, flattened distad; petiole about 1.25 centimeters in width, finely striated longitudinally, the upper surface rounded and terminating in a gently curved sinus formed by the crowded proximal extremities of the foliar rays; venation consisting of a major and a minor series in each ray, the major series about 6 to each ray, with 3 or 4 of the minor series in each of the intermajor areas.

The characters of the venation are best preserved in the distal fragments shown in figures 2a and 3, plate 22. These fragments would fit, approximately, to certain ends of the fragmentary median remains of the rays shown in plate 112, and these in turn could be fitted to the proximal part of the leaf depicted in plate 111. A fair reconstruction of the leaf could thus be obtained.

It is quite possible that these specimens may be referable to *Flabellaria grönlandica* Heer,[11] a Tertiary species from Greenland, based upon fragments that represented only median parts of the leaf, and as no other specimens of the species were ever figured, as far as I am aware, by Heer or by any other author, the characters of a perfect or comparatively perfect leaf are not available for comparison. The apparent dimension of the rays, however, and the characters of the venation agree satisfactorily with the same features in equivalent parts of our specimens; but it may also be remarked that it is difficult to discern any striking difference between these and equivalent parts of several other fan palms that have been described under various names, such as *Thrinax eocenica* Berry [12] and *Flabellaria eocenica* Lesquereux,[13]

[6] 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. 288, pl. 56, 1917 [1918].

[7] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 177, pl. 12, figs. 1–3; pl. 14, fig. 1, 1916.

[8] Brongniart, Adolphe, Prodrome d'une histoire des végétaux fossiles, p. 123 (121), Paris, 1828, = *Palmacites lamanonis* Brongniart, Sur la classification et la distribution des végétaux fossiles en général et sur ceux des terrains de sédiment supérieur en particulier: Mus. hist. nat. (Paris) Mém., vol. 8, p. 311, pl. 14 (3), fig. 1, 1822.

[9] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 69, pl. 68, figs. 5, 5b, 6a, 7, 1883 (*F. grönlandica*); p. 70, pl. 104, figs. 1, 2; pl. 105; pl. 106, fig. 1 (*F. johnstrupi*).

[10] Potonié, Henry, Lehrbuch der Paläobotanik, ed. 2 (rev. by Walther Gothan), p. 14, Berlin, 1921.

[11] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 69, pl. 68, figs. 5–7, 1883.

[12] Berry, E. W., The Upper Cretaceous and Eocene floras of South Carolina and Georgia: U. S. Geol. Survey Prof. Paper 84, p. 136, pl. 24; pl. 25, fig. 3, 1914.

[13] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 111, pl. 13, figs. 1–3, 1878.

from North America, and *F. raphifolia* Sternberg [14] as depicted by Ettingshausen,[15] *F. latania* Rossmaessler,[16] etc., from Europe.

I am inclined to believe that critical studies of all the many described species of this general type would result in segregations under fewer specific names. Until such studies and revision shall be made, however, it would seem to be the wiser course to designate the specimens from different regions under different names, even though they may be all of equivalent geologic age.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392) (pl. 22, figs. 2a, 3). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pls. 111, 112).

Order LILIALES

Family SMILACACEAE

Genus SMILAX Linnaeus

Smilax reticulata Heer

Plate 22, figure 1

Smilax reticulata Heer, Beiträge zur Naturkunde Preussens, no. 2, p. 62, pl. 16, figs. 4, 5, Königsberg, 1869.

The genus *Smilax* is sparingly represented in the fossil flora of America, and there does not appear to be any recorded species which is at all similar to our specimen. In the Old World, however, a number of species have been described which include a great diversity of leaf forms, and at least one of these (Heer's fig. 4), from the Miocene of the Baltic provinces, appears to be identical with our specimen from Alaska.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

Subclass DICOTYLEDONAE

Division CHORIPETALAE

Order PIPERALES

Family PIPERACEAE

Genus PIPER Linnaeus

Piper septentrionalis Hollick, n. sp.

Plate 113, figures 1–6; plate 114, figure 1

Leaves varying from cordate to cordate-truncate and orbicular, about 8.5 centimeters in maximum length by 8 centimeters in maximum width, bluntly and rather abruptly acuminate at the apex, cordate or cordate-truncate and slightly oblique at the base, petiolate; margin entire; venation palmate-flabellate from the base, camptodrome, consisting of a midrib, a strong inner pair of acrodrome primaries that are branched from the outer sides, and one or two less conspicuous outer pairs that occasionally appear as if branching from the base of the contiguous inner pair, spreading at the base, soon ascending, curved upward, more or less forked or branched on the outer or under sides and ultimately becoming camptodrome.

The leaves, although varying somewhat in shape and size, are so closely alike in their essential characters that specific differentiation does not appear to be warranted, especially in view of the heterophylly that prevails in many of the existing species of the genus.

The genus *Piper* is represented in our existing flora by about 600 species, of tropical distribution, in both the Old and New Worlds, and it seems somewhat remarkable that only six fossil species have been recorded—three Eurasian and two North American of Tertiary age, and one of Pleistocene age from Africa. These are *P. antiquum* Heer, from Sumatra; *P. feistmanteli* Ettingshausen, from Australia; *P. europaeum* Engelhardt, from North Germany; *P. guineense* Schumann, from Africa; *P. heerii* Lesquereux [17] from Colorado; and *P.* sp. Knowlton,[18] from Washington. Neither of the two American species has been made the subject of a published figure, and only the one from Colorado was described; hence our specimens from Alaska that are included in the genus under the two specific names published in this paper are the first American fossil representatives of the genus to be satisfactorily described and figured.

Mention should be made, however, of two species from the Tertiary of Costa Rica, described and figured under the names *Piperites cordatus* Berry [19] and *P. quinquecostatus* Berry.[20] These two species, but especially the latter, might equally well be included under the genus *Piper*; and the same might also be said of certain leaves from the middle Cretaceous of Alabama, described and figured under the name *Piperites tuscaloosensis* Berry.[21] Whether or not these species should all be relegated to one and the same genus may be regarded merely as a matter of individual opinion. The discovery of abundant remains

---

[14] Sternberg, Kaspar, Versuch einer geognostisch-botanischen Darstellung der Flora der Vorwelt, vol. 1, pt. 2, p. 32, pl. 21, Leipzig and Prague, 1822.

[15] Ettingshausen, Constantin von, Die Eocene Flora des Monte Promina: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 8, p. 28 (12), pl. 3, fig. 4; pl. 14, fig. 1, 1855.

[16] Rossmaessler, E. A., Beiträge zur Versteinerungskunde, no. 1, p. 39, pl. 11, fig. 49, Dresden and Leipzig, 1840.

[17] Lesquereux, Leo, Fossil plants collected at Golden, Colo.: Harvard Coll. Mus. Comp. Zoology Bull., vol. 16, no. 3, p. 44, 1888.

[18] Knowlton, F. H., Preliminary report on fossil plants from the State of Washington: Washington Geol. Survey Ann. Rept. for 1901, vol. 1, p. 33, 1902.

[19] Berry, E. W., Tertiary fossil plants from the Dominican Republic: U. S. Nat. Mus. Proc., vol. 59, p. 171, pl. 22, fig. 1, 1921.

[20] Idem, p. 172, pl. 22, fig. 2.

[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. 72, pl. 12, fig. 3, 1919.

of plants of this generic type in the Tertiary of Alaska furnishes additional evidence of the tropical climate that must have prevailed at the time when these plants were living there.

Localities: Lower Chignik Lake, valley to right of South Mountain, Alaska Peninsula; collected by Waldo F. Schmidt, U. S. Bureau of Fisheries, 1911 (U. S. Nat. Mus. no. 34092) pl. 113, fig. 1). T. E. O'Brien coal claim, three-fourths mile south of Matanuska River, 14 miles above mouth of Chickaloon River, Matanuska-Cook Inlet region; collected by G. A. Parks, 1911 (lot 6289) (pl. 113, fig. 2). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 960); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3522) (pl. 113, figs. 3–6). Matanuska coal field, Matanuska-Cook Inlet region, Kings River, east bank, at coal camp 7 miles above mouth, talus slope at base of cliff; collected by F. J. Katz in 1910 (lot 5895) (pl. 114, fig. 1).

Piper convertabilis Hollick, n. sp.

Plate 114, figures 2, 3a, 4–9

Leaves more or less inequilateral, varying greatly in size, broadly cordate to lanceolate, narrowed above to a rather blunt acuminate apex, cordate or oblique at the base, petiolate; margin entire; venation palmate-flabellate from the base, camptodrome; lateral primaries consisting of a strong, acrodrome inner pair and one or two pairs of successively weaker, upward-curving outer pairs, all branched from the outer or under sides, the branches ultimately becoming camptodrome.

The leaves included under this specific name represent a series of very diverse forms which might readily be separated into two or three varietal types and, had each type come from a distinctly separate geologic horizon, or even were each type confined to a single locality, they would almost certainly have been regarded not only as varietally but probably as specifically distinct. But all the forms are found associated locally, and if the various forms from a single locality are arranged in sequence, as exemplified by figures 2–5, the difficulty of drawing a satisfactory line of demarkation between them may be appreciated.

It is perhaps also significant that leaves of this species and of the species last described are found associated together, and not infrequently, as in connection with figure 8, plate 114, it is somewhat difficult to decide under which species a certain specimen should be placed. If it were not for the pronounced heterophylly of many of the existing species of the genus the decision to segregate the several forms under only two specific names would certainly have to receive very careful consideration, even though they were closely associated in the same piece of matrix.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, south of pond on top of mountain between Kings River and Youngs Creek, about 1 mile northwest of Kings River bridge; collected by G. C. Martin and F. J. Katz in 1910 (lot 5898) (pl. 114, figs. 2–5). West side of Herendeen Bay, Alaska Peninsula, north of location 19 (original no. 20); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5183) (pl. 114, figs. 6–8). Anchorage Bay, Chignik Bay, Alaska Peninsula, in valley of creek 1 mile northeast of Pacific Packing & Navigation Co's. cannery (original no. 960); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3522) (pl. 114, fig. 9).

Piper concavum Hollick, n. sp.

Plate 115, figures 1, 2

Leaves inequilateral, 8 to 9 centimeters in length by 4 to 5 centimeters in maximum width, oblique on one side, rounded on the other; margin entire; midrib slightly curved or concave toward the oblique side; venation pinnate, ascending; secondary veins all diverging at acute angles from the midrib, thinning out and disappearing close to the margin, the lower ones opposite, the upper two alternate, acrodrome.

This species appears to belong to the general type of leaf represented by *Rhamnus oeningensis* Alex. Braun, as depicted by Heer[22] from the Tertiary of Switzerland; but our leaves are much larger and have bases somewhat more acute, and I am inclined to regard this form of leaf as indicative of the genus *Piper* rather than of *Rhamnus*.

Localities: Yakutat-Copper River region, Grade Trail cabin opening along west contact of coal with shale (original no. 30); collected by A. G. Maddren in 1905 (lot 3842) (pl. 115, fig. 1). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, highest in the series (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 115, fig. 2).

Piper disputabilis Hollick, n. sp.

Plate 114, figure 10

Leaf apparently slightly asymmetrical, oblong or oblong-ovate, about 10.5 centimeters in length by about 5 centimeters in maximum width; margin entire; venation pinnate-acrodrome; midrib turned to one side distad, stout and straight proximad; secondary veins, 4 or 5 on each side, diverging at acute angles from the midrib, ascending, irregularly disposed and spaced, curving upward, strong proximad, thinning out close to the margin and apparently becoming obscurely camptodrome; tertiary venation obscure.

This is not a satisfactory specimen upon which to base a description of a new species, and it is too fragmentary for accurate comparison with described species. It resembles *Piper concavum*, the species last described, but is not so conspicuously asymmetrical or cuneate at the base. It is also suggestive of the genus *Cornus* in the strongly acrodrome character of its secondary nerves. A more perfectly preserved specimen would probably reveal characters that might

[22] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 78, pl. 123, fig. 31, Winterthur, 1859.

result in a modification or extension of the description above given and might also result in a different conclusion in regard to its generic relationship. In the meantime, however, it may be regarded as representing one of the several species of *Piper* that were prominent elements of the tropical flora of southern Alaska in early Tertiary time.

Locality: Yakutat-Copper River region, bed of creek flowing into head of Canyon Creek from Mount Chezum, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846).

Piper chapini Hollick, n. sp.

Plate 115, figure 3

Leaf inequilateral, roughly ovate, one side rounded, the other oblique at the base; margin entire; venation pinnate, acrodrome, slender; secondary veins 5 on each side, simple, opposite or subopposite, curving upward, thinning out and disappearing near the margin, those on the oblique side diverging at uniform acute angles of about 30° from the midrib, those on the rounded side diverging at obtuse angles below, at successively acute angles above; tertiary venation fine, straight or slightly flexed, horizontal or nearly so, except in the lower part of the rounded side, forming a conspicuous network of quadrilateral areolae throughout the spaces between the secondaries.

Whether this leaf belongs in the genus *Piper*, in the genus *Rhamnus*, or in the genus *Cornus* may be regarded as an open question. The venation might be identified with either, but the conspicuously inequilateral shape would rather appear to indicate relationship with *Piper*. The character of the secondary venation, however, is suggestive of *Rhamnus graeffii* Heer [23]; and it may also be compared with *Cornus paucinervis* Engelhardt and *C. studeri* Heer as figured by Engelhardt.[24]

The specific name is given in recognition of the work of the collector, Theodore Chapin, of the United States Geological Survey.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Order SALICALES

Family SALICACEAE

Genus POPULUS Linnaeus

Populus arctica Heer

Plate 22, figure 5a; plate 23, figures 1, 2; plate 24, figures 1–3; plate 27, figure 4; plate 117, figures 4–8; plate 118, figure 5

Populus arctica Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 275, 1866; Flora fossilis arctica, vol. 1, p. 100, pl. 4, figs. 6a, 7; pl. 5, figs. 1–14b; pl. 6, figs. 5, 6; pl. 8, figs. 5, 6; pl. 17, figs. 5b, c; p. 137, pl. 21, figs. 14, 15a; p. 158, pl. 30, fig. 9a?, 1868.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 2, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 260, 1883.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896; U. S. Geol. Survey Bull. 467, pp. 56, 57, 1911; U. S. Geol. Survey Bull. 500, p. 52, 1912.

Hollick, U. S. Geol. Survey Bull. 500, pp. 42, 51, 1912.

In one or another of its many forms and varieties this species has been recorded from Alaska, the United States, British America, Greenland, Spitsbergen, Sakhalin, and northern Siberia. Heer [25] described and figured five varieties from Greenland alone, which differ in every gradation of shape between orbiculate, ovate, and lanceolate and which have margins that are either crenate, sinuate, or entire. Whether or not all or any of these forms are properly referable to the genus *Populus* has been questioned and discussed by nearly every author who has had occasion to study them. This question, however, need not concern us here. The essential matter is the identification of our specimens with certain of the leaf forms to which the name has been applied, and this has been satisfactorily determined.

The form that is most commonly represented in the Alaskan collections is suborbiculate, palmately 5-veined, and with entire or sinuate margins. This form is shown in figures 5a, plate 22; figures 1, 2, plate 23; figures 1, 2, plate 24; and figure 4, plate 27 (=var. b, Heer, op. cit., pl. 5, figs. 1a, 2b, 3, 4). One specimen, represented by figure 3, plate 24, with a rounded or subcordate base and crenate margin, is comparable with Heer's figure 6, plate 5, and, as far as the subcordate base is concerned, with his figure 14, plate 21. Comparison may also be made between figure 7, plate 117, and Heer's figure 5, plate 10 (Die Miocene Flora and Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 55, 1870).

The first specimens collected in Alaska, by W. H. Dall, at Chignik Bay, Alaska Peninsula, in 1880, were identified by Lesquereux.[26] The one figured by Lesquereux represents a fragment with crenate margin and subcordate base, but with secondary venation that is subpinnate instead of palmate from the base, and, if correctly depicted, cannot be satisfactorily compared with any recognized form of the species. The branching of the secondary venation in fact, appears to represent a *Hedera*, allied to certain specimens referred to *H. macclurii* Heer,[27] rather than a

[23] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 79, pl. 126, fig. 4, Winterthur, 1859.

[24] Engelhardt, Herman, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-car. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 46, pl. 17 (10), fig. 13 (=*C. studeri*); p. 47, pl. 17 (10), fig. 30 (=*C. paucinervis*), 1885.

[25] Heer, Oswald, Flora fossilis arctica, vol. 1, pp. 100–101, 1868.

[26] Lesquereux, Leo, Contributions to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 2 [U. S. Nat. Mus. no. 1403], 1882 [1883].

[27] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 60, pl. 13, figs. 29–32a, 33, 1870.

Populus; but the suprabasal origin of the nerves, as depicted in Lesquereux's figure, would hardly be applicable to either genus.

Somewhat more satisfactory identifications, however, were made by Dawson,[28] based upon specimens from the Eocene of the Mackenzie River region in British America, and two of his figures (figs. 3 and 4) may be referred to the species without question.

A large number of specimens, mostly representing forms with entire margins, from Eocene localities in Wyoming and Colorado, were described and figured by Lesquereux,[29] and certain of these figures (vol. 7, pl. 23, fig. 3; vol. 8, pl. 46, fig. 6) are exactly comparable with our figures 1 and 2, plate 23, and figure 1, plate 24. Lesquereux at first maintained his *P. decipiens* as a distinct species, but later (vol. 8, p. 225) referred to it as a varietal form of *P. arctica* (=*Populus arctica decipiens* (Lesquereux) Cockerell [30]). It is commonly regarded as a typical Eocene species; but Kryshtofovich [31] discussed its apparent presence as an element in the Cretaceous flora of the island of Sakhalin. His figures, so far as the conspicuous, strongly defined looping of the secondary venation is concerned, are strikingly like our figures 2, 3, plate 24; but the margins of his figures are crenate-dentate, whereas ours are entire or crenate-sinuate. The type of secondary venation peculiar to these forms would seem to justify their segregation and inclusion under a distinct specific name in any critical revision of the species. Incidentally he also referred to Heer's error [32] in identifying all of the fossil flora of Sakhalin as Tertiary, despite the presence of *Nilssonia*, partly because a leaf identified as *Populus arctica* was found in the same piece of matrix with the *Nilssonia.* Kryshtofovich contended, therefore, that *Populus arctica* cannot be accepted as a safe index fossil for the Eocene or even for the Tertiary age of any deposits in which it may be found. It should always be borne in mind, however, that identifications in connection with such a polymorphous species as *P. arctica* must always be largely a matter of individual opinion.

In one or another of its forms it is widely distributed in Alaska. It has been identified in collections from 6 localities in the Matanuska-Cook Inlet region, 9 on Alaska Peninsula, and at least 1 on the Yukon River, and from these were selected for illustration representative forms from each of the main regions.

Localities: Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519) (pl. 22, fig. 5a). Head of Herendeen Bay, east of Portage Valley, Alaska Peninsula (original no. 10); collected by W. W. Atwood in 1908 (lot 5180) (pl. 23, fig. 1). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 23, fig. 2). Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178) (pl. 24, fig. 1). Upper Yukon region, Seventymile Creek half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 24, figs. 2, 3). Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298) (pl. 27, fig. 4; pl. 117, fig. 8). Summit of mountain 1 mile southwest of forks of Pumicestone Creek, Alaska Peninsula (original no. P–23); collected by W. R. Smith in 1922 (pl. 117, figs. 4–7). Divide between Folger Creek and Nowitna River, 19.15 miles N. 35° E. of north butte of Twin Buttes, central Yukon region (original no. 2); collected by J. R. Mertie, Jr., in 1915 (lot 7007) (pl. 118, fig. 5).

Populus arctica var. b Heer

Plate 117, figure 8

Populus arctica var. *b* Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 101, pl. 5, figs. 1a, 2b, 3, 4, 7b; pl. 17, fig. 5c, 1868.

There seems to be no question that this specimen represents the variety *b* of *Populus arctica* which Heer described as "foliis fere orbiculatis, margine sinuatis." Our specimen is broken off on the left side along the outer lateral primary and hence appears, at first sight, as if inequilateral rather than orbiculate; the indications are that the base was rounded or curved-truncate; and the sinuous margin and one prominent sinuous dentition are conspicuous characters.

Locality: Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Populus richardsoni Heer

Plate 27, figures 1–3; plate 28, figure 2; plate 29, figures 1–3; plate 33, figure 1a

Populus richardsoni Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 7, p. 179, 1862.
Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 1, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 260, 1883.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 581, 1893; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896; U. S. Geol. Survey Bull. 467, p. 54, 1911.
Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

This species is better defined in its essential characters than *Populus arctica* (see above), and it can

[28] Dawson, J. W., On fossil plants collected by Mr. R. A. McConnell on Mackenzie River and by Mr. T. C. Weston on Bow River: Roy. Soc. Canada Trans., vol. 7, sec. 4, p. 71, pl. 10, figs. 2–4, 1890.
[29] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 178, pl. 23, figs. 1–6 (figs. 7–11 as *P. decipiens* Lesquereux), 1878; The Cretaceous and Tertiary floras: Idem, vol. 8, p. 225, pl. 46, figs. 2–13, 1883.
[30] Cockerell, T. D. A., The fossil flora of Florissant, Colo.: Am. Mus. Nat. Hist. Bull., vol. 24, p. 83, 1908.
[31] Kryshtofovich, A. N., On the Cretaceous flora of Russian Sakhalin: Imp. Univ. Tokyo Coll. Sci. Jour., vol. 40, art. 8, pp. 48–50, text fig. 7, 1918.
[32] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, pp. 20, 26, pl. 2, figs. 1a, 1b, 1878.

generally be recognized with reasonable certainty, if the remains are not too fragmentary. Fortunately it is abundantly represented in several of the collections from Alaska, and excellent material is available for comparison. The type of the species was described by Heer from specimens collected in Greenland; but it was not until subsequently that these and other Greenland specimens representing the species were figured by him.[33]

Our figures 1 and 2, plate 26, may be compared, especially, with his fig. 3, pl. 4, vol. 1 (op. cit.), and our figure 2, plate 26, figure 2, plate 27, and figure 3, plate 28, with his fig. 3b, pl. 55, vol. 2 (op. cit.).

Specimens were also described and figured by Heer from Spitsbergen,[34] Siberia,[35] and Canada.[36] It may be regarded as a characteristic Arctic Eocene species. Specimens from the island of New Siberia were described and figured by Schmalhausen,[37] and others from the Amur River region in eastern Siberia by Konstantow.[38] Schmalhausen's figure 23 represents a large leaf with abnormally coarse marginal crenations, and Konstantow's figures represent specimens similar to certain crenate-leaved forms that have been referred to *Populus arctica.*

The first specimen of *Populus richardsoni* from Alaska that was identified as the species was collected by W. H. Dall in 1880, at Chignik Bay, Alaska Peninsula, and was described and figured by Lesquereux.[39] This figure represents a typical large form of the leaf, similar to figure 3, plate 29. Subsequently it was identified in other collections from the Alaska Peninsula and from the Yukon River region, the Matanuska coal fields, and southeastern Alaska. It evidently had a very extensive distribution throughout Alaska and British America, but there does not appear to be any satisfactory record of its occurrence in America outside the Arctic and sub-Arctic regions.

Leaves from the Miocene of Nevada were identified as belonging to the species by Lesquereux,[40] but his figures do not agree with the species as defined and figured by Heer, especially in connection with the lateral primaries, which in Lesquereux's figures are conspicuously suprabasilar, and they might better be referred to *Populus lindgreni* Knowlton,[41] so far as may be judged by a comparison of the figures. A fragmentary specimen from the Eocene of Montana was also referred to the species by Ward,[42] but it is too imperfect for satisfactory identification.

Localities: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 27, fig. 1). West side of Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 962); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3524) (pl. 27, fig. 2; pl. 29, fig. 1). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 27, fig. 3; pl. 28, fig. 2; pl. 29, fig. 2; pl. 33, fig. 1a). Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH 9b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246b) (pl. 29, fig. 3).

Populus speciosa Ward?

Plate 31, figure 2

Populus speciosa Ward, U. S. Geol. Survey 6th Ann. Rept., p. 550, pl. 34, figs. 1–4, 1886; U. S. Geol. Survey Bull. 37, p. 20, pl. 5, figs. 4–7, 1887.

This is too unsatisfactory a specimen upon which to base a positive identification, but it agrees more closely in its essential characters with Ward's figures of the type specimens from the Eocene (Fort Union formation) of Montana than does the figure of a specimen from the Eocene of the Yellowstone National Park that is referred to the species by Knowlton.[43]

It is very difficult to differentiate *Populus speciosa* from certain leaf forms that have been described under *P. amblyrhyncha* Ward, the species next described, and it is probable that a critical revision of the genus would result in relegating all to a single species, with possible recognition of varietal differences.

Populus speciosa was listed by Penhallow[44] from the Eocene of British Columbia, but without any description or figure, and this appears to be the only

[33] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis artica, vol. 1, p. 98, pl. 4, figs. 1–5, 6b; pl. 6, figs. 7, 8; pl. 15, fig. 1c, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 468, pl. 44, figs. 7–9; pl. 55, fig. 3b, 1869; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 73, pl. 66, fig. 1, 1883.

[34] Heer, Oswald, Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 158, pl. 31, fig. 1, 1868; Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 54, pl. 10, figs. 8–12, 1870; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 68, pl. 17, fig. 7e; pl. 14, fig. 4; pl. 32, figs. 1, 2, 1877.

[35] Heer, Oswald, Beiträge zur fossilen Flora Sibiriens und des Amurlandes—VI, Tertiäre Pflanzen aus dem Amurlande und der Mandschurei: Idem, vol. 5, no. 2, p. 49, pl. 15, fig. 7, 1878.

[36] Heer, Oswald, Miocene Pflanzen vom Mackenzie: Idem, vol. 1, p. 137, pl. 23, figs. 2a, 3, 1868; Beiträge zur Miocene Flora von Nord-Canada: Idem, vol. 6, Abt. 1, no. 3, p. 13, pl. 1, figs. 2d, 3, 1880.

[37] Schmalhausen, Johannes, Wissenschaftliche Resultate der von der Kaiserlichen Akademie der Wissenschaften zur Erforschung des Janalandes und der Neusibirischen Inseln in den Jahren 1885 und 1886 ausgesandten Expedition, pt. 2, Tertiäre Pflanzen der Insel Neusibirien: Acad. imp. sci. St.-Pétersbourg Mém., sér. 7, vol. 37, no. 5, p. 14, pl. 1, figs. 23–25, 1890.

[38] Konstantow, S. W., Die Tertiäre Flora des Bjelogorje Aufschlusses am Unterlauf des Fl. Bureja: Com. géol. Mém., nouv. sér., no. 113, p. 18, pl. 3, figs. 3–5, Petrograd, 1914.

[39] Lesquereux, Leo, Contributions to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 1, 1882 [1883].

[40] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 177, pl. 22, figs. 10–12, 1878.

[41] Knowlton, F. H., Fossil plants of the Payette formation: U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 725, pl. 100, fig. 3, 1898; Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 29, pl. 2, fig. 1, 1902.

[42] Ward, L. F., Flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 550, pl. 36, fig. 4, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 23, pl. 8, fig. 6, 1887.

[43] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 694, pl. 84, fig. 3, 1899.

[44] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 79, 1908.

record of the species from outside of Alaska and the United States.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. IV); collected by W. W. Atwood in 1907 (lot 4391).

Populus amblyrhyncha Ward

Plate 25, figure 5a; plate 28, figure 1; plate 30, figure 4a; plate 116, figure 7

Populus amblyrhyncha Ward, U. S. Geol. Survey 6th Ann. Rept., p. 550, pl. 34, figs. 5–9; pl. 35, figs. 1–6, 1886; U. S. Geol. Survey Bull. 37, p. 20, pl. 6, figs. 1–8; pl. 7, figs. 1–3, 1887.

There appears to be little doubt that our specimens are referable to this species, which includes leaves of considerable diversity in size, although it is exceedingly difficult to differentiate between this species and the closely allied *Populus speciosa* Ward, the species last described. Our leaves, however, are longer than broad, and the lateral primaries are clearly suprabasilar—characters which would appear to indicate relationship with *P. amblyrhyncha* rather than with *P. speciosa*, according to the specific descriptions.

As one of many examples of the difficulty of identifying our specimens with either of the above species to the exclusion of the other, however, comparison may especially be made between two figures of *P. speciosa* Ward[45] and two of *P. amblyrhyncha* Ward[46] in which specific or even varietal differences are not very apparent.

It is with some hesitation that the small and rather obscurely defined specimen represented by figure 5a, plate 25, is referred to the species, and yet, except for its smaller size, it appears to possess a satisfactory resemblance to certain of Ward's figures, especially to his figure 1, plate 35, in the 6th annual report and figure 6, plate 6, in Bulletin 37. The species is abundantly represented in the Fort Union (Eocene) and Lance (Eocene?) formations of South Dakota, Montana, and Wyoming but has not heretofore been recorded from other areas.

Localities: Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298) (pl. 25, fig. 5a). Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 28, fig. 1; pl. 30, fig. 4a). Nenana coal field, Tanana region, Lignite Creek, north side, bluff between two creeks in eastern part of sec. 30, T. 11 S., R. 6 W. Burned beds overlying coal (original no. 7); collected by R. M. Overbeck in 1916 (lot 7266) (pl. 116, fig. 7). Matanuska-Cook Inlet region, Eska Creek; collected by Theodore Chapin in 1910 (lot 5897).

[45] Ward, L. F., Flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., pl. 34, fig. 1, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, pl. 5, fig. 4, 1887.

[46] Idem (6th Ann. Rept.), pl. 35, fig. 6; (Bull. 37), pl. 7, fig. 3.

Populus flexuosa Hollick, n. sp.

Plate 30, figure 5; plate 33, figure 2; plate 117, figure 9

Leaves 10 to 13 centimeters in length by about 12 centimeters in width below the middle, broadly subcordate or with an obliquely truncate base; apex narrowly wedge-shaped, acuminate; margin crenate or crenate-dentate; venation 7-palmate from the base, consisting of a midrib with one strong and two successively weaker lateral primaries on each side, the lateral primaries conspicuously flexuous, the inner pair curved upward and forming acute angles with the midrib, the two outer pairs relatively straight and at obtuse angles with the midrib, all branched irregularly from their outer or under sides, the branches coalescing in a series of angular loops, with subbranches or veins extending from the angles to the marginal dentitions; secondary veins about four on each side, more or less flexuous, irregularly spaced and disposed and forming various angles of divergence with the midrib from about the middle upward, becoming camptodrome in a series of irregular, angular loops and ultimately craspedodrome through fine branches or veins that extend from the angles of the loops to the marginal dentitions.

These leaves evidently belong to the same general type as those that I have referred to *Populus amblyrhyncha* Ward, the species last described; but the average larger size, the flexuous venation, and the broad oblique base are characters that appear to differentiate them from all other allied species.

Localities: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 30, fig. 5; pl. 33, fig. 2). Summit of mountain half a mile east of head of north branch of Russel Creek, Alaska Peninsula (original no. P–24); collected by W. R. Smith in 1922 (pl. 117, fig. 9).

Populus genetrix Newberry

Plate 26, figure 5

Populus genetrix Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 64, 1868; U. S. Geol. Survey Mon. 35, p. 44, pl. 27, fig. 1, 1898.

Newberry's single figure of the type of this species, based on a specimen from the Eocene of Montana, is the only one heretofore published. In all essential characters it agrees with ours from Alaska, and their mutual specific identity can hardly be questioned. It may be suggested, also, that they are both so closely similar to *Populus obtrita* Dawson,[47] from the Eocene of British Columbia, that it is difficult to escape the conviction that all belong to the same species. Dawson's single figure of the type of this species, like Newberry's figure of *P. genetrix*, is the only one published;

[47] Dawson, J. W., Fossil plants from the Similkameen Valley and other places in the southern interior of British Columbia: Roy. Soc. Canada Trans., vol. 8, sec. 4, p. 82, text fig. 12, 1890.

but a comparison of the two figures indicates that there is no essential difference between them, except in size. Variation in size, however, is so common among many species of *Populus* that it has little or no specific significance. Incidentally it may also be noted that the only other published record relating to *P. genetrix* is that by Dawson,[48] in connection with provisional identifications of specimens from the Eocene of British Columbia, but, unfortunately, without any accompanying description or figure.

Locality: Yukon River, south bank, 2 to 4 miles above Rampart, central Yukon region (original no. 15); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4710).

Populus latior Alex. Braun

Plate 25, figure 4; plate 26, figures 1–4

Populus latior Alex. Braun, in Buckland, Geology and mineralogy, etc., vol. 1, p. 512, London, 1837; Neues Jahrb., 1845, p. 169.

Unger, Genera et species plantarum fossilium, p. 416, Vienna, 1850; K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 4, p. 117, pl. 44, figs. 3–5, 1851.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 25, pl. 2, fig. 4, 1869.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 580, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 216, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

Many divergent leaf forms that differ more or less in details of venation and dentition have been included under *Populus latior* and the numerous varieties that have been recognized by various authors; and certain of the varietal forms have also been regarded by other authors as distinct species.

Although Braun originally mentioned the species by name, in 1837, and described it in 1845, it was first depicted in 1851 by Unger, who figured 3 specimens. Later, Heer[49] described and figured some 20 or 30 specimens of the species, including 7 named varieties; and subsequently other authors either extended or restricted the specific or varietal limits of these and allied leaf forms, so that each of our 5 figured specimens from Alaska may be compared more or less satisfactorily with one or another of the many published figures that have been referred either to the species or to certain of its varieties.

Figure 4, plate 25, and figure 4, plate 26, apparently represent the variety *denticulata* Heer.[50] Figures 1 and 2, plate 26, which possess well-defined lateral primaries, suggest the variety *attenuata* (Braun) Braun,[51] which he, apparently, originally described as a distinct species and afterward relegated to varietal rank. Heer[52] also described and figured specimens of this form and restored the variety to its original specific rank. Our leaves, however, both possess the conspicuous lateral width characteristic of *P. latior* and may, on the whole, be more satisfactorily compared with the variety *rotundata* Braun[53] as described and figured by Heer,[54] but having blunter apices and finer marginal dentition and, in these characters, resembling a leaf from the Eocene of North Dakota, described and figured by Lesquereux[55] and referred to *Populus glandulifera* Heer. The only specimen figured by Heer in his Flora fossilis alaskana,[56] collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, is so closely similar to figure 1, plate 26, that their mutual specific identity can hardly be questioned; and figure 2 on the same plate appears to represent merely a larger specimen of the same type of leaf.

Figure 3, plate 26, is almost identical, except for its smaller size, with figure 4, plate 44, in Unger's Iconographia plantarum fossilium.

The Old World distribution of *Populus latior*, including its varieties, was extensive, but any evidence of its occurrence anywhere in America, outside of Alaska, is based upon more or less unsatisfactory records. Both the species and the variety *cordifolia* Braun[57] were listed by Penhallow[58] from the Oligocene [?] of British Columbia, but with only very meager descriptions and without illustrations. A specimen referred to the variety *cordifolia*, from the Eocene of Wyoming, was described and figured by Lesquereux,[59] but his figure shows only the basal portion of the leaf and in connection with it he mentions a previous description[60] of a specimen from the same locality, which he originally referred to the variety *transversa* (Alex. Braun) Heer[61] but which he here remarks is apparently referable to the variety *cordifolia*. A similar imperfect specimen, referred to

[48] Dawson, J. W., The Mesozoic floras of the Rocky Mountain region of Canada: Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 17, 1885 [1886].

[49] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, pp. 11–15, pls. 53–57 in part, Winterthur, 1856.

[50] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 14, pl. 54, fig. 6; pl. 56, figs. 2, 3, Winterthur, 1856.

[51] Braun, Alexander, in Bruckmann, Dr., Flora oeningensis fossilis: Ver. vaterl. Naturk. Württemberg Jahresh., vol. 6, p. 230, 1850; in Stizenberger, Ernst, Uebersicht der Versteinerungen des Grossherzogthums Baden, p. 79, Freiburg, 1851; =*P. attenuata* Braun MS., in Unger, Franz, Genera et species plantarum fossilium, p. 417, Vienna, 1850.

[52] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 15, pl. 57, figs. 8–12; pl. 58, figs. 1–4, Winterthur, 1856.

[53] Braun, Alexander, in Bruckmann, Dr., op. cit., p. 230; in Stizenberger, Ernst, op. cit., p. 79.

[54] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 13, pl. 56, figs. 4–7, Winterthur, 1856.

[55] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 226, pl. 46A, fig. 4, 1883.

[56] Heer, Oswald, Flora fossilis arctica, vol. 2, no. 2, p. 25, pl. 2, fig. 4.

[57] Braun, Alexander, in Bruckmann, Dr., op. cit., p. 230.

[58] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, pp. 77, 78, 1908.

[59] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 172, pl. 22, fig. 8, 1878.

[60] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 287, 1872.

[61] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 14, pl. 57, figs. 3, 6–7, Winterthur, 1856, =*Populus transversa* Alex. Braun, in Bruckmann, Dr., op. cit., p. 230.

the variety *truncata* (Braun) Braun,[62] from the Eocene (Fort Union formation) of North Dakota, was also described and figured by Lesquereux,[63] but in connection with it he said: "The leaf is perhaps too fragmentary for satisfactory identification." An equally unsatisfactory specimen, from the Pleistocene (Sunderland formation) of Maryland, was provisionally referred to the species by Hollick.[64] These are, apparently, the only records heretofore published relating to the occurrence of the species of any of its varieties in America.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 25, fig. 4; pl. 26, figs. 2–4). Bryant Creek, upper Yukon region (original no. 3AP 350); collected by L. M. Prindle in 1903 (lot 3229) (pl. 26, fig. 1). Port Graham, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm, fide Heer.

Populus hookeri Heer

Plate 24, figure 6

Populus hookeri Heer, Miocene Pflanzen vom Mackenzie: Flora fossilis arctica, vol. 1, p. 137, pl. 21, figs. 16, 16b, 16c(?), 1868.

This is apparently the only satisfactory record of this species, other than the original one by Heer in connection with the type locality in the Mackenzie River region of British America; although Dawson[65] figured a specimen from the same region and referred it to the species. Dawson's figure, however, is of doubtful identity and, in any event, can hardly be regarded as specifically identical with *Populus hookeri* as defined and figured by Heer.

Locality: Bryant Creek, upper Yukon region (original no. 3AP 350); collected by L. M. Prindle in 1903 (lot 3229).

Populus glandulifera Heer

Plate 31, figure 1; plate 32, figures 5, 6; plate 116, figure 1

Populus glandulifera Heer, Flora tertiaria Helvetiae, vol. 2, p. 17, pl. 58, figs. 5–11; pl. 63, fig. 7, Winterthur, 1856; K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 26, pl. 2, figs. 1, 2, 1869.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 580, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

There can be but little doubt that our specimens are referable to this species, despite the size of the two larger ones, which exceed in their dimensions any other published figures of the species with which they may be compared. Even with these included, however, it does not show a greater diversity of leaf forms than are found in certain other species of the genus, such as *P. zaddachi* Heer,[66] to which Heer refers specimens that range in length from 2.25 to 18 centimeters. In this connection it may be pertinent to note that certain of the larger of Heer's figures of *P. zaddachi* (pl. 6, figs. 4, 6; pl. 12, fig. 1c) are more or less suggestive of our figure 1, plate 31, and figure 5, plate 32; although in our specimens the bases are broadly cuneate or truncate instead of cordate.

In the Old World the species has a geographic distribution that embraces Switzerland, Hungary, Germany, Portugal, and the island of Sakhalin, and it appears to be everywhere associated with Miocene deposits, except possibly in Sakhalin, where the flora indicates a lower Tertiary horizon. In the United States it is apparently an Eocene species and may be found recorded by Lesquereux,[67] Ward,[68] and Knowlton[69] from North Dakota, Montana, and the Yellowstone National Park, respectively.

Localities: Yukon River, south bank, just above Rampart central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 31, fig. 1, pl. 32, fig. 5). Yukon River, south bank, 1½ miles above Rampart and 300 feet above 11AE1, central Yukon region (original no. 11AE2); collected by H. M. Eakin in 1911 (lot 6095) (pl. 32, fig. 6). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 116, fig. 1). Port Graham, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm, fide Heer.

Populus balsamoides Goeppert

Plate 23, figures 3, 4; plate 25, figure 1; plate 116, figures 3, 4

Populus balsamoides Goeppert, Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 493, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 23, pl. 15, figs. 5, 6, Görlitz, 1855; Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 204, 1861.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana; Flora fossilis arctica, vol. 2, no. 2, p. 26, pl. 2, fig. 3, 1869.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 580, 1893; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

Many diverse leaf forms have been included in this species from time to time by the several writers who have had occasion to study it and allied forms of *Populus*. The particular one with which our specimens may be most satisfactorily compared is *P.*

[62] Braun, Alexander, in Stizenberger, Ernst, op. cit., p. 79, =*P. truncata* Braun, in Bruckmann, Dr., op. cit., p. 230.

[63] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 226, pl. 46, fig. 14, 1883.

[64] Hollick, Arthur, Systematic paleontology of the Pleistocene deposits of Maryland: Maryland Geol. Survey, Pliocene and Pleistocene, p. 224, pl. 70, fig. 7, 1906.

[65] Dawson, J. W., On fossil plants collected by Mr. R. A. McConnell on Mackenzie River and by Mr. T. C. Weston on Bow River: Roy. Soc. Canada Trans., vol. 7, sec. 4, p. 71, pl. 10, fig. 5, 1889.

[66] Heer, Oswald, Miocene baltische Flora, p. 30, pl. 5, figs. 1–5; pl. 6, figs. 1–7; pl. 12, fig. 1c; p. 65, pl. 14, fig. 24b; pl. 17, fig. 9(?), Königsberg, 1869.

[67] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 226, pl. 46 A, figs. 3, 4, 1883.

[68] Ward, L. F., Flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 550, pl. 33, figs. 1–4, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 19, pl. 14, figs. 1–4, 1887.

[69] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 694, pl. 84, fig. 1, 1899.

balsamoides eximia (Goeppert) Heer,[70] as depicted by Goeppert,[71] Heer,[72] Lesquereux,[73] and others. Goeppert described *P. balsamoides* and *P. eximia* as distinct species, but subsequent writers, for the most part, apparently regarded them as mere leaf forms of a single species and included them and all similar leaves, irrespective of size, under *P. balsamoides.* Heer,[74] in his discussion of a relatively small specimen of this species, collected by Hjalmar Furuhjelm at English Bay [Port Graham], Kenai Peninsula, said: "*Populus eximia* Goepp. * * * non est distincta", and Lesquereux, in discussing a large fragmentary specimen from California, said: "The fragment, fig. 4, represents the variety *eximia* of Goepp., 'Schoss. Fl.', pl. 16, fig. 5."

The specimen represented by figure 1, plate 25, is referred to the species with some hesitation, as it is too imperfect for satisfactory identification; but the characters of the secondary nervation and of the margin appear to justify at least provisional reference to *P. balsamoides.*

The species has been more or less confused with other so-called species of *Populus*, and Stur [75] figured an undoubted specimen of the species, from the Miocene of Hungary, and referred it to *P. glandulifera* Heer. He also discussed [76] the various points of resemblance and difference between these and other similar leaf forms which have been included under several different specific names.

Populus undulata Wessel,[77] described and figured from the Miocene of Germany, may also be compared with certain of the forms that have been referred to *P. balsamoides;* and it is perhaps significant that Wessel's species has apparently not been recognized or mentioned by any subsequent author. Wessel himself was evidently in doubt in regard to the specific status of *P. undulata*, but he discussed its possible varietal relationship with *P. latior* Alex. Braun (see p. 64) and did not suggest its similarity to *P. balsamoides.*

The species is sparingly represented in our collections from Alaska, but it is evidently widely distributed in the region, inasmuch as specimens were collected by Lt. Peter Doroschin on "Hudsnoi" [Kootznahoo or Admiralty] Island, southeastern Alaska,[78] and subsequently by others; by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, as already mentioned; and at two other widely separated localities—the Yukon River Valley and the Controller Bay region. In one or another of its forms the species has an extensive geographic distribution in Europe, where it is apparently identified mostly with Miocene deposits. In the United States it has been recorded from the Miocene of Colorado,[79] California,[80] and the Yellowstone National Park,[81] and from the Eocene of North Dakota.[82] These figures, with the exception of Lesquereux's figure 4, plate 31, are fairly representative of both large and small forms of the species, and the fragmentary specimen from Corral Hollow, Calif., represented by Lesquereux's figure 4, plate 6, was evidently, in its entirety, as large as our specimens from Alaska.

Certain specimens, of presumable Eocene age, from British Columbia, were referred to the species by Dawson,[83] but they are not satisfactorily identifiable with it and are probably referable to *P. gaudini* Fischer-Ooster, the species next described, and may be disregarded as records of *P. balsamoides.*

Localities: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 23, fig. 3). Yakutat-Copper River region, 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 23, fig. 4). Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 25, fig. 1). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 116, fig. 3). Nenana coal field, near Jinx coal bed, above mouth of Coal Creek, Tanana region; collected by Mrs. John A. Davis in 1923, fide S. R. Capps (lot 7634); (pl. 116, fig. 4). Port Graham, Matanuska-Cook Inlet region;

[70] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 18, Winterthur, 1856, =*P. eximia* Goeppert, H. R., Die tertiäre Flora von Schossnitz in Schlesien, p. 23, pl. 16, fig. 5, 1855.

[71] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 493, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 23, pl. 15, figs. 5, 6, 1855; Ueber die Tertiärflora der Polargegenden: Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 204, 1861.

[72] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 150, fig. 11, 1859.

[73] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 248, pl. 55, fig. 4, 1883.

[74] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 26, pl. 2, fig. 3, 1869.

[75] Stur, Dionys, Beiträge zur Kenntniss der Flora, der Süsswasserquarze, der Congerien- und Cerithien-Schichten im Wiener und ungarischen Becken: K.-k. geol. Reichsanstalt Jahrb., vol. 17, no. 1, p. 163 (87), pl. 4, fig. 5, 1867.

[76] Idem, p. 164 (88).

[77] Wessel, Philipp, Neuer Beitrag zur tertiär Flora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 4, no. 4, p. 141 (31), pl. 24 (5), fig. 1, 1855.

[78] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., p. 204, 1861.

[79] *Populus balsamoides?* Goeppert var. *latifolia* Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 158, pl. 31, fig. 4, 1883, = *P. scudderi* Cockerell, T. D. A., Fossil plants from Florissant, Colo.: Torrey Bot. Club Bull., vol. 33, p. 307, 1906.

[80] *Populus balsamoides* Goeppert, Lesquereux, Leo, op. cit., p. 248, pl. 55, figs. 3–5.

[81] *Populus balsamoides* Goeppert, Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 696, pl. 86, fig. 1, 1899.

[82] *Populus balsamoides* var. *eximia* Goeppert, Lesquereux, Leo, op. cit., p. 226, pl. 46A, fig. 10.

[83] Dawson, J. W., On collections of Tertiary plants from the vicinity of the city of Vancouver, B. C.: Roy. Soc. Canada Trans., ser. 2, vol. 1, sec. 4, p. 146, pl. 4, fig. 8; pl. 6, fig. 9, 1895.

collected by Hjalmar Furuhjelm, fide Heer. Kootznahoo Inlet, southeastern Alaska; collected by Peter Doroschin, fide Goeppert, 1861.

Populus gaudini Fischer-Ooster

Plate 25, figures 2, 3

Populus gaudini Fischer-Ooster, in Heer, Flora tertiaria Helvetiae, vol. 2, p. 24, pl. 64, figs. 1–9, Winterthur, 1856. Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

The only previous record of this species in America was made by Lesquereux,[84] based upon the identification of a single specimen from the Eocene of Colorado; but unfortunately the specimen was not figured. Dawson,[85] however, described and figured under the name *Populus balsaminoides* Goeppert [for *P. balsamoides* Goeppert], specimens from the Tertiary (Eocene?) of British Columbia that are almost certainly referable to *P. gaudini;* and his figure 9 is almost identical in size and shape with our specimens, especially with the one represented by our figure 2.

P. gaudini is a polymorphous species, with a wide geographic distribution that includes Switzerland, Italy, Bohemia, France, Germany, Sakhalin, and Greenland. Most of the figured specimens of large leaves show elongated, attenuated apices, which, unfortunately, are not preserved in either of our specimens, so that exact comparisons are impossible. The particular specimen that agrees most closely with our figure 3 is depicted by Heer,[86] from the Eocene of Greenland. Whether or not this specimen is properly referable to the species as originally defined by the author may, perhaps, be questioned. Minor characters of the nervation are quite different from those of specimens elsewhere figured by Heer; but there can be no question of its identity with the specimen represented by our figure.

It is possible that the species, in its entirety, may not be a *Populus* but may, at least in part, be referable to the genus *Ficus* and perhaps be identical with certain leaves included under *Ficus monodon* (Lesquereux) Berry[87]; but that is largely a matter of individual opinion.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 25, fig. 2). Matanuska coal field, gulch on north side of Red Mountain, 4 miles north of mouth of Youngs Creek Matanuska-Cook Inlet region (original no. 10AKz); collected by F. J. Katz in 1910 (lot 5904) (pl. 25, fig. 3).

Populus congerminalis Hollick, n. sp.

Plate 116, figure 2

Leaf ovate, 10.5 centimeters in length by 7 centimeters in maximum width, rounded to a broad-cuneate base and abruptly contracted to a narrow apiculate apex; margin apparently entire or possibly obscurely and finely denticulate; venation simply pinnate; secondary veins 8 or 9 on each side, irregularly spaced and disposed, the upper more widely spaced than the lower, all forming obtuse angles with the midrib (the lower somewhat more obtuse than the upper), ascending, curving upward and becoming camptodrome close to the margin, with fine branches and veinlets extending from their under or outer sides to the margin or marginal denticulations.

This beautifully preserved specimen might, perhaps, be regarded as a form of *Populus gaudini* Fischer-Ooster,[88] originally described from the Miocene of Switzerland, especially if compared with his figure 5, which appears to differ from ours mostly in being smaller. In shape it is exactly like ours, and the margin is specifically described as entire or undulate; but the venation in all the figures is too poorly defined for satisfactory comparison.

It may also be compared with certain forms of *Populus balsamoides* Goeppert[89] and *P. eximia producta* Goeppert,[90] from the Miocene of Silesia, but both of these species have margins that are distinctly and uniformly dentate. A considerable diversity of forms, however, have been included in *P. balsamoides* by various authors, and two specimens figured by Heer[91] simulate ours very closely, except in their obviously denticulate margins. Lesquereux[92] figures a specimen from the Miocene of California which is also suggestive of ours, except for its finely denticulate margin and broader apex.

It is evident that our specimen belongs to the same general type of leaf as the particular specimens of the species above cited, and it differs from either one of them less than either of them differs from other forms in their respective species. In the circumstances, and in view of the difficulty of referring our specimen to any one of the species mentioned to the

[84] Lesquereux, Leo, Fossil plants collected at Golden, Colo.: Harvard Coll. Mus. Comp. Zoology Bull., vol. 16, no. 3, p. 47, 1888.

[85] Dawson, J. W., On collections of Tertiary plants from the vicinity of the city of Vancouver, B. C.: Roy. Soc. Canada Trans., ser. 2, vol. 1, sec. 4, p. 146, pl. 4, fig. 8; pl. 6, fig. 9, 1895.

[86] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 99, pl. 50, fig. 9, 1868.

[87] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 201, pl. 32, fig. 2; pl. 33, fig. 2, 1916, =*Populus monodon* Lesquereux, Leo, On fossil leaves from Fort Ellsworth, Nebr.: Am. Philos. Soc. Trans., vol. 13, p. 413, pl. 15, figs. 1, 2, 1869.

[88] Fischer-Ooster, Carl von, in Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 24, pl. 64, figs. 1–9, Winterthur, 1856.

[89] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsche geol. Gesell. Zeitschr., vol. 4, p. 492, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 23, pl. 15, figs. 5, 6, Görlitz, 1855.

[90] Idem (Schossnitz), pl. 16, figs. 3, 4; pl. 17, figs. 1, 2.

[91] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, pl. 59, fig. 2; pl. 60, fig. 1, Winterthur, 1856.

[92] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 248, pl. 55, fig. 3, 1883.

exclusion of the others, we may properly describe it under a new specific name.

Locality: Kukak Bay, Alaska Peninsula, north shore, 1 mile west of Cape Nukhshak (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3517).

Populus mutabilis Heer

Plate 33, figure 1b

Populus mutabilis Heer, Flora tertiaria Helvetiae, vol. 2, p. 19, pl. 53, figs. 2a–2d, 9a–9d; pl. 60, figs. 1–17; pl. 61, figs. 1–15; pl. 62, figs. 1–6; pl. 63, figs. 1–4, Winterthur, 1856; vol. 3, p. 173, pl. 150, fig. 10, 1859.

In this exceedingly variable species 11 of the leaf forms have been given distinctive varietal names, but these names can only be regarded as a convenient means of designating leaf forms that evidently represented polymorphy on individual trees, as several of these so-called varieties were found attached to one and the same branch, as figured by Heer.[93]

The specimen represented by figure 1b, plate 33, may be most closely compared with *P. mutabilis crenata*, represented by Heer's figure 9, plate 60; and this same variety was recorded by Lesquereux [94] from Wyoming but was not figured or subsequently referred to by Lesquereux or any other author.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897)

Populus leucophylla Unger

Populus leucophylla Unger, Genera et species plantarum fossilium, p. 417, Vienna, 1850; K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 4, p. 118, pl. 44, figs. 7, 8, 1852.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 26, pl. 2, fig. 6, 1869.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 580, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

A fragmentary leaf specimen, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was provisionally identified and listed by Heer in 1868 as belonging to this species. In the following year he described and figured the specimen without any indication of reservation, but with a queried reference to *Populus acerifolia* Newberry,[95] apparently with the intention of indicating that Newberry's species might be referable to *P. leucophylla*, or at least to this particular specimen. From an examination and comparison of the figures it may be seen that Heer's Alaska specimen and certain of Newberry's specimens of *P. acerifolia* (figs. 5, 8) might be regarded as specifically identical, but that none of them appear to have any specific relationship with the type specimens of *P. leucophylla* figured by Unger.

In the circumstances, and in view of all the available information, it would hardly seem justifiable to affirm, definitely, that either species was an element in the Tertiary flora of Alaska; although I am inclined to believe that perfect or more complete material of the same type as the fragmentary specimen figured by Heer, would prove it to be closely allied to if not specifically identical with *Populus acerifolia* Newberry, rather than with *P. leucophylla* Unger.

Populus obscura Hollick, n. sp.

Plate 27, figures 5, 6

Leaves suborbicular, rounded below on one side, oblique on the other; margin crenate or crenate-dentate except toward the base; venation thin, obscure, palmate from the base, 3 lateral primaries on the rounded side, 2 on the oblique side, irregularly forked or branched and connected at their extremities by cross venation from which fine veinlets spring, each terminating in a marginal crenation.

These leaves are rather puzzling subjects for study. The venation is obscurely defined, as if it was either very thin and weak or else was buried in the parenchyma of the leaves, which may have been coriaceous. They are suggestive of *Populus rotundifolia* Newberry,[96] from the Eocene of North Dakota, Montana, and Wyoming, not only by reason of general similarity in size, shape, and marginal characters, but also because of the peculiar obscure nervation that is mutually characteristic, in connection with which Newberry remarked: [97] "The tissue of the leaf would seem to have been thick and leathery, since the surfaces are unusually smooth, and the nerves sunk in the parenchyma are often scarcely perceptible."

It is possible that the leaf represented by our figure 6 may be abnormally contorted by the fracture that has disrupted it, and that the actual inequality of the two sides may be more apparent than real. Our other figure appears to represent a leaf more nearly symmetrical in outline. If our specimens were equilateral they would compare quite satisfactorily with Newberry's *P. rotundifolia*.

Locality: Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

[93] Heer, Oswald, op. cit., vol. 2, pl. 63, figs. 2, 3.

[94] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 386, 1873.

[95] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, pt. 1, p. 65, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 37, pl. 28, figs. 5–8, 1898.

[96] Newberry, J. S., Brief description of fossil plants, chiefly Tertiary, from western North America: U. S. Nat. Mus. Proc., vol. 5, p. 506, 1883; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 51, pl. 29, figs. 1–4, 1898, =*P. cyclomorpha* Knowlton and Cockerell, in Knowlton, F. H., A catalog of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 487, 1919.

[97] Newberry, J. S., op. cit. (Mon. 35), p. 52.

Populus zaddachi Heer?

Plate 24, figures 4, 5; plate 116, figures 5, 6

Populus zaddachi Heer, Flora tertiaria Helvetiae, vol. 3, p. 307, Winterthur, 1859; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 26, pl. 2, fig. 5a, 1869.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 580, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.
Populus zaddachi Heer? Knowlton, U. S. Geol. Survey Bull. 467, p. 57, 1911.
Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

This highly variable species, in one or another of its forms, has a wide distribution on the Eurasian continent and throughout the Arctic regions. In the United States it was recorded by Lesquereux from the Miocene of California [98] and Colorado,[99] and from the Eocene of Wyoming; [1] by Knowlton from the Miocene of the Yellowstone National Park [2] and Oregon; [3] and by Smith and Duror,[4] Jennings,[5] and Chaney [6] from Tertiary beds in Washington, Montana, and Oregon, respectively.

The specimens represented by figures 4 and 5, plate 24, appear to be more or less satisfactorily identified with the species, but they may also be seen to be suggestive of certain forms of *Populus arctica* Heer,[7] described and figured under var. *a*, var. *c* (=*P. arctica zizyphoides*), and var. *d*. It is evident that a thorough revision of the numerous and diverse leaf forms that have been listed from time to time by various authors under the species *P. arctica* and *P. zaddachi* would result in considerable rearrangement of varietal and specific names and, possibly, in reference to some genus other than *Populus*—at least insofar as certain of the forms are concerned.

The other two specimens here figured are too fragmentary for positive identification, but they may be tentatively referred to the species.

Localities: Upper Yukon region, Seventymile Creek half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 24, fig. 4). Sheep Valley, Matanuska coal field, Matanuska-Cook Inlet region (arkose series); collected by G. C. Martin in 1910 (lot 5900) (pl. 24, fig. 5). Nenana coal field, Tanana region, conglomerate beds, about 0.8 mile N. 48° E. of southwest corner of sec. 10, T. 9 S., R. 6 W., elevation 2,000 feet (original no. 4); collected by G. C. Martin and R. M. Overbeck in 1916 (lot 7263) (pl. 116, fig. 5). Nenana coal field, Tanana region, about 0.8 miles N. 48° E. of southwest corner of sec. 10, T. 9 S., R. 6 W., elevation 2,025 feet (original no. 5); collected by G. C. Martin and R. M. Overbeck in 1916 (lot 7264) (pl. 116, fig. 6).

The Alaskan specimen figured by Heer was collected by Hjalmar Furuhjelm at English Bay [Port Graham], Kenai Peninsula, in the Matanuska-Cook Inlet region, and specimens provisionally identified by Knowlton and Hollick were collected by W. W. Atwood and H. M. Eakin at Herendeen Bay, Alaska Peninsula (lot 5182) and by Theodore Chapin in the lower Matanuska Valley, Matanuska-Cook Inlet region (lot 5902).

Populus sp.?

Plate 118, figure 4

This small imperfect specimen might perhaps be referred to *Populus acerifolia* Newberry [8]—especially to one of the small leaves such as the one depicted in his figure 6. It might also be compared with *Populus hookeri* Heer [9] (see this paper, pl. 24, fig. 6); but the fragmentary condition of our specimen renders any definite identification impossible.

Locality: Divide between Folger Creek and Nowi River, 19.15 miles N. 3.5° E. of north butte of Twin Buttes, central Yukon region (original no. 2); collected by J. B. Mertie, Jr., in 1915 (lot 7007).

Genus SALIX Linnaeus

Salix alaskana Hollick, n. sp.

Plate 31, figure 4

Leaf elongated elliptical, 6.5 centimeters in length by 3 centimeters in width across the middle, tapering to a blunt wedge-shaped base and apex; margin finely crenulate-serrate-denticulate; secondary veins numerous, leaving the midrib almost at right angles and curving upward along the margin, with fine, obscurely defined veinlets extending to the marginal denticulations.

This leaf evidently belongs with the same specific types of *Salix* as are represented by the existing *S. sitchensis* Bougard, *S. hookeriana* Hooker, *S. piperi* Bebb, and *S. nuttallii* Sargent, all of which are natives of the Pacific coast region.

There does not appear to be any described fossil species with which it may be compared, except,

[98] 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. 11, pl. 8, figs. 1–8, 1878.

[99] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 158, pl. 31, fig. 8, 1883.

[1] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 292, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 176, pl. 22, fig. 13, 1878.

[2] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 694, 1899.

[3] Knowlton, F. H., Fossil plants associated with the lavas of the Cascade Range: U. S. Geol. Survey 20th Ann. Rept., pt. 3, p. 40, pl. 1, fig. 11, 1900.

[4] Smith, W. S., and Duror, C. A., Stratigraphy of the Skykomish Basin, Washington, with report upon paleontology and paleophytology: Jour. Geology, vol. 24, p. 577, 1916.

[5] Jennings, O. E., Fossil plants from the beds of volcanic ash near Missoula, western Montana: Carnegie Mus. [Pittsburgh] Mem., vol. 8, p. 406, pl. 24, fig. 6; pl. 25, figs. 1, 2; pl. 26, figs. 1–3, 5, 6, 1920.

[6] Chaney, R. W., The flora of the Eagle Creek formation: Walker Mus. [Chicago] Contr., vol. 2, p. 161, pl. 7, figs. 1, 2, 1920.

[7] Heer, Oswald, Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 100, pl. 5, figs. 9–13; pl. 6, fig. 6a, 1868.

[8] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 65, 1868; Later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 37, pl. 28, figs. 5–8, 1898.

[9] Heer, Oswald, Miocene Pflanzen vom Mackenzie: Flora fossilis arctica, vol. 1, p. 137, pl. 21, figs. 16, 16b, 16c(?), 1868.

possibly, *Salix elliptica* Lesquereux,[10] from the Miocene of California, which differs from the Alaska specimen mostly in its shorter, broader shape and in the more upward-curving secondary veins. The two leaves might perhaps be regarded as varietal forms of one and the same species, the ancestor of the group of willows above mentioned, which are typical of the present-day flora of the region from Alaska to California.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, 30 feet below Bradley coal (original no. 910); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5820).

Salix angusta Alex. Braun

Plate 29, figures 4, 5; plate 30, figure 3

Salix angusta Alex. Braun, in Bruckmann, Ver. vaterl. Naturk. Württemburg Jahresber., vol. 6, p. 229, 1850.

This species, well known in the Old World as a Miocene species, has been also recorded from a number of localities in the western United States, with a vertical range that extends from the Upper Cretaceous to the middle Tertiary. Analysis and examination of the published descriptions and figures, however, indicate that several of the identifications of the species from the United States are open to question, and that some of them are undoubtedly erroneous. Lesquereux[11] described and figured two specimens from the Green River (Eocene) shales of Wyoming, which agree satisfactorily with the species as figured by European authors, and his figure 4 (op. cit.), although larger than ours, appears to be otherwise identical. The same author[12] also described and figured specimens from the Miocene of California that appear to be identical with ours in every way.

Newberry,[13] however, described and figured a specimen from the Green River shales of Wyoming which is undoubtedly not a *Salix* but a *Eucalyptus*. Knowlton also described and figured a specimen from the Upper Cretaceous of Wyoming[14] and one from the middle Tertiary of Nevada;[15] but the former is of doubtful identity and the latter is certainly not referable to the species.

Our specimens belong to the narrow form of the species, with attenuate base, as distinguished from the form in which the base is wedge shaped or somewhat rounded.

Localities: Fairbanks district, Tanana region (original no. 31); collected by L. M. Prindle and H. B. Blair in 1906 (lot 7476) (pl. 29, figs. 4, 5). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 30, fig. 3).

Salix lavateri Alex. Braun

Plate 34, figures 7a, b

Salix lavateri Alex. Braun, in Bruckmann, Ver. vaterl. Naturk. Württemberg Jahresh., vol. 6, p. 229, 1850.
Heer, Flora tertiaria Helvetiae, vol. 2, p. 28, pl. 66, figs. 1–12; pl. 68, fig. 6, 1856; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 2, fig. 10, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 218, 1894; Geol. Soc. America Bull., vol. 5, p. 581 [1894]; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

It is perhaps questionable if all the leaf forms that have been referred to this species should be regarded as specifically distinct from *Salix varians* Goeppert, the species next described. Several such leaf forms were relegated to varietal rank in *S. varians* by Schimper,[16] and it might be that our specimens would fall into the same category; but they appear to be sufficiently distinct to be readily recognized, and their assumed systematic status, either as a species or a variety, is of little consequence.

A specimen from Port Graham, Kenai Peninsula, collected by Hjalmar Furuhjelm and referred to *Salix lavateri* by Heer,[17] differs so little from a specimen figured on the same plate (fig. 8) and referred to *S. varians* that it is difficult to differentiate between them. Both are more coarsely denticulate than ours, and they do not appear to resemble the species to which they are respectively referred as closely as the Alaskan specimens resemble *S. lavateri*, for in our specimens the denticulations are so fine that the margins appear to be almost entire; but otherwise Heer's specimens agree very closely with ours.

The only records of the species from any region in America other than Alaska were made by Lesquereux,[18] from the Miocene (?) of Oregon, and by Knowlton,[19] from the Eocene (?) of the Yellowstone National Park; but neither of these records includes any description or illustration of the specimens.

Locality: Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182).

---

[10] 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. 10, pl. 1, fig. 22, 1878 [not *Salix elliptica* Sleich, 1815], =*Salix merriami* Cockerell, T. D. A., Descriptions of Tertiary plants: Am. Jour. Sci., 4th ser., vol. 26, p. 543, 1908.

[11] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 168, pl. 22, figs. 4, 5, 1878.

[12] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 247, pl. 55, fig. 6, 1883.

[13] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 54, pl. 65, fig. 2, 1898.

[14] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 38, pl. 7, fig. 6, 1900.

[15] Knowlton, F. H., Fossil plants of the Esmeralda formation: U. S. Geol. Survey 21st Ann. Rept., pt. 2, p. 212, pl. 30, fig. 22, 1900.

[16] Schimper, W. P., Traité de paléontologie végétale, vol. 2, p. 667, pl. 88, fig. 16, Paris, 1872.

[17] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 2, fig. 10, 1869.

[18] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 35, 1888.

[19] Knowlton, F. H., Fossil flora of the Yellowstone National Park; U. S. Geol. Survey Mon. 32, pt. 2, p. 697, 1899.

Salix varians Goeppert

Plate 31, figure 5

Salix varians Goeppert, Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsche geol. Gesell., Zeitschr., vol. 4, p. 493, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 26, pl. 19, figs. 17, 18; pl. 20, figs. 1, 2, 1855.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 2, fig. 8; pl. 3, figs. 1–3, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

There can be no doubt in regard to the identity of our specimen with this species as described and figured by Goeppert; but most of the specimens from Alaska figured by Heer were evidently much larger leaves, in which the marginal denticulations, although fine, are relatively coarse and distinctly visible—characters that apparently indicate specific relationship with *Salix macrophylla* Heer,[20] which the author says "ist nahe verwandt mit der *Salix varians*"—whereas in ours and in the type specimens the denticulations are microscopic in size. The specimens upon which Heer based his identifications were collected by Hjalmar Furuhjelm at Ninilchik and Port Graham, Kenai Peninsula.

The species was recorded from several localities in British Columbia by Dawson [21] and Penhallow,[22] from California by Lesquereux,[23] and from Oregon,[24] Washington,[25] and the Yellowstone National Park by Knowlton.[26] The only satisfactory one of these records, however, is in connection with the specimen from California described and figured by Lesquereux. This figure apparently represents the species. In reregard to the Oregon specimen, which is not figured, Knowlton says: "I regard this identification as more or less doubtful." The Washington record consists merely of the name, without description or illustration; and the figure of the Yellowstone specimen indicates a leaf with entire margin, although Knowlton's description reads: "The example figured certainly belongs to this species. It is the same shape, but a little larger, and has the same erose-dentate margin and the same midrib and general nervation." To judge from the figure alone, however, it would appear to be more nearly referable to *Salix grandifolia* Weber. (See p. 72.)

In the Old World *Salix varians* is a Miocene species, and it may, apparently, be also so regarded in the United States.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821).

Salix wimmeriana Goeppert

Salix wimmeriana Goeppert, Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 493, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 26, pl. 21, figs. 1–3, Görlitz, 1855; Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 201, 1861.

Salix wimmeriana Goeppert as a synonym for *S. varians* Goeppert, Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 881, 1896.

Whether or not *Salix wimmeriana* should be regarded as distinct from or specifically identical with *Salix varians* is, apparently, merely a matter of individual opinion. Heer [27] treated them as a single species and relegated *S. wimmeriana* to synonymy. Goeppert, the author of both specific names, protested against this interpretation of their systematic status, in connection with his description of a specimen collected by Lt. Peter Doroschkin at Ninilchik, Kenai Peninsula, in the Matanuska-Cook Inlet region, in the following words:[28]

Die Mitte eines Weidenblattes, wohl von *Salix wimmeriana*, einer Art, die ich nicht, wie Heer meint, mit der *Salix varians* zu vereinigen vermag, und die namentlich durch die abgerundete Form ihrer Basis viel mehr von *S. varians* abweicht als die von Heer aufgestellte *Salix macrophylla* die ich in derselben Grösse, wie Heer zu Oeningen, in Schossnitz beobachtete, ahne sie deswegen als besondere Art betrachten zu können.

Salix macrophylla Heer

Salix macrophylla Heer, Über die an der hohen Rhonen entdeckten fossilen Pflanzen: Schweiz. naturf. Gesell. Verh., 1846, p. 36, 1847; Flora tertiaria Helvetiae, vol. 2, p. 29, pl. 67, figs. 1a–1e, 2, 3a–3c, 4, Winterthur, 1856; K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 66, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 2, fig. 9, 1869.

Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 113, pl. 4 [6 on plate], fig. 5, St. Petersburg, 1871.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 217, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

Fragmentary remains of a leaf collected at Port Graham, Kenai Peninsula, in the Matanuska-Cook

---

[20] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 29, pl. 67, figs. 1a, b, c, d, e, 2, 3a, b, c, 4, Winterthur, 1856.

[21] Dawson, J. W., On collections of Tertiary plants from the vicinity of the city of Vancouver, B. C.: Roy. Soc. Canada Trans., 2d ser., vol. 1, sec. 4, p. 147, pl. 6, fig. 11, 1895.

[22] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 86, 1908.

[23] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 247, pl. 55, fig. 2, 1883.

[24] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 30, 1902.

[25] Knowlton, F. H., in Smith, G. O., U. S. Geol. Survey Geol. Atlas, Ellensburg folio (no. 86), p. 3, 1903.

[26] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 697, pl. 85, fig. 3, 1899.

[27] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, pp. 26–28, Winterthur, 1856.

[28] Goeppert, H. R., op. cit. (Schlesische Gesell.), pp. 201–202.

Inlet region, by Hjalmar Furuhjelm, were figured by Heer in his Flora fossilis alaskana and referred to this species. It is apparently specifically identical with certain leaves figured in plate 3, figures 1–3, of the same work and referred to *Salix varians* Goeppert. (See p. 71.)

Salix tenera Alex. Braun

Plate 34, figures 8–10

Salix tenera Alex. Braun, Neues Jahrb., 1845, p. 169.
Heer, Flora tertiaria Helvetiae, vol. 2, p. 32, pl. 68, figs. 7–13, Winterthur, 1856.

Although this species has not heretofore been recorded from any American locality the identity of our specimens appears to be reasonably certain. The leaves are narrowed to the bases, and the margins are entire or so minutely denticulate as to be indiscernible.

It is represented in the Miocene and Pliocene of Switzerland, Italy, and the Balkan States and the Eocene (?) of Greenland; and a single specimen from the latter region was described and figured by Heer [29] which, except for its smaller size, is identical in appearance with the specimens represented by our figure 8. Those represented by figures 9 and 10 have bases that are somewhat less attenuated, thus approaching the closely allied species *Salix media* Alex. Braun as depicted by Heer,[30] Lesquereux,[31] and other authors. In fact, the distinction between these two so-called species is considerably less than the differences between many of the leaf forms commonly included under the single species *Salix varians* Goeppert. (See p. 71.)

Localities: Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182) (pl. 34, fig. 8). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 34, figs. 9, 10).

Salix grandifolia Weber

Plate 28, figure 4; plate 30, figure 1

Salix grandifolia Weber, Palaeontographica, vol. 2, p. 178 (64), pl. 20 (3), figs. 1a–1c, 1851.

Our figure 1 is practically identical with Weber's figures of this species from the Tertiary (Oligocene?) of Germany, except that the base, although wedge-shaped, is less attenuated. It is also apparently identical with a leaf from the Miocene of the Yellowstone National Park, referred by Knowlton [32] to *Salix varians* Goeppert [33] as described and depicted by Heer; [34] but, if Knowlton's figure correctly depicts the specimen, it has, like ours, an entire margin and a wedge-shaped base, whereas *Salix varians* has a margin that is dentate or denticulate and a base that is blunt and rounded.

Our figure 4 apparently represents a somewhat smaller specimen of the species.

Whether or not *Salix grandifolia* is actually and properly referable to the genus *Salix* may be regarded as an open question; and in this connection it is of interest to note the words of Weber in his discussion of its probable systematic position:

> Ich gestehe gern, dass mir die Bestimmung dieses Blattes einigermassen unsicher erscheint; ich finde unter den Blättern lebender Pflanzen nirgends eine recht schlagende Aehnlichkeit. Doch habe ich mich bereits früher dafür ausgesprochen, dass man nach sorgfältiger Vergleichung immer besser thut, einem bestimmten Geschlechte die einzelnen Arten unterzuordnen, als sie unter dem nichtssagenden Ausdrucke *Phyllites* laufen zu lassen.

The genera *Rhododendron*, *Ligustrum*, and *Laurus* are then mentioned as worthy of investigation for comparison of foliar characters. Inasmuch, however, as our specimens are associated, in the same collection, with unquestionable leaves and fruit of *Salix* (see pl. 34), I have but little doubt that the generic name is correctly applied.

Until its identification as an element in the Tertiary flora of Alaska, the species does not appear to have been recognized elsewhere than in connection with the type specimens from the Old World.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 28, fig. 4.) Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182) (pl. 30, fig. 1).

Salix raeana Heer

Plate 34, figure 5, 6a; plate 117, figure 3

Salix raeana Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 276, 1866; Flora fossilis arctica, vol. 1, p. 102, pl. 4, figs. 11–13; pl. 47, fig. 11; p. 137, pl. 21, fig. 13, 1868.
Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 8, fig. 6, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 260, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 218, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

Our specimens are apparently large leaves of this species, which varies considerably in size and shape.

[29] Heer, Oswald, Nachträge zur Miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 1, p. 21, pl. 4, fig. 11a, 1874.
[30] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 32, pl. 68, figs. 14–19, Winterthur, 1856.
[31] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr Rept., vol. 7, p. 168, pl. 22, fig. 3, 1878.
[32] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 697, pl. 85, fig. 3, 1899.
[33] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsche geol. Gesell. Zeitschr., vol. 4, p. 395, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 26, pl. 19, figs. 17, 18; pl. 20, figs. 1, 2, Görlitz, 1855.
[34] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 26, pl. 65, figs. 1–3, 6–16, Winterthur, 1856.

In shape a leaf from the Mackenzie River region in British America, represented by Heer's figure 13, plate 21, approaches ours most nearly. Our specimens may be compared with one from Greenland, also figured by Heer.[35]

A specimen collected at Cook Inlet by W. H. Dall in 1880 was figured and referred to the species by Lesquereux.[36] This specimen compares very closely with ours, both in size and shape, differing only in the apex, which is indicated as more sharply acuminate.

The species was recorded by Penhallow [37] from several Eocene (?) localities in Canada and, provisionally, by Lesquereux,[38] from the Miocene of Oregon; but neither of these records is accompanied by illustrations or descriptive text. A fragmentary specimen from the Miocene of Virginia, however, that apparently represents a small lanceolate form of the species was described and figured by Berry.[39]

The larger leaves of the species are difficult to differentiate satisfactorily from *Salix grönlandica* Heer,[40] which, according to the author's description, differs from *S. raeana* mostly in the secondary nervation, in connection with which the nerves are described as "fewer and therefore wider apart." In general it may be said that the larger, broader forms of *S. raeana* differ from *S. grönlandica* far less than many of the larger and smaller forms of *S. raeana* differ from each other.

Localities: Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182) (pl. 34, figs. 5, 6a). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 117, fig. 3).

Salix libbeyi Lesquereux?

Plate 34, figures 4, 6b, 6c

Salix libbeyi Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 156, pl. 31, fig. 3, 1883.

Our two specimens show a considerable variation in size, and each of them is smaller than Lesquereux's figure of the type, from the Miocene of Colorado, but otherwise they appear to compare very closely with it. Lesquereux regarded it as closely related to *Salix abbreviata* Goeppert,[41] but it might equally well or better be compared with *Salix integra* Goeppert;[42] and a specimen from the Eocene (?) of Wyoming, described and figured by Lesquereux [43] and referred to *S. integra*, is hardly distinguishable from the small specimen represented by our figure 4.

A great variety of leaf forms were included by Goeppert in the two species *S. abbreviata* and *S. integra*, and in each are leaves that are oblanceolate or oblong, similar to ours and to *S. libbeyi;* but most of the specimens figured differ widely from these, and it would be almost impossible to select any particular leaf form that could be recognized as typical of either species, whereas *S. libbeyi* is well defined.

In general we may say that our smaller specimen may be compared with certain forms of *S. abbreviata* and *S. integra*, and the larger one with *S. libbeyi*, but that the comparison in either case can hardly be regarded as conclusive.

Locality: Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182).

Salix abbreviata Goeppert

Plate 30, figure 2

Salix abbreviata Goeppert, Deutsche geol. Gesell. Zeitschr., vol. 4, p. 495, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 25, pl. 17, figs. 4–11, Görlitz, 1855.

These specimens, although too imperfect for accurate and thoroughly satisfactory comparison, are apparently referable to Goeppert's species based upon specimens from the Tertiary (Miocene?) of Silesia. It has not been heretofore recorded from America and only sparingly from the Old World.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Salix pilosula Goeppert

Salix pilosula Goeppert, Acad. imp. sci. St.-Pétersbourg Bull., vol. 3, p. 456, 1861.

Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 108, St. Petersburg, 1871.

This specimen, collected by Lt. Peter Doroschkin at Ninilchik, on the west coast of Kenai Peninsula, is almost certainly the one originally described by Goeppert,[44] without any specific name, as

[35] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 76, pl. 49, fig. 2, 1883.

[36] Lesquereux, Leo, Contributions to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 8, fig. 6, 1882 [1883].

[37] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 86, 1908.

[38] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 17, 1888.

[39] Berry, E. W., A Miocene flora from the Virginia Coastal Plain: Jour. Geology, vol. 17, p. 23, fig. 2, 1909.

[40] Heer, Oswald, Ueber den versteinerten Wald von Atanekerdluk in Nordgrönland: Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 276, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 101, pl. 4, figs. 8–10, 1868.

[41] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsche geol. Gesell. Zeitschr., vol. 4, p. 493, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 25, pl. 17, figs. 4–11, Görlitz, 1855.

[42] Idem (Schossnitz), pl. 19, figs. 1–16.

[43] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 167, pl. 22, fig. 2, 1878.

[44] Goeppert, H. R., Ueber die Tertiärflora der Polargegenden: Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 202, 1861.

Ein *Salix*-Blatt, dessen untere vorliegende Fläche mit zahlreichen feinen, die Nerven verdeckenden und von ihrer Verbreitung ganz unabhängigen Längsstrichen versehen ist, *die ich von Haaren ableite, in welchem Falle es als neue Art anzusehen ist,*[45] da wir bis jetzt noch nirgends ein behaartes Weidenblatt gefunden haben.

The species, or rather the specific name, was not subsequently mentioned by Goeppert or by any other author, so far as I am aware, except by Eichwald in his list of Goeppert's species from Alaska.

Salix integra Goeppert?

Salix leaf, Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 202, 1861.

Salix integra Goeppert. Knowlton, Geol. Soc. America Bull., vol. 5, p. 581, 1894: U. S. Nat. Mus. Proc., vol. 17, p. 218, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

This specimen, collected by Lt. Peter Doroschkin at Ninilchik, on the west coast of Kenai Peninsula, in the Matanuska-Cook Inlet region, is described by Goeppert as "Ein *Salix*-Blatt, mit keiner der bekannten Arten recht übereinstimmend, am nächsten noch mit *Salix integra* m." It is, however, listed by Knowlton under the species suggested for comparison by Goeppert.

Salix minuta Knowlton

Salix minuta Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 218, pl. 9, fig. 1, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

This species was based upon a single specimen [U. S. Nat. Mus. no. 3761], collected by C. H. Townsend in 1890 at Herendeen Bay, Alaska Peninsula. It has not been since identified in any of the collections from Alaska or elsewhere, so far as I am aware.

Salix sp. Heer

Salix sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868.

One of the specimens collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was listed merely under its generic name by Heer. It was, perhaps, subsequently included under *Salix varians* Goeppert. (See p. 71.)

Pistillate ament of Salix sp.?

Plate 34, figure 3

Associated with leaves of *Salix raeana* Heer, *S. lavateri* Alex. Braun, and *S. libbeyi* Lesquereux, occasionally in the same piece of matrix with the leaves, are specimens of more or less dismembered aments that evidently belong to one or another of the above species. A part of a pistillate ament is represented in our figure.

Locality: Herendeen Bay, west side, opposite Marble Point, Alaska Peninsula (original no. 19); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5182).

Order MYRICALES

Family MYRICACEAE

Genus COMPTONIA Banks

Comptonia cuspidata Lesquereux

Plate 2, figure 1b; plate 33, figures 4–6

Comptonia cuspidata Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 445, pl. 6, figs. 10–12, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 258, 1883.

Myrica (*Comptonia*) *cuspidata* (Lesquereux) Dawson, G. M., Roy. Soc. Canada Trans., vol. 8, sec. 4, p. 80, fig. 9, 1890. Knowlton, Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 221, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

Comptonia cf. *C. cuspidata* Lesquereux, Knowlton, U. S. Geol. Survey Bull. 467, p. 57, 1911.

The specimens upon which Lesquereux based this species were collected by W. H. Dall in 1880 at Coal Harbor, Unga Island, Alaska Peninsula, where it was found associated with *Osmunda doroschkiana* Goeppert (see p. 40), and it is interesting to note this same association of species in our specimens. In fact, in figure 1, plate 2, the two species may be seen preserved in one and the same piece of matrix. Incidentally it may be noted that Knowlton, as a result of his examination of these specimens, remarked that the species "may be new."

The species was also recorded from the Miocene (?) of British Columbia by Dawson under the name *Myrica* (*Comptonia*) *cuspidata;* and a closely similar species from the same locality is *Comptonia columbiana* Dawson,[46] which may well be regarded as identical with it.

Locality: Head of Herendeen Bay, east of Portage Valley, Alaska Peninsula (original no. 10); collected by W. W. Atwood in 1908 (lot 5180).

Comptonia praemissa Lesquereux

Comptonia praemissa Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 445, pl. 6, fig. 13, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 258, 1883.

Myrica (*Comptonia*) *praemissa* (Lesquereux) Knowlton, Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

Lesquereux's description and figure of this species were based upon specimens collected by W. H. Dall in 1880 at Chicknic [Chignik] Bay, Alaska Peninsula (fide Lesquereux), although Knowlton gives Coal Harbor, Unga Island, as Dall's locality.

[45] The italicizing is mine.—A. H.

[46] Dawson, G. M., op. cit., p. 81, fig. 10.

So far as I am aware the type specimen represents the only record of the species.

Genus MYRICA Linnaeus

Myrica (Comptonia) vindobonensis (Ettingshausen) Heer

Myrica (Comptonia) vindobonensis (Ettingshausen) Heer, Flora tertiaria Helvetiae, vol. 2, p. 34, pl. 70, figs. 5, 6, Winterthur, 1856; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 3, figs. 4, 5, 1869.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 583, 1893; U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.
Dryandra vindobonensis Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 1, p. 18, pl. 3, fig. 6, 1851.
Myrica vindobonensis Ettingshausen. Hollick, U. S. Geol. Survey Bull. 500, p. 50, 1912.

Two specimens from Ninilchik, on the west coast of Kenai Peninsula, in the Matanuska-Cook Inlet region, collected by Hjalmar Furuhjelm, were described and figured by Heer in his Flora fossilis alaskana as belonging to this species; but a comparison of his figures with the figure of Ettingshausen's type of the species indicates but little more than a probable family or a possible generic relationship. However, a great diversity of leaf forms were referred to the species by Unger [47] and other authors, and Heer merely followed their lead. Specimens from the Baltic provinces of Prussia, that somewhat resemble those from Alaska, were also described and figured by Heer [48] under the same specific name, and it is possible that these might all be regarded as specifically identical with each other, but not with *Myrica vindobonensis* as represented by the figure of the type of the species, or to specimens subsequently referred to the species by Heer.

I am inclined to believe, however, that in any critical revision of the genus, Heer's two specimens from Alaska, or at least the smaller one, would be referred, without question, to *Myrica schlechtendali* Heer [49] and not to any one of the many forms of *M. vindobonensis*, and in this connection it is of interest to note that *M. schlechtendali* has not been heretofore recorded from elsewhere than the type locality at Bornstadt, in Saxony.

A specimen originally identified as *M. vindobonensis*, collected by Theodore Chapin in 1910 in the Matanuska coal field at the 4,800-foot point in the traverse of the Matanuska River west from Moose Creek (original no. 4, lot 5901), was included by me [50] in a list of fossil plants of that region; but its specific identity is open to question.

[47] Unger, Franz, Die fossile Flora von Kumi auf der Insel Euboea: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 27, p. 46 [22], pl. 4, figs. 20–30, 1867.

[48] Heer, Oswald, Beiträge zur Naturkunde Preussens: Miocene baltische Flora: no. 2, p. 32, pl. 7, figs. 5–10, Königsberg, 1869.

[49] Heer, Oswald, in Zincken, C., Neues Jahrb., 1867, p. 83; Ueber die Braunkohlenpflanzen von Bornstädt: Naturf. Gesell. Halle Abh., vol. 11, p. 12, pl. 1, fig. 7, 1869.

[50] Hollick, Arthur, in Martin, G. C., and Katz, F. J., Geology and coal fields of the Matanuska Valley, Alaska: U. S. Geol. Survey Bull. 500, p. 50, 1912.

Myrica banksiaefolia Unger

Myrica banksiaefolia Unger, Synopsis plantarum fossilium, p. 214, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxvii, Leipzig, 1845; Genera et species plantarum fossilium, p. 395, Vienna, 1850; K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 160 [30], pl. 27 [6], figs. 3, 4; pl. 28 [7], figs. 2–6, 1850.
Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 28, pl. 2, fig. 11, 1869.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 221, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

A single specimen of this species, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was identified, described, and figured by Heer, and this constitutes the only published record of its occurrence on the North American continent. Certain figures of the species—for example, figure 5, plate 28 [7], in Unger's work on the flora of Sotzka and some of the figures under *Dryandroides banksiaefolia* in Heer's work on the Tertiary flora of Switzerland [51]—appear to be so closely similar to certain figures referred to forms of *M. lignitum*, such as the variety *serrata* of Ettingshausen and Standfest,[52] that it is difficult, if not impossible, to separate one from the other satisfactorily.

A revision of all the fossil forms that have been referred to the genus, based upon critical examinations of the specimens, is greatly to be desired, as specific and varietal separations and segregations, based upon comparisons of figures alone, can never be regarded as conclusive or satisfactory.

Myrica banksiaefolia curta Hollick, n. var.

Plate 32, figures 2, 3; plate 109, figures 14–16

Leaves 4 to 6 centimeters in length by 1 to 1.5 centimeters in maximum width, linear-elliptical, tapering to base and apex, uniformly serrate-dentate, the serrations diminishing in size and disappearing in the vicinity of the base; venation simply pinnate, craspedodrome; secondary nerves all diverging at obtuse, almost right angles from the midrib, curving upward toward their extremities in the marginal dentitions.

These leaves are, perhaps, referable to one or another of the many Tertiary leaf forms that have been included at one time or another under various specific and varietal names in the genera *Myrica*, *Myricophyllum*, *Dryandroides*, etc., but critical analyses of descriptions and careful comparisons of figures have

[51] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 102, pl. 100, figs. 3–10, Winterthur, 1856.

[52] Ettingshausen, Constantin von, and Standfest, Franz, Über *Myrica lignitum* Unger und ihre Beziehungen zu den lebenden *Myrica*-Arten: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 54, p. 257 [5], pl. 2, fig. 24, 1888.

failed to identify our specimens satisfactorily with any particular one of the species or varieties to the exclusion of certain others. For that reason they are here described under a new varietal name in the species which they seem most nearly to resemble.

Myrica banksiaefolia Unger, the species last described, as originally figured by Unger, includes leaves that are long and narrow and one (Unger's pl. 28, fig. 5) that is considerably broader than the others; and a somewhat similar series of leaf forms was subsequently depicted by Heer under the genus *Dryandroides*. Our specimens differ from these figures of the species merely in their shorter lateral dimensions and their relatively greater width as compared with their length—differences which may, perhaps, not be regarded as constituting even a varietal distinction. All the specimens, however, so closely resemble certain forms of *Myrica longifolia* Ludwig [53] and *M. lignitum serrata* Ettingshausen and Standfest,[54] that they might, about equally well, be included under either of these names, and reference to one species or the other becomes largely a matter of mere personal opinion.

Under *Myrica acuminata* Unger [55] a number of specimens have been figured that resemble ours more or less closely, among which may be mentioned two fragments from the Tertiary of Greenland, so identified by Heer,[56] with serrate dentition and secondary nerves that subtend obtuse angles with the midrib, as in ours; but the fragments represent only upper portions of the leaves, and their complete shapes and dimensions cannot be determined. Heer [57] also provisionally identified two specimens from the Tertiary of Saxony that possess characters of dentition and nervation identical with the Greenland specimens, and these compare very closely with ours except in their much larger size. Incidentally it may also be remarked that the figures of the specimens from Saxony are more or less suggestive of the figure of a specimen from Alaska identified by Heer [58] as *Myrica banksiaefolia* Unger. (See p. 75.)

Certain specimens from Colorado and Utah, identified as *M. acuminata* by Lesquereux,[59] are more closely comparable with ours in shape and size than are those previously mentioned, but the secondary nervation is shown as subtending conspicuously acute angles with the midrib; otherwise they might be regarded as identical with ours, irrespective of whether or not Lesquereux's identification of the species was correct.

Descriptions and figures of other Tertiary species that may be considered in this connection are *Myrica nigricans* Lesquereux,[60] from the Eocene (Green River) shales of Wyoming; *M. rigida* Lesquereux,[61] from the Miocene of Florissant, Colo., which he described as intermediate between *M. acuminata* Unger and *M. zachariensis* Saporta;[62] and *M. zachariensis* as identified by Lesquereux [63] from Florissant, Colo., and Alkali station, Wyo.

Localities: Cape Douglas, Alaska Peninsula, middle one of three small coves on east side of cape; collected by R. W. Stone in 1904 (lot 5939) (pl. 32, figs. 2, 3). Summit of mountain half a mile east of head of north branch of Russel Creek, Alaska Peninsula (original no. P–24); collected by W. R. Smith in 1922 (pl. 109, figs. 14–16).

Myrica (Dryandroides) lignitum (Unger) Saporta

Plate 32, figure 4; plate 109, figure 13

Myrica (*Dryandroides*) *lignitum* (Unger) Saporta, Études sur la végétation du sud-est de la France à l'époque tertiare, vol. 2, pt. 2, p. 102, pl. 5, figs. 10A, A′, B, B′, 1866; Annales sci. nat. [Paris], sér. 5, Botanique, vol. 4, p. 246, pl. 5, figs. 10A, A′, B, B′, 1865.

Quercus lignitum Unger, Synopsis plantarum fossilium, p. 217, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxix, Leipzig, 1845; Idem, pt. 1, p. 113, pl. 31, figs. 5–7, 1847.

To few species of fossil leaves have so great a diversity of forms been assigned as have been included under the specific name *lignitum* in the genera *Quercus*, *Dryandroides*, and *Myrica*. If all the leaf forms that have been so included are actually referable to a single species it is about as heterophyllous as any one that is recognized in paleobotanic literature. Unger's three type specimens, figured in his Chloris protogaea, include two quite distinct forms, and subsequent authors added others to the species until a single specific description that would embrace them all became practically impossible.

In 1888 Ettingshausen and Standfest,[64] in a review and discussion of the species, named and figured 30

[53] Ludwig, Rudolph, Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-Formation: Palaeontographica, vol. 8, p. 94, pl. 28, figs. 8, 9; pl. 29, figs. 1, 3, 5–7; pl. 30, fig. 1, 1861.

[54] Ettingshausen, Constantin von, and Standfest, Franz, op. cit., p. 257 [5], pl. 2, fig. 24.

[55] Unger, Franz, Synopsis plantarum fossilium, p. 214, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxvii, Leipzig, 1847; Genera et species Plantarum fossilium, p. 396, Vienna, 1850; Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 160 [30], pl. 27 [6], figs. 5–10; pl. 28 [7], fig. 19, 1850.

[56] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 102, pl. 4, figs. 14, 14b, c, 1868.

[57] Heer, Oswald, Ueber die Braunkohlenpflanzen von Bornstädt: Naturf. Gesell. Halle Abh., vol. 11, p. 13, pl. 2, figs. 1, 1b, 1869.

[58] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 28, pl. 2, fig. 11, 1869.

[59] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 130, pl. 17, figs. 1–4, 1878.

[60] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, suppl., p. 6, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 132, pl. 17, figs. 9–12, 1878.

[61] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 145, pl. 25, figs. 3, 4, 1883.

[62] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 1, pt. 3, p. 47, 1863; Annales sci. nat. [Paris], sér. 4, Botanique, vol. 9, p. 201, pl. 5, fig. 1, 1863, =*Myricophyllum zachariense* Saporta, op. cit., p. 66; p. 220, pl. 8, fig. 2.

[63] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 146, pl. 25, fig. 5; pl. 45, figs. 6–9, 1883.

[64] Ettingshausen, Constantin von, and Standfest, Franz, Über *Myrica lignitum* Unger und ihre Beziehungen zu den lebenden *Myrica*-Arten: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 54, pp. 255–260, pls. 1, 2, 1888.

varieties, and other authors recognized additional forms; and as these have all been figured—some of them several times—the number of published illustrations of the species and its varieties is in excess of 100, hardly any two of which are exactly alike. Our figure 4, plate 32, represents certain of the forms or varieties with crenate-dentate margin and may be most closely compared with the varieties *arguteserrata*, *crenata*, *grandidentata*, *grossedentata*, and *duplicoserrata* of Ettingshausen and Standfest.[65] The specimen represented by our figure 13, plate 109, is too fragmentary for satisfactory comparison with any particular figure, especially as the margin is entirely lacking.

The possible relationship of this and other allied species with the Proteaceae, the Fagaceae, or the Myricaceae was discussed by Saporta in his Études, Ettingshausen,[66] and others, and the specific, generic, and family relationships of most of the described and figured specimens have been questioned at one time or another.

The species, including its numerous varietal forms, has a wide distribution in Europe, but it appears to have been only sparingly recognized in collections from other countries. Heer[67] described and figured a specimen with entire margin, from the island of Sakhalin, and two with dentate margins, from Greenland.[68] Whether or not the Sakhalin specimen is properly referable to the species may, however, be questioned. It does not appear to have been heretofore recognized in any collections from the North American continent, except in connection with five specimens from Arizona, identified and recorded by Lesquereux,[69] but without description or illustration.

Localities: Cape Douglas, Alaska Peninsula, middle one of three small coves on east side of cape; collected by R. W. Stone in 1904 (lot 5939) (pl. 32, fig. 4). Summit of mountain half a mile east of head of north branch of Russel Creek, Alaska Peninsula (original no. P–24); collected by W. R. Smith in 1922 (pl. 109, fig. 13).

Myrica speciosa Unger

Plate 32, figure 1a; plate 33, figure 3

Myrica speciosa Unger, Genera et species plantarum fossilium, p. 396, Vienna, 1850; K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 161 [31], pl. 28 [7], fig. 7, 1850.

It is with some hesitation that these specimens are referred to this species, which does not appear to have been recognized by any author subsequent to Unger. They occur at the same locality and in matrix of the same character as the specimens described and figured under *Myrica banksiaefolia curta* and *M. lignitum*, described above, and, if the policy of segregation of other authors is followed, they might all be considered specifically identical or, possibly, merely varietally distinct.

A form of *M. lignitum* with which our figures may be compared is the variety *irregularis* Ettingshausen and Standfest,[70] and also certain figures of *M. lignitum* depicted by Heer[71] under the genus *Dryandroides* that appear to represent that variety.

Comparison may also be made with certain figures referred by Ludwig[72] to *Myrica ungeri* Heer,[73] especially with his figures 2 and 3, plate 30.

As a matter of fact figures of half a dozen so-called species with which our Alaskan specimens might be more or less satisfactorily identified could be selected from paleobotanic publications, but such identifications would possess no other significance than that attaching to expressions of individual opinion. In general it may be said that in the series of Alaskan specimens referred to *Myrica* in this paper it is possible to recognize three more or less distinct leaf forms, which are discussed under the three specific names *banksiaefolia*, *lignitum*, and *speciosa;* but whether or not they should be regarded as distinct species or merely as varietal forms of one or another of these species is an open question.

Locality: Cape Douglas, Alaska Peninsula, middle one of three small coves on east side of cape; collected by R. W. Stone in 1904 (lot 5939).

Order JUGLANDALES

Family JUGLANDACEAE

Genus JUGLANS Linnaeus

Juglans acuminata Alex. Braun

Plate 117, figure 10

Juglans acuminata Alex. Braun, Lethaea geognostica, vol. 2, p. 867, 1838.

Unger, Genera et species plantarum fossilium, p. 468, Vienna, 1850, Weber, Palaeontographica, vol. 2, p. 210 (96), pl. 23 (6), fig. 8, 1851 [1852].

Goeppert, Schlesische Gesell, vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 204, 1861.

---

[65] Ettingshausen, Constantin von, and Standfest, Franz, op. cit., pl. 2, figs. 25–28.

[66] Ettingshausen, Constantin von, Die Proteaceen der Vorwelt: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., Jahrg. 1851, pp. 711 [3]–745 [37], pls. 30 [1]=34 [5], 1851; Über fossile Proteaceen: Idem, vol. 9, no. 4, pp. 820–824, pls. 57–58, 1852.

[67] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 27, pl. 14, fig. 1b, 1878.

[68] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 77, pl. 102, fig. 11; pl. 103, fig. 8, 1883.

[69] Lesquereux, Leo, List of recently identified fossil plants belonging to the United States National Museum, with descriptions of several new species: U. S. Nat. Mus. Proc., vol. 10, p. 41, 1887.

[70] Ettingshausen, Constantin von, and Standfest, Franz, Über *Myrica lignitum* Unger und ihre Beziehungen zu den lebenden *Myrica*-Arten: K. Akad. Wiss. [Wien], Math.-Naturwiss. Cl., Denkschr., vol. 54, pl. 2, figs. 39, 40, 1888.

[71] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, pl. 99, figs. 9–15, Winterthur, 1856.

[72] Ludwig, Rudolph, Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-Formation: Palaeontographica, vol. 8, p. 95, pl. 29, figs. 2, 2a, 4; pl. 30, figs. 2, 3, 1861.

[73] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 35, pl. 70, figs. 7, 8, Winterthur, 1856.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 38, pl. 9, figs. 1a, b, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896; Alaska, vol. 4, p. 152, Harriman Alaska Expedition, 1894.

This species, originally named by Braun, described by Unger, and figured first by Weber, is widely distributed throughout the Northern Hemisphere. In connection with Alaska, it was identified by Goeppert in a collection from Admiralty Island, southeastern Alaska, made by Lt. Peter Doroschin; by Heer in a collection from Port Graham, Kenai Peninsula, made by Hjalmar Furuhjelm; and by Knowlton in a collection from Kukak Bay, Alaska Peninsula, made by De Alton Saunders. The specimens from Port Graham are figured by Heer in his Flora fossilis alaskana, and they are fairly representative of the species as elsewhere figured by Heer and other authors. The identity of specimens recorded from other localities on the North American continent, however, is very uncertain. An imperfect specimen from the Mackenzie River region of Canada was described and figured by Heer;[74] the species was recorded, without illustration, from British Columbia, by Penhallow;[75] a fragmentary specimen from the Pleistocene of Maryland was provisionally referred to the species by Hollick;[76] an almost perfectly preserved leaf, from the Miocene of Oregon, was given the name, provisionally, by Knowlton,[77] on the strength of the identification of the specimen by Lesquereux, despite the fact that it has a denticulate margin; and a leaf with entire margin and numerous rather rigid, subparallel secondary nerves and a thick midrib, from the Eocene (Raton formation) of Colorado was identified by Knowlton[78] and referred to the species with the brief remark: "I am not able to distinguish this from leaves so referred by other students."

The species has been tentatively identified in several of the collections made in recent years in Alaska, but it belongs to such a common, polymorphous type of leaf that any except perfect specimens might readily be mistaken for any one of several other species, or vice versa. The one specimen selected for illustration appears to be fairly representative of the species.

Locality: Nenana coal field, Tanana region, Coal Creek just west of Healy Creek Coal Corporation's mine (original no. 23AC 7); collected by S. R. Capps in 1923 (lot 7622).

Juglans acuminata latifolia (Alex. Braun) Heer

Plate 41, figure 3

Juglans acuminata latifolia (Alex. Braun) Heer, Flora tertiaria Helvetiae, vol. 3, p. 88, pl. 129, figs. 2–8, Winterthur, 1859.

Juglans latifolia Alex. Braun, Neues Jahrb., 1845, p. 17.

Whatever may be thought of the varietal or specific status of *Juglans latifolia*, there can be little question that our leaf is identical with those from the Miocene of Switzerland that Heer described and figured as the variety *latifolia* of Alex. Braun's *Juglans acuminata*, especially when compared with his figure 2 above cited.

Apparently the form *latifolia* has not heretofore been recognized in any American collections, either as a species or a variety, and none of the many figured specimens of *Juglans acuminata* in American paleobotanic literature appear to be referable to it.

Locality: Yukon River, north bank, central Yukon region, at Drew's mine (original no. 14); collected by W. W. Atwood in 1907 (lot 4708).

Juglans strozziana Gaudin?

Plate 103, figure 1b

Juglans strozziana Gaudin, Allg. schweiz. Gesell. gesammt. Naturwiss. Verh. (Versammt. 42), p. 60, 1857.

Gaudin and Strozzi, Soc. helvétique sci. nat. Nouv. mém., vol. 16, no. 3, p. 39, pl. 8, figs. 7, a, b, 8, 1858.

This species, to which our specimen appears to be referable, was originally based upon specimens of leaflets from rocks of supposed Pliocene age in Italy; but subsequently Heer[79] referred certain leaflets from the Eocene of Greenland to the species. These appear to be the only specimens, other than ours from Alaska, that have been recorded from elsewhere than the type locality, and it can hardly be said that the identifications are entirely satisfactory, especially as it is very difficult to distinguish between certain of these figures and certain of the narrow-leaved forms of *Juglans acuminata* Alex. Braun[80] and *J. rugosa* Lesquereux.[81] In shape our specimen also resembles *J. longifolia* Heer,[82] but that species is much larger, and only a single figure of it is available for comparison. This is of doubtful specific validity, and after the original specific description and figure were pub-

[74] Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, no. 3, p. 15, pl. 1, fig. 2c, 1880.

[75] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 59, 1908.

[76] Hollick, Arthur, Systematic paleontology of the Pleistocene deposits of Maryland: Maryland Geol. Survey, Pliocene and Pleistocene, p. 220, pl. 72, fig. 15, 1906.

[77] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 35, pl. 3, fig. 5, 1902.

[78] 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. 292, pl. 65, fig. 1, 1917 [1918].

[79] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 125, pl. 49, figs. 3–6, 1868; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 99, pl. 86, figs. 13, 14, 1883.

[80] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 128, fig. 10, 1859. Knowlton, F. H., Fossil plants from Kukak Bay: Alaska, vol. 4, pl. 33, fig. 3, Harriman Alaska Expedition, 1904.

[81] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, pl. 55, fig. 2; pl. 56, fig. 1, 1878, etc.

[82] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 91, pl. 129, fig. 10, Winterthur, 1859.

lished it does not appear to have been mentioned by Heer; and the only reference to it by any other author was made by Ettingshausen,[83] without any accompanying illustration.

That our specimen is referable to one or another of the four species discussed appears to be certain, and inasmuch as specific differentiation is difficult in connection with certain figures of these species, I have decided to refer our specimen, tentatively, to the species recognized by Heer for leaflets of closest general resemblance to it.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Juglans salicifolia Goeppert

Plate 28, figure 3

Juglans salicifolia Goeppert, Deutsche geol. Gesell. Zeitschr. vol. 4, p. 495, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 36, pl. 25, figs. 4, 5, Görlitz, 1855.

It is with some hesitation that I have decided to recognize *Juglans salicifolia* as a distinct and valid species and to refer our specimen to it, rather than to regard it as a synonym for *J. acuminata* Alex. Braun,[84] in accordance with Heer,[85] or to question its generic relationship as suggested by Menzel [86] under "*Rhus salicifolia* n. sp.," and by Kräusel [87] under "*Juglans ? salicifolia* Goeppert."

None of the examples of foliar diversity in *Juglans acuminata* as figured by Heer appear to be exactly comparable with *Juglans salicifolia* as originally defined and figured by Goeppert, or with either of our specimens, and the same may be said of most of the numerous figures of *J. acuminata* by other authors. The differences may be more easily recognized by the eye than described in words, but in general it may be said that *Juglans salicifolia* is more elongated, and more conspicuously narrowed in the lower part.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129).

Juglans longiapiculata Hollick, n. sp.

Plate 10, figures 1b, 2c; plate 41, figures 1, 2

Leaves inequilateral, oblong obovate, 15 centimeters in length by about 6 centimeters in width across the expanded upper part, curved and ultimately rather abruptly narrowed to an elongated, acuminate apex, tapering toward and terminating in an inequilateral, wedge-shaped base, acute and almost straight on one side, obtuse and more or less rounded on the other; margin entire; secondary veins numerous, diverging at more acute angles on one side of the midrib than on the other, all curving upward toward the margin, where they apparently coalesce and become camptodrome.

These leaves are apparently closely allied to *Juglans laurifolia* Knowlton,[88] from the Miocene of the Yellowstone National Park, from which they appear to differ merely in their larger size and somewhat blunter base, although Knowlton described the margin as "remotely and slightly denticulate", whereas in none of our specimens is there any indication of denticulation.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Juglans thermalis Lesquereux

Plate 60, figure 1a

Juglans thermalis Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, suppl., p. 17, 1872; U. S. Geol. Survey Terr. Rept., vol. 7, p. 287, pl. 56, figs. 3, 4, 1878.

It may seem somewhat hazardous to base a specific identification upon such meager criteria as our one specimen from Alaska and the two figures of the type specimens from the Eocene (Denver formation) of Colorado; but the mutually identical character of the peculiar upright basal secondary veins, combined with the characters of the tertiary nervation, are too apparent to be ignored. Our specimen is somewhat narrower and more oblong than is represented in Lesquereux's figures, but otherwise there does not appear to be any basis for specific differentiation.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Juglans egregia Lesquereux

Plate 22, figure 2b; plate 100, figure 5

Juglans egregia Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 36, pl. 9, fig. 12; pl. 10, fig. 1, 1878.

This well-defined species, originally described and figured by Lesquereux from the Miocene gravel of California, does not appear to have been found elsewhere until specimens were discovered in Alaska that are, apparently, referable to it.

[83] Ettingshausen, Constantin von, Die fossile Flora des Tertiär-Beckens von Bilin, pt. 3: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 29, p. 46, 1869.

[84] Braun, Alex., in Bronn, H. G., Lethaea geognostica, vol. 2, p. 867, Stuttgart, 1838; Die Tertiär-Flora von Oeningen: Neues Jahrb., 1845, p. 170.

[85] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 88, pl. 128, figs. 1–10; pl. 129, fig. 1, Winterthur, 1859.

[86] Menzel, Paul, Über die Flora der Senftenberger Braunkohlen-Ablagerungen: K. preuss. geol. Landesanstalt Abh., n. ser., no. 46, pp. 87–91, pl. 5, fig. 11, 1906.

[87] Kräusel, Richard, Nachträge zur Tertiärflora Schlesiens: Preuss. geol. Landesanstalt Jahrb., 1919, vol. 40, pt. 1, pp. 423–424, 1931.

[88] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 688, pl. 83, figs. 2, 3, 1899.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392) (pl. 22, fig. 2b). Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178) (pl. 100, fig. 5).

Juglans crossii Knowlton

Plate 40, figures 1–4; plate 44, figures 3, 4; plate 103, figure 3a

Juglans crossii Knowlton, U. S. Geol. Survey Bull. 152, p. 122, 1898, =*Juglans denticulata* Heer, 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, pt. 2: Idem, vol. 7, p. 101, pl. 75, figs. 2–10, 1883. Not *Juglans denticulata* Weber, Palaeontographica, vol. 2, p. 211 (97), pl. 6, figs. 10a, b, 1851 [1852].

This species, as represented by the type specimens from Greenland figured by Heer and by our specimens from Alaska, may be readily distinguished from *J. denticulata* Weber, and it was evidently Heer's intention that they should be regarded as specifically distinct, inasmuch as he changed the name of Weber's species to *Pterocarya denticulata* (Weber) Heer [89] and included in it a number of relatively narrow leaf forms from the Miocene of Switzerland and one from the Upper Atane beds of Greenland [90] but retained the name *Juglans denticulata* Heer [91] for leaves similar to and associated with the latter but of broader habit. A similar association of narrow and broad leaves that are apparently specifically identical with those from Greenland occurs in connection with our specimens from the Matanuska region in Alaska, and it is the broader ones, identified as *Juglans denticulata* Heer, that are here figured and discussed under the specific name *crossii*.

So far as I have been able to ascertain, this species, as above defined and delimited, has not been found outside of the Arctic regions, although it was listed by Dawson [92] and by Penhallow [93] from British Columbia, and a specimen from Wyoming, referred to the species, was described and figured by Lesquereux; [94] but these records all are plainly referable to *Juglans denticulata* Weber and not to *J. denticulata* Heer.

The species most likely to be confused with the one here discussed under the name *Juglans crossii* is the one commonly known as *Juglans bilinica* Unger (see below, under *Juglans juglandiformis* (Sternberg) Giebel), and it appears to be probable that certain of the Alaskan leaves here referred to that species and at least one specimen from Greenland so referred by Heer [95] may belong to *J. crossii.* In regard to the Greenland specimen Heer remarked that it most nearly approaches certain forms of *J. bilinica*, but that the teeth are wider apart; and incidentally it may be noted that the figure shows not only the characteristic denticulations of *J. crossii*, confined to the upper portion of the margin, but also the equally characteristic entire, lower portion of the margin and the tapering wedge-shaped base.

Incidentally it may be of interest to note another species that bears a close resemblance to our larger specimens of *Juglans crossii* and to *J. bilinica*, represented by leaves from the Miocene of Bohemia, which seem to have been first described and figured under the name "*Carya ungeri* Ettingsh.", by Unger,[96] in regard to which he remarked:

> Diese Theilblättchen eines offenbar zusammengesetzten Blattes haben bisauf die Grösse solche Ähnlichkeit mit den Theilblättchen von *Carya* [*Juglans*] *bilinica*, dass ich fast Anstand nehme, sie als eine besondere Art zu bezeichnen.

It is evident that considerable rearrangement would result from any critical study and revision of these several species.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 40, figs. 1–4; pl. 103, fig. 3a). Matanuska coal field, 4,800-foot point on traverse of the Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 44, figs. 3, 4).

Juglans juglandiformis (Sternberg) Giebel

Plate 39, figures 1–4, 5–7(?); plate 43, figures 3–5

Juglans juglandiformis (Sternberg) Giebel, Deutschlands Petrefacten, p. 149, Leipzig, 1852.

Phyllites juglandiformis Sternberg, Versuch einer geognostisch-botanischer Darstellung der Flora der Vorwelt, vol. 1, no. 3, p. 39, pl. 35, fig, 1, Leipzig and Prag, 1823.

Hicoria juglandiformis (Sternberg) Knowlton, U. S. Geol. Survey Bull. 152, p. 117, 1898.

These leaves or leaflets, variable in size and shape, appear to be referable to forms of this species as figured by Heer [97] and other authors under the name *Juglans bilinica* Unger.[98] The only previous record of the species in America was by Lesquereux,[99] based

[89] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 94, pl. 131, figs. 5–7, Winterthur, 1859.

[90] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 102, pl. 76, fig. 1, 1883.

[91] Idem, p. 101, pl. 75, figs. 2–10.

[92] Dawson, J. W., On collections of Tertiary plants from the vicinity of the city of Vancouver, B. C.: Roy. Soc. Canada Trans., ser. 2, vol. 1, sec. 4, p. 148, 1895.

[93] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 59, 1908.

[94] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 289, pl. 58, fig. 1, 1878.

[95] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 100, pl. 69, fig. 8, 1883.

[96] Unger, Franz, Sylloge plantarum fossilium, pt. 1: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, p. 40, pl. 18, figs. 1–4, 1860.

[97] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 130, figs. 5–7, 9, 10, 15–17, Winterthur, 1859; Die fossile Flora Grönlands, pt. 2; Flora fossilis arctica, vol. 7, pl. 69, fig. 8, 1883.

[98] Unger, Franz, Genera et species plantarum fossilium, p. 469, Vienna, 1850.

[99] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 191, pl. 39, figs. 1, 2, 13, 1883.

upon certain narrower forms of the leaves from the Miocene of Colorado.

A critical comparison of the figures of the Old World specimens with a figure of a specimen from Greenland, referred to the species by Heer,[1] appears to indicate certain differences in character, especially in connection with the marginal dentitions, which in the Greenland specimen are irregular, more or less triangular denticulations, as compared with the more uniform and regular serrations of the Old World leaves. Our specimens are more nearly like Heer's figure of the Greenland specimen, and I feel some hesitation in referring them, without question, to the Old World *Juglans bilinica.* Certain of our specimens are almost impossible to distinguish from *Juglans denticulata* Heer,[2] which Heer describes as " like *J. bilinica,* but the secondary nerves are nearer the margin, and the teeth are more delicate." The differences between these two species are evidently very slight, and it is impossible to differentiate between them satisfactorily with only fragmentary specimens; but I am inclined to believe that perfect specimens would show differences that would enable us to recognize distinctive specific characters. Our specimens from Alaska, which I have tried to differentiate into the two species, are associated together in the same collections from the Matanuska region, along with certain other species of Juglandaceae and Fagaceae in a manner identical with the association of genera and species figured by Heer[3] in connection with the upper Atane beds of Greenland, and it needs but a glance at Heer's plates to realize the difficulties attending any attempt at a satisfactory differentiation of the genera and species there depicted.

The specimens represented by figures 5–7, plate 39, are referred provisionally to *Juglans juglandiformis,* but they may belong to some other of the several species of *Juglans* or *Hicoria* with which they are associated.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 39, figs. 1–7; pl. 43, figs. 3–5). Matanuska River, 4,800-foot point on traverse of the Matanuska west from Moose Creek, Alaska, Matanuska-Cook Inlet region; collected by Theodore Chapin for G. C. Martin, June 15, 1910 (lot 5901).

Juglans woodiana Heer

Juglans woodiana Heer, Soc. helvétique sci. nat. Neue Denkschr., vol. 21, no. 3, p. 9, pl. 2, figs. 4–7, 1865; K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 449, 1882 [1883]. U. S. Geol. Survey Terr. Rept., vol. 8, p. 263, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

This species is of doubtful validity, but it is admitted into the Tertiary flora of Alaska as a distinct species for the reason that Heer, the author of the species, so recognized it in connection with a specimen from Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region collected by Hjalmar Furuhjelm. Lesquereux also listed the species among the specimens collected at Chignik Bay, Alaska Peninsula, by W. H. Dall in 1880. None of these specimens were figured—in fact, the only published figures of the species, so far as I am aware, are those of the type specimens from British Columbia, which might be compared with certain of the leaf forms referred to *Juglans bilinica* Unger, *J. nigella* Heer, and *J. picroides* Heer, and one figure by McBride,[4] which bears very little resemblance to those of the type specimens.

Juglans nigella Heer

Plate 38, figures 1–5

Juglans nigella Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 38, pl. 9, figs. 2a, b, 2c, 3, 4, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

Newberry, U. S. Geol. Survey Mon. 35, p. 33, pl. 51, figs. 2 (in part), 4, 1898.

This rather well defined species was based by Heer on specimens collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula. Specimens collected by Capt. W. A. Howard, of the U. S. revenue Cutter *Lincoln,* in 1867, at Admiralty Inlet,[5] were subsequently identified by Newberry.

A specimen from the Eocene (Fort Union formation) of North Dakota was described and figured by Lesquereux;[6] one from the same formation in Wyoming by Ward,[7] and several from the Eocene (Raton formation) in Colorado by Knowlton.[8]

[1] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pl. 69, fig. 8.

[2] 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, =*Juglans crossii* Knowlton, the species last described.

[3] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pls. 74, 75, 76, 1883.

[4] McBride, T. H., The Little Missouri badlands: Pop. Sci. Monthly, vol. 23, p. 637, fig. 5, 1883.

[5] This locality, so designated in Newberry's manuscript, has not been satisfactorily identified. It may have been Yakutat Bay, in the Mount St. Elias region, named "Admiralty Bay" by Portlock and Dixon in 1786, or, more probably, it refers to some locality in the vicinity of Admiralty Island, southeastern Alaska, in which region our specimens were collected.—A. H.

[6] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 235, pl. 46A, fig. 11, 1883.

[7] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 552, pl. 40, fig. 6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 33, pl. 15, fig. 1, 1887.

[8] 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. 292, pl. 55, fig. 2; pl. 68, fig. 2, 1917 [1918].

Outside of the United States it has been recorded by Dawson [9] and Penhallow [10] from Canada; by Heer [11] from the island of Sakhalin and Greenland; and by Nathorst [12] and Kryshtofovich [13] from Japan. The Japanese specimen is very fragmentary, however, and its identification is questioned by the author.

Localities: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 3652) (pl. 38, fig. 1). Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 38, figs. 2-4). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 38, fig. 5).

Juglans picroides Heer

Plate 37, figure 2; plate 43, figure 7

Juglans picroides Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.
Juglans (Carya) picroides Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 39, pl. 9, fig. 5, 1869.

This species was based by Heer on a single specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula. It was not subsequently mentioned or referred to by Heer, nor does any except the type specimen appear to have been recognized or recorded by any other author. Specifically it is evidently closely related to *Juglans bilinica* Unger [14] as figured by Heer [15] and other authors, but it was apparently Heer's intention to maintain the specific integrity of his Alaska specimen, with which our leaves appear to be identical.

Close specific relationship is also indicated with *Juglans nigella* Heer (see p. 81), a species based upon specimens found at the same locality as *Juglans picroides;* with *Juglans woodiana* Heer (see p. 81), a species based upon specimens from British Columbia; and with *Juglans sieboldiana fossilis* Nathorst,[16] from Japan.

Localities: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 37, fig. 2). Nenana coal field, Tanana region, near Jinx coal bed, about 300 yards above mouth of Coal Creek; collected by Mrs. John A. Davis in 1923 (lot 7634) (pl. 43, fig. 7).

Juglans valida Hollick, n. sp.

Plate 104, figure 1

Leaflet ovate-lanceolate, sessile, asymmetric proximad, 15 centimeters in length by 5 centimeters in maximum width, tapering to an acuminate apex and rounded to an inequilateral base that is oblique on one side and curved-truncate on the other; margin serrate-crenate dentate; venation pinnate, craspedodrome; secondary veins numerous, diverging at obtuse angles from the midrib below and at more acute angles above, curving upward, occasionally becoming subcamptodrome, with veinlets branching from the under or outer sides, each main vein and veinlet terminating in one of the marginal dentitions; tertiary venation straight or slightly flexed and at approximately right angles to the secondaries throughout.

This large, strongly defined leaflet apparently represents a heretofore undescribed species of *Juglans* but one so closely similar in general appearance to *J. meneghiniana* (Massalongo) Massalongo,[17] from the Miocene of Italy, that, if found in the same beds, I doubt if they would be regarded as specifically distinct. The only difference that may be noted is that our leaf is slightly more alternated distad.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, lower of three horizons (original no. III); collected by W. W. Atwood in 1907 (lot 4392).

Juglans? pseudopunctata Hollick, n. sp.

Plate 104, figures 2-5

Leaflets ovate-lanceolate, 4 to 6 centimeters in length by 1.5 to 2.25 centimeters in maximum width, rounded or slightly cordate at the base, tapering from above the middle to a long, slender, acute apex; margin serrate-dentate toward the apex, doubly serrate-dentate in the middle, becoming entire at the base; venation pinnate, craspedodrome; secondary veins irregularly spaced and disposed, diverging at rather obtuse angles

[9] Dawson, J. W., in Dawson, G. M., Report on explorations in British Columbia: Canada Geol. Survey Rept. Progress for 1875-76, p. 259, 1877.

[10] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 60, 1908.

[11] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 41, pl. 10, figs. 6, 7; pl. 11, figs. 1, 2, 1878; Beiträge zur Miocenen Flora von Sachalin: Idem, no. 4, pp. 9, pl. 4, fig. 10, 1878; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 100, pl. 91, figs. 2b, 6, 1883.

[12] Nathorst, A. G., Zur fossilen Flora Japan's: Palaeont. Abh., vol. 4, no. 3, p. 210 (10), pl. 21 (5), fig. 8; pl. 24 (8), figs. 10(?), 11, Berlin, 1888.

[13] Kryshtofovich, African, A new fossil palm and some other plants of the Tertiary flora of Japan: Geol. Soc. Tokyo Jour., vol. 27, no. 322, p. 7, pl. 13 (1), fig. 2, 1920.

[14] Unger, Franz, Genera et species plantarum fossilium, p. 469, Vienna, 1850, =*Carya bilinica* (Unger) Ettingshausen, Constantin von, Fossile Pflanzenreste aus dem trachytischen Sandstein von Heiligenkreuz bei Kremnitz: K.-k. geol. Reichsanstalt Abh., vol. 1, pt. 3, no. 5, p. 12, pl. 2, fig. 17, 1852, =*Phyllites juglandiformis* Sternberg, K., Versuch einer geognostisch-botanische Darstellung der Flora der Vorwelt, vol. 1, no. 3, p. 39, pl. 35, fig. 1, Leipzig and Prag, 1823, =*Juglans juglandiformis* (Sternberg) Giebel, C. G., Deutschlands Petrefacten, p. 149, Leipzig, 1852, =*Hicoria juglandiformis* (Sternberg) Knowlton, F. H., A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 117, 1898.

[15] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 90, pl. 130, figs. 5-9, Winterthur, 1859.

[16] Nathorst, A. G., Contributions à la flore fossile du Japon: K. svenska vet.-akad. Handl., vol. 20, no. 2, p. 37, pl. 1, figs. 13-17, 18(?), 1883.

[17] Massalongo, A. B., Synopsis florae fossilis Senogalliensis, p. 116, Verona, 1858; Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 394, pl. 32, fig. 2; pl. 43, fig. 7, Imola, 1859, =*Triplaris meneghiniana* Massalongo, Sulla flora fossile di Sinigaglia (Lettera del Dr. Abramo B. Massalongo al chiariss. Sig. Giuseppe Scarabelli), p. 23, Verona, 1857.

from the midrib, soon curving upward, simple or branched distad from the lower side, each main vein and branch terminating in one of the dentitions; tertiary venation at right angles to the secondaries, branched and connected, forming a reticulated network of fine veinlets.

These leaflets appear to be different from any other fossil species of *Juglans* heretofore described; and they are suggestive of certain of the figures of *Rhus meriani* Heer.[18] Heer's figures vary greatly in size and considerably in venation—in fact, they differ among themselves more than our figures differ from them. The secondary venation in all our specimens is practically similar, and the veins diverge from the midrib at angles that are uniformly more obtuse than those shown in Heer's figures, a character which appears to represent the most noticeable difference between them.

We may also compare our figures with the figure of *Ulmus punctata* Alex. Braun (=*Rhus? punctatum* Alex. Braun) fide Heer,[19] from the Tertiary of Switzerland, in regard to which Heer remarked: "Es hat diess Blatt grosse Aehnlichkeit mit dem Fiederblatt von *Rhus* und namentlich mit *Rhus meriani* m." In the circumstances the generic identification of our specimens is questioned.

Localities: Kachemak Bay, near entrance to Fritz Creek, Matanuska-Cook Inlet region (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131) (pl. 104, fig. 2). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 104, fig. 3). Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 3652) (pl. 104, figs. 4, 5).

Juglans townsendi Knowlton

Juglans townsendi Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, pl. 9, fig. 5, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.

The specimen (U. S. Nat. Mus. no. 3762) on which this species was based must have been exceedingly fragmentary, and the figure is of little value for either comparison or identification. It was collected at Herendeen Bay, Alaska Peninsula, by C. H. Townsend, in 1892 (lot 539). The species was not subsequently recognized in any collections from Alaska or elsewhere, so far as I am aware.

Juglans sp.?

Plate 42, figure 1b

This specimen, an imperfect and partly folded leaf, apparently represents one or another of the several species of *Juglans* or *Hicoria* with which it is associated, but any attempt to identify it specifically would be mere guesswork.

Locality: Matanuska coal field, 4,800-foot point on traverse of the Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 40); collected by Theodore Chapin in 1910 (lot 5901).

Genus HICORIA Rafinesque

Hicoria antiquora (Newberry) Knowlton

Plate 37, figure 1

Hicoria antiquora (Newberry) Knowlton, U. S. Geol. Survey Bull. 152, p. 117, 1898.

Carya antiquorum Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 72, 1868; U. S. Geol. Survey Mon. 35, p. 35, pl. 31, figs. 1-4, 1898.

This species is represented by specimens from Alaska Peninsula and, possibly, by some from the Yukon River region. It was reported from several localities in British America by Penhallow,[20] from Washington by Smith and Duror,[21] from Louisiana by Berry,[22] and from localities in Wyoming, Montana, and the Dakotas by Lesquereux,[23] Ward,[24] and Knowlton.[25]

It appears to be a typically American Eocene species, represented in the Wilcox formation in Louisiana, the Paskapoo in British America, and the Lance and Fort Union in the western United States; and certain specimens from Alaska appear to be identical with those figured by Newberry, Lesquereux, and Ward. A species that compares very closely with it, however, is *Hicoria magnifica* Knowlton,[26] from the Eocene of Kukak Bay, Alaska Peninsula; and Knowlton discussed this resemblance between the two species but recognized specific differences.

Locality: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523).

Hicoria magnifica Knowlton

Plate 35, figures 1, 2; plate 36, figures 1, 2; plate 38, figure 6

Hicoria magnifica Knowlton, Alaska, vol. 4, p. 152, pl. 26, fig. 1; pl. 27; pl. 29, fig. 1, Harriman Alaska Expedition, 1904.

---

[18] Heer, Oswald, Gartenflora, vol. 2, p. 297, pl. 66, fig. 11, 1853; Flora tertiaria Helvetiae, vol. 3, p. 82, pl. 126, figs. 5–11, Winterthur, 1859.

[19] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 60, pl. 79, fig. 23, Winterthur, 1856.

[20] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 43, 1908.

[21] Smith, W. S., and Duror, C. A., Stratigraphy of the Skykomish Basin, Wash.: Jour. Geology, vol. 24, p. 575, 1916.

[22] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 187, 1916.

[23] Lesquereux, Leo, The Tertiary flora; U. S. Geol. Survey Terr. Rept., vol. 7, p. 289, pl. 57, figs. 1–5; pl. 58, fig. 2, 1878.

[24] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 552, pl. 60, fig. 7, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 34, pl. 15, fig. 2, 1887.

[25] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 690, 1899; The stratigraphic relations and paleontology of the "Hell Creek beds," "*Ceratops* beds," and equivalents: Washington Acad. Sci. Proc., vol. 11, no. 3, pp. 189, 190, 202, 211, 214, 1909.

[26] Knowlton, F. H., Fossil plants from Kukak Bay: Alaska, vol. 4, p. 152, pl. 26, fig. 1; pl. 27; pl. 29, fig. 1, Harriman Alaska Expedition, 1904.

The three figures of this species above cited (U. S. Nat. Mus. nos. 30080, 30082, and 30085, respectively), collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899, possess a close specific resemblance to *Hicoria antiquora* (Newberry) Knowlton (the species last described), as noted by Knowlton in his discussion of the species. It is, therefore, with some hesitation that I have referred some specimens to one species and other specimens to the other. *Hicoria antiquora* has been found at many localities in the United States and British America, and it is represented by leaflets that include a wide diversity of shapes and sizes, but *H. magnifica* has not been recorded from elsewhere than Alaska.

Localities: Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH 9c); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246b) (pl. 35, figs. 1, 2; pl. 36, figs. 1, 2). Yukon River, north bank, opposite mouth of Hess Creek, central Yukon region (original no. 2AC 140a); collected by A. J. Collier in 1902 (lot 2972) (pl. 38, fig. 6).

Genus PTEROCARYA Kunth

Pterocarya septentrionale Hollick, n. sp.

Plate 40, figures 5–7

Leaves narrowly lanceolate-ovate, 9 to 13 centimeters in length by 2.25 to 3 centimeters in maximum width, tapering to wedge-shaped bases and slender apices; margin entire below, sharply denticulate above; midrib straight or slightly curved; venation pinnate, campto-craspedodrome; secondary veins irregularly disposed, flexuous, diverging at acute angles from the midrib below and at successively more and more obtuse angles above, irregularly camptodrome near the margin, with fine veinlets extending to the denticulations.

These leaves are apparently identical with a leaf from Greenland that Heer [27] referred to *Pterocarya denticulata* Weber sp. [=*Juglans denticulata* Weber [28]], but a comparison of his figure with those of Weber shows no indication of specific identity, although generic relationship may be assumed. In the circumstances, therefore, I have here included the Greenland specimen of Heer with ours from Alaska under the new specific name *septentrionale*.

In Alaska, as in Greenland, the species is associated with broader leaves of similar general type (*Juglans denticulata* Heer, *Quercus juglandina* Heer, *Q. laharpi* Gaudin, etc.), as figured by Heer,[29] and in connection with certain of the specimens, especially those that are more or less fragmentary, it is difficult to identify them satisfactorily with one of the associated species, or to differentiate them from one another. It is interesting to note, however, that the Matanuska region of Alaska contains a Tertiary flora that is identical in many of its most abundantly represented species with the flora that is characteristic of the Upper Atane beds of Greenland.

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original: no. 3); collected by G. C. Martin in 1910 (lot 5892).

Genus ENGELHARDTIA Leschen

Engelhardtia ettingshauseni Berry

Plate 119, figure 3

Engelhardtia ettingshauseni Berry, U. S. Geol. Survey Prof. Paper 91, p. 185, pl. 19, figs. 1, 3, 5, 1916.

I was at first inclined to identify this leaf as a species of *Sapindus*, such as *S. pseudaffinis* Berry,[30] from the Eocene of Tennessee, but the configuration of the base is that of *Engelhardtia* rather than *Sapindus*, and the leaf compares so closely in all its characters with the species to which it is here referred that differentiation between them does not appear possible.

Incidentally it is of interest to note that Berry [31] cited, as identical in part, *Sapindus dubius* Unger, fide Lesquereux,[32] from the Eocene of Kentucky, in connection with which he remarked: [33] "A specimen from Wickliffe that was referred to *Sapindus dubius* by Lesquereux is unquestionably a leaf of this species, *Engelhardtia ettingshauseni*."

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129).

Order FAGALES

Family BETULACEAE

Genus CARPINUS Linnaeus

Carpinus grandis Unger

Plate 47, figure 7a, plate 49, figure 1; plate 50, figure 9

Carpinus grandis Unger, Chloris protogaea, pt. 6, p. lxxix, Leipzig, 1845; Genera et species plantarum fossilium, p. 408, Vienna, 1850; K. Akad. Wiss. [Wien] Denkschr., Math.-naturwiss. Cl., vol. 4, p. 111, pl. 43, figs. 2–5, 1852.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana; Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 2, fig. 12, 1869.

---

[27] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 102, pl. 76, fig. 1, 1883.

[28] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 211 (97), pl. 23 (6), figs. 10a, b, 1851 [1852].

[29] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pls. 74–76, 1883.

[30] Berry, E. W., op. cit., p. 272, pl. 67, fig. 6.

[31] Idem, p. 185.

[32] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 12, 1888.

[33] Berry, E. W., op. cit., p. 186.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 446, pl. 7, figs. 5, 6, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 259, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

This characteristic Tertiary species was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, Matanuska-Cook Inlet region (fide Heer), and by W. H. Dall at Kachemak Bay, Kenai Peninsula (fide Lesquereux), and it is represented in collections from other localities in southern Alaska. Its known distribution embraces practically the whole of the Eurasian continent, including the islands of Sakhalin and Spitsbergen, as well as many localities in the United States, British America, and Greenland.

Specimens from Colorado and Nevada were described and figured by Lesquereux,[34] and from Washington by Newberry,[35] and the species was recorded from Oregon by Knowlton,[36] from Virginia by Berry,[37] and from Vermont by Lesquereux.[38] It was also listed from several localities in British Columbia by Penhallow.[39]

Leaves that vary considerably in form and dimensions have been included in the species from time to time by various authors, and in the literature of European paleobotany it may be found figured in dozens of different sizes and a wide variety of shapes. Heer[40] depicted some 25 specimens in his report on the Tertiary flora of Switzerland alone, and these figures give an excellent idea of the wide variation in the leaves found associated together in a single locality or region.

The Alaskan specimens are mostly small—about 4.5 centimeters in length—and may be compared in shape with the elongated forms from Switzerland represented by Heer's figures 19, 22–24, plate 72; although the two specimens from Kachemak Bay figured by Lesquereux are about 10 centimeters in length and broad in proportion.

Localities: Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 47, fig. 7a). West shore of Cook Inlet, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. 1); collected by C. E. Weaver in 1906 (lot 4130) (pl. 49, fig. 1). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 960); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3522) (pl. 50, fig. 9).

[34] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 143, pl. 19, fig. 9; pl. 64, figs. 8–10, 1878.

[35] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 59, pl. 54, fig. 3 in part; pl. 55, fig. 6, 1898.

[36] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 38, 1902.

[37] Berry, E. W., A Miocene flora from the Virginia Coastal Plain: Jour. Geology, vol. 17, p. 23, 1909.

[38] Lesquereux, Leo, On the fossil fruits found in connection with the lignites of Brandon, Vt.: Am. Jour. Sci., 2d ser., vol. 32, p. 360, 1861.

[39] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 41, 1908.

[40] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 40, pl. 71, figs. 10b, c, d, e; pl. 72, figs. 2–24; pl. 73, figs. 2–4, Winterthur, 1856.

Carpinus sp.

Carpinus sp. Goeppert, Schlesische Gesell. vaterl. Cultur 39te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 201, 1861.

This generic identification was based upon specimens described as having been collected "am Meerbusen Ugolni, einem Theile des kenaischen Meerbusens, der zur Halbinsel Alaschka gehört." This locality was apparently one of the several topographic features known as Coal Bay, Cove, or Harbor, but the description—"a part of Cook Inlet that belongs to Alaska Peninsula"—does not fit any one of the features now known under such name. The nearest are indentations in the shores of Kachemak Bay and Port Graham.

Genus CARPINITES Goeppert and Berendt

Carpinites truncatus Hollick, n. sp.

Plate 49, figure 2

Leaf triangular ovate, about 10 centimeters in length by about 7 centimeters in maximum width; margin somewhat undulate, finely and uniformly denticulate, except at the rounded truncate base, where it is entire; venation pinnate; secondary veins about 7 on each side, irregularly spaced and disposed, all except the basilar ones making angles of about 50° with the midrib, curving upward and branched from the under sides distad, each vein and branch terminating in a denticulation; basilar secondaries weak, at right angles with the midrib, forming submarginal veins close to the entire part of the basal margin; tertiary venation bent, flexed, and forked, at approximately right angles to the supporting secondaries and branches throughout.

This is apparently a type of leaf similar to *Alnus alaskana* Newberry (see p. 94, pl. 51, fig. 8), from which it differs mostly in its truncate instead of rounded base and the wider spacing of its secondaries. The character of the marginal denticulations appears to be identical in both species.

It is also strikingly similar to *Carpinites macrophyllus* Goeppert,[41] an Old World Tertiary species—especially to a leaf figured and referred to the species by Unger,[42] from which it differs so slightly that they might very well be regarded as both specifically and generically identical.

Locality: Nenana coal field, Tanana region, Lignite Creek, north side, bluff between two creeks in eastern part of sec. 30, T. 12 S., R. 6 W., burned beds overlying coal (original no. 7); collected by R. M. Overbeck in 1916 (lot 7266) (pl. 49, fig. 2).

[41] Goeppert, H. R., Beiträge zur Tertiärflora Schlesiens: Palaeontographica, vol. 2, p. 273 (17), pl. 34 (2), fig. 2, 1852.

[42] Unger, Franz, Die fossile Flora von Gleichenberg: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 7, p. 176 (20), pl. 3, fig. 5, 1854.

Genus CORYLUS Linnaeus

Corylus adumbrata Hollick, n. sp.

Plate 47, figure 6; plate 49, figures 5–7

Leaves lanceolate-cordate, from 5 to 9 centimeters in length by 3.75 to 5.50 centimeters in width; margin sharply serrate-dentate below, except in the basilar sinus, undulate-dentate above; venation pinnate, craspedodrome; secondary nerves about 10 on each side, irregularly disposed, the lower ones opposite or subopposite and diverging from the midrib almost at right angles, the lowest pair weak and bent downward, upper ones alternate and subtending more acute angles with the midrib, subparallel, more or less curved upward toward their extremities.

I am in some doubt as to whether the larger of these leaves should be regarded as belonging to the species. The upper part of the margin of this leaf is destroyed, so that it cannot be compared with the corresponding part of the smaller leaves, and the lower part of the margins in the smaller leaves are imperfect so that they cannot be satisfactorily compared with the lower margin of the larger leaf. The general shape, the base, and the arrangement and course of the secondary nerves, however, are identical in both leaves, and I am inclined to believe that the smaller ones merely represent younger individuals than the larger ones.

Although they are too imperfect for complete description or critical comparison, it may be seen that they all possess the general characters of the genus *Corylus* and that they are not very different from certain of the forms described under *C. kenaiana.* (See p. 87.) Also, if it were not for the distinctly dentate margin, the other characters in the larger leaf would suggest relationship with *Quercus dallii* Lesquereux (see p. 103, pl. 52, fig. 4), with which it is associated in the same collection.

It is always hazardous to base a new species upon imperfect material, but it is also a question to decide whether it is better to do this or to run the chance of identifying it erroneously with some other species.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131) (pl. 47, fig. 6). Kachemak Bay, Kenai Peninsula, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 49, figs. 5, 6). West shore of Cook Inlet, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. 1); collected by C. E. Weaver in 1906 (lot 4130) (pl. 49, fig. 7).

Corylus americana fossilis Newberry

Plate 45, figure 3b; plate 48, figures 1–3

Corylus americana fossilis Newberry, U. S. Geol. Survey Mon. 35, p. 60, pl. 29, figs. 8–10, 1898.

Corylus americana Walter. Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 59, 1868.

The type specimens of these leaves, from the Eocene (Fort Union formation) of North Dakota, were originally referred by Newberry to the living species *Corylus americana*, and subsequently he added the varietal name *fossilis*, which is here adopted.

The dentitions in our specimens are somewhat sharper than they are depicted in Newberry's figures, but otherwise the leaves appear to be identical. A number of specimens from the Fort Union formation of Montana were described and figured by Ward,[43] and the species was recorded from several localities in British Columbia and listed by Penhallow;[44] otherwise it does not appear to have been recognized in paleobotanic literature, although certain figures of specimens referred to *Corylus macquarrii* (Forbes) Heer [45] (see p. 88) are exceedingly difficult to differentiate from it; and the probability appears to be that the particular figures cited and certain others that might be selected could, with equal propriety, be referred to *C. americana fossilis.*

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 45, fig. 3b; pl. 48, figs. 1, 2). Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186) (pl. 48, fig. 3).

Corylus evidens Hollick, n. sp.

Plate 49, figure 3

Leaf ovate-acuminate, 8 centimeters in length by 5 centimeters in maximum width; margin finely serrate-dentate near base and apex, coarsely dentate between, with the dentitions finely dentate or denticulate; venation simply pinnate, craspedodrome; secondary veins irregularly disposed, about 15 on each side, subparallel, almost straight or slightly curved upward, mostly diverging at angles of about 45° from the midrib, the upper ones somewhat more acute, the lower ones more obtuse, each one terminating in one of the marginal dentitions, the median veins branched distad from their under sides, each branch terminating in one of the minor denticulations; tertiary venation fine, closely approximated, well defined, bent, forked, angled, approximately at right angles to the secondaries, forming a fine network of irregular-shaped areolae throughout the lamina.

This leaf is described as a new species largely for the reason that its characters are so well preserved and so clearly defined, although it might be tentatively

---

[43] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 551, pl. 38, figs. 1–5, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 28, pl. 11, figs. 3–5; pl. 12, figs. 1, 2, 1887.

[44] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 47, 1908.

[45] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 4, figs. 2–4, 1869.

identified with certain of several previously described fossil species in the genus *Alnus*, especially *Alnus kefersteinii* (Goeppert) Unger, from Alaska and the island of Sakhalin, as identified and figured by Heer.[46] A large number of leaf forms have been referred to this species, from time to time, by various authors; and some of these can hardly be distinguished from other leaf forms that have been referred to certain species of *Corylus*—for example, *Corylus macquarrii* (Forbes) Heer.[47] The leaves of our existing species in these two genera frequently vary more or less on individual plants, and it seems likely that in any critical revision of the fossil species considerable rearrangement might result.

Locality: Kukak Bay, north side, 1 mile west of Cape Nukhshak, Alaska Peninsula (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3517).

Corylus harrimani Knowlton

Corylus harrimani Knowlton, Alaska, vol. 4, p. 154, pl. 23, fig. 1, Harriman Alaska Expedition, 1904.

The beautiful specimen upon which this species was based (U. S. Nat. Mus. no. 30072) was collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders, in 1899. The figure, reduced to three-fifths natural size, does not give an adequate conception of the actual dimensions of the leaf, which is described as 20 centimeters in length by about 17 centimeters in width. It evidently belongs to the same general type of leaf as those that I have described under the name *Corylus kenaiana* (below), and it is significant that Knowlton remarks: "It is much the same in appearance as certain leaves referred to *C. macquarrii*, but * * * differs in certain details." It might, indeed, be regarded merely as a large form of the same leaf as that figured by Heer[48] from Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, and referred to *C. macquarrii*, which, however, is clearly not that species but is identical with *C. kenaiana*. If it were not for the great difference in size I might be inclined to think that *C. kenaiana* and *C. harrimani* were, possibly, specifically identical; but as yet no specimen of *C. kenaiana* has been found that approaches the dimensions given for *C. harrimani*.

Corylus kenaiana Hollick, n. sp.

Plate 45, figures 1–3a; plate 46, figures 1b, 2–5; plate 47, figures 1–5

Corylus macquarrii (Forbes) Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 4, figs. 1–4, 5a, 6–8 [excl. fig. 9, pl. 3], 1869.

Leaves varying in size, the larger ones ovate-lanceolate, the smaller ones oblong-lanceolate to orbiculate, all with more or less cordate bases and acuminate apices; nervation simply pinnate, craspedodrome; secondary veins irregularly disposed, mostly alternate, the lower ones diverging at obtuse angles from the midrib and branched from below toward their extremities, the upper diverging at angles successively more and more acute, with fewer or less conspicuous branches, the two basilar secondaries usually opposite or subopposite, weak, and bent more or less downward; margin irregularly doubly serrate-dentate, the major series of dentitions, in which the secondaries terminate, supporting the minor series of dentitions, in which the branches of the secondaries terminate; tertiary venation fine, straight or slightly flexed, at right angles to the secondaries throughout.

There can be no question that the leaves above described are specifically identical with those collected by Hjalmar Furuhjelm at Ninilchik and Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region and referred to *Corylus macquarrii* by Heer, but comparison with the type of this species[49] shows them to be so characteristically different that there is no apparent difficulty in distinguishing between them. *C. macquarrii* has lower secondaries that are conspicuously ascending, and all subtend approximately identical acute angles of divergence with the midrib, while in Heer's figures and in the specimens of *C. kenaiana* the lower secondaries are horizontal or nearly so and only the upper ones subtend conspicuously acute angles with the midrib.

Corylus kenaiana in its various forms is abundantly represented in the Tertiary flora of the Kenai Peninsula, and the leaves are among the most beautifully preserved of all in the Alaskan collections. Heer also remarked, in connection with his specimens referred to *C. macquarrii*: "Frequens in terra Alaskana; collectio Furuhjelmi continet folia plurima pulcherrima." They vary not only in size but also more or less in shape, and the question may perhaps be raised whether or not all the forms are properly referable to one and the same species. Some, such as those represented by figures 2, 3, plate 46, more or less oblong, with acute teeth, are suggestive of *Alnus corylina* Knowlton and Cockerell (see pl. 49, fig. 9, and pl. 50, fig. 1); others, such as are figured on plate 45, figures 1–3a, and plate 47, figure 3, are difficult to differentiate from *Corylus americana fossilis* Newberry (see pl. 48, figs. 1–3).

Heer's figures of *Corylus macquarrii* show an almost equally diverse lot of leaf forms. Leaves of average size and shape are represented by his figures 3 and 4, which may be compared with our figures 3 and 4, plate 47; his figure 8 is the same type as our figures 2 and 3,

[46] Heer, Oswald, Fossile Flora von Alaska: Flora fossilis arctica, vol. 2, no. 2, pl. 3, fig. 7, 1869: Miocene Flora der Insel Sachalin: Idem, vol. 5, no. 3, pl. 5, fig. 8, 1878; Beiträge zur Miocenen Flora von Sachalin: Idem, vol. 5, no. 4, pl. 2, fig. 1, 1878.

[47] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, pl. 4, fig. 3, 1869.

[48] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 4, fig. 1.

[49] This paper, pl. 46, fig. 6. Heer, Oswald, Flora fossilis arctica, vol. 1, p. 104, pl. 9, fig. 1, 1868.

plate 46; and his figures 1 and 2 are identical with our figures 1, 2, and 3a, plate 45. His figures 6 and 7, which he refers to *Corylus macquarrii macrophylla* Heer,[50] indicate specimens larger than any of ours, but apparently they represent the same type of leaf and not *C. macquarrii.*

Heer [51] also described and figured certain leaves from Spitsbergen, to which he gave the name *Corylus macquarrii microdonta*, one of which, represented by his figure 2, plate 29, is almost identical with our figure 1, plate 45, the only apparent difference being the more widely spaced secondary venation of the former.

The small, oblong-orbiculate leaves represented by figures 4 and 5, plate 46, appear to be merely depauperate forms of the type represented by figures 3 and 4, on the same plate. The larger orbiculate forms, with conspicuously coarse dentition and obliquely cordate bases, represented by figures 1 and 4, plate 47, might be given a distinctive varietal name or they might be referred to *Corylus orbiculata* Newberry,[52] except for the finer and more uniform dentition of that species; but, when compared with all the other specimens, they may be seen to represent forms that belong at one end of an intergrading series, in which figures 3 and 4, plate 47, are intermediate, and figures 1–3a, plate 45, represent the other end. They all occur at the same locality, in the same character of matrix, and they differ among themselves no more than the individual leaves upon the branches of living species of *Corylus.*

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821).

Corylus macquarrii (Forbes) Heer

Corylus macquarri (Forbes) Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 7, p. 178, 1862; K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 3, figs. 9, 9b, 9c [excl. pl. 4, figs. 1–4, 5a, 8], 1869.

Eichwald, Geognostisch-palaeontologische Bemerkungen ueber die Halbinsel Mangischlak und die Aleutischen Inseln, p. 113, pl. 4 [vi], fig. 6, St. Petersburg, 1871.

Lesquereux, U. S. Nat. Mus. Proc., vol. 10, p. 38, 1887.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896; U. S. Geol. Survey 18th Ann. Rept., pt. 3, pp. 194, 195, 1898; Alaska, vol. 4, p. 153, Harriman Alaska Expedition, 1904.

Alnites? macquarrii Forbes, Geol. Soc. London Quart. Jour., vol. 7, pt. 1, p. 103, pl. 4, fig. 3, 1851.

[50] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 105, pl. 9, fig. 3, 1868.

[51] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 72, pl. 15, fig. 2; pl. 29, fig. 2, 1877.

[52] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 58, 1863; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 62, pl. 32, fig. 4, 1898.

Although many specimens from Alaska have been identified as belonging to this species, and most of them can be identified with other specimens and with figures that were referred to the species, there is no doubt that a number of these identifications were either erroneous or questionable.

The figure of the specimen from Ardtun Head, Isle of Mull, Scotland, upon which the species was based by Forbes, is reproduced, for comparison, in plate 46, figure 6, and the same figure was also reproduced by Heer,[53] for comparison with his specimens from Greenland,[54] which are evidently specifically identical with the type. One of the Alaska specimens figured by Heer [55] may also be properly referred to the species; but others from the same region [56] can hardly be so referred, and are apparently specifically distinct, as discussed on page 87.

A fragmentary specimen from Herendeen Bay, Alaska Peninsula, collected by C. W. Townsend in 1890, figured by Knowlton,[57] is apparently referable to the species; but most of the Alaskan specimens that from time to time have been identified as *C. macquarrii* are apparently referable to other species.

Specimens from the Eocene (Fort Union formation) of Montana and North Dakota, the identity of which appears to be valid, were described and figured by Ward [58] and Newberry;[59] and a specimen of what appears to be the species, from the Miocene (?) of the Yellowstone National Park, was described and figured by Knowlton.[60] The species was also recorded by Penhallow [61] from several localities in British Columbia, but in the absence of figures the identifications can hardly be regarded as conclusive; also, two fragmentary specimens from the Mackenzie River region in Canada, which may belong to the species, were described and figured by Heer.[62]

The species, even with all doubtful forms eliminated, had an extensive geographic distribution in early

[53] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 104, pl. 9, fig. 1, 1868.

[54] Idem, pl. 8, figs. 9–12; pl. 9, figs. 1–8; pl. 17, fig. 5d; pl. 19, fig. 7c.

[55] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 3, fig. 9, 1869.

[56] Idem, pl. 4, figs. 1–4, 5a, 8.

[57] Knowlton, F. H., A review of the fossil flora of Alaska: U. S Nat. Mus. Proc., vol. 17, p. 219, pl. 9, fig. 4, 1894.

[58] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 551, pl. 39, fig. 7, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 30, pl. 13, fig. 7, 1887.

[59] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 61, pl. 32, fig. 5; pl. 48, fig. 4, 1898, = *C. grandifolia* Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 59, 1868; Illustrations of Cretaceous and Tertiary plants, pl. 15, fig. 5, U. S. Geol. and Geog. Survey Terr., 1878.

[60] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 699, pl. 86, fig. 3, 1899.

[61] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 48, 1908.

[62] Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, no. 3, p. 14, pl. 1, figs. 1, 2b, 1880.

Tertiary time that included Austria, Germany, Switzerland, France, Scotland, Ireland, Spitsbergen, Iceland, Greenland, Canada, the United States, Alaska, and Sakhalin.

Some 13 descriptions and more than 50 figures of specimens of valid and doubtful identity, from the Arctic regions alone, may be found in the several volumes of Heer's Flora fossilis arctica; and an interesting discussion of the species, botanically and geologically, by Laurent,[63] may be found in connection with descriptions of specimens from Puy-de-Dome, illustrated by excellent examples of leaf forms specifically identical with the type specimen and, for comparison, a reproduction of a figure by Heer.[64]

Localities: Collected by Furuhjelm, fide Heer and Eichwald, from Port Graham and Ninilchik village and river, east shore of Cook Inlet, Matanuska-Cook Inlet region; and from Kuiu Island, southeastern Alaska. Collected by De Alton Saunders, 1899, at Kukak Bay, Alaska Peninsula.

Corylus macquarrii macrophylla Heer

Corylus macquarrii macrophylla Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 105, pl. 9, figs. 3, 3b; p. 138, pl. 22, figs. 3–5; pl. 23, fig. 1; Miocene Flora von Island; Idem, p. 149, pl. 26, fig. 3, 1868; Flora fossilis alaskana: Idem, vol. 2, no. 2, p. 30, pl. 4, figs. 6, 7, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

In his description and discussion of leaves of *Corylus macquarrii* from Greenland, Iceland, and the Mackenzie River region in British America, Heer [65] mentions specimens " die bis einen halben Fuss Länge erreicht haben müssen. Wir bezeichnen diese Form als *Corylus macquarrii macrophylla* und halten sie nur für eine, aber allerdings sehr beachtenswerthe Varietät."

The Alaskan specimens that Heer referred to this variety were collected by Hjalmar Furuhjelm, at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. The dimensions of these specimens are not given, but Heer [66] says: " Fig. 6 et 7 repraesentant folia multo majora hujus speciei." Unfortunately these figures represent only fragmentary specimens, but they indicate leaves that must have been larger than any leaves of the genus included in any of our collections, except, perhaps, *C. harrimani* Knowlton (p. 87), which is described as having a length of 20 centimeters, or about 8 inches.

It appears to be quite probable that *Corylus macquarrii macrophylla* Heer is identical with *C. grandifolia* Newberry,[67] from the Eocene (Fort Union formation) of North Dakota, a distinct species, but subsequently recognized by Newberry [68] as a large form of *C. macquarrii* in the following words:

> A large amount of material has been collected and described since the description of *C. grandifolia* was written, and it has been shown that numerous leaves of *Corylus* of large size occur in the Tertiary beds of many parts of North America and extend to the European continent. Comparing our specimens with these figures and descriptions, we are led to believe that our *C. grandifolia* is only a large and strong form of *C. macquarrii*.

A comparison of Newberry's figure 5, plate 32, with Heer's figure 3, plate 22, indicates the correctness of Newberry's conclusions. Incidentally it is also of interest to note that Newberry's specific name *grandifolia* and Heer's varietal name *macrophylla*, each having the same descriptive meaning and each applied to apparently specifically identical leaves, were both originally published in the same year—1868.

Subsequently Heer [69] described another species, from Spitsbergen, under the name *Corylus scottii*—a species closely resembling *C. macquarrii macrophylla*—in connection with which he remarked: " Eine sehr ähnliche Art scheint die *C. grandifolia* * * * zu sein, so weit sich dies aus der kurzen Beschreibung ohne Abbildung ermitteln lässt." Only the description of Newberry's species was at that time available, the figure not having been published until the following year. *C. scottii* was not subsequently mentioned by Heer, nor is there any record by any other author of the recognition of the species other than in connection with the type specimen and locality. The probability appears to be, therefore, that *Corylus grandifolia* Newberry, *C. macquarrii macrophylla* Heer, and *C. scottii* Heer may all be referable to a single species or variety, and in that event a question in nomenclature would arise in regard to priority in connection with the names *grandifolia* and *macrophylla*, both of which were published in 1868.

Corylus? palachei Knowlton

Corylus? palachei Knowlton, Alaska, vol. 4, p. 154, pl. 22, fig. 2 [U. S. Nat. Mus. no. 30069]; pl. 28, fig. 1 [U. S. Nat. Mus. no. 30083], Harriman Alaska Expedition, 1904.

The generic affinity of these leaves was questioned by Knowlton, but they appear, undoubtedly, to belong to the genus *Corylus*, especially the one represented by his figure 1, plate 28, which is of the same general

[63] Laurent, Louis, Flore fossile des schistes de Menat (Puy-de-Dôme): Mus. hist. nat. Marseille Annales, vol. 14, p. 79, pl. 6, figs. 5, 6; pl. 8, figs. 3, 4, 5c; pl. 9, fig. 1, and text figs. 37 (p. 80), 38 (p. 81), 39 (p. 82), 1912.

[64] Heer, Oswald, Die Miocene Flora des Grinnell-Landes: Flora fossilis arctica, vol. 5, no. 1, p. 33, pl. 6, fig. 6, 1878.

[65] Heer, Oswald, op. cit., vol. 1, p. 105.

[66] Idem, vol. 2, p. 30.

[67] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 59, 1868; Illustrations of Cretaceous and Tertiary plants, pl. 15, fig. 5, U. S. Geol. and Geog. Survey Terr., 1878.

[68] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 61, pl. 32, fig. 5, 1898.

[69] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 73, pl. 29, fig. 1, 1877.

type as *C. kenaiana* (p. 87) from Kenai Peninsula, Matanuska-Cook Inlet region.

The specimens upon which Knowlton based the species were collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899.

From a study of more than 100 specimens and figures of fossil leaves from Alaska and elsewhere, referred to certain species and varieties in the genus *Corylus*,[70] I am compelled to admit that it is difficult in many instances to recognize satisfactory specific differentiations, and that the discovery of additional specimens may result in modifying some of our concepts of their specific and varietal limitations or expansions.

Staminate aments of Corylus sp.?

Plate 49, figure 4

These remains are more or less fragmentary and are not very clearly defined, and their general appearance and characters can be discerned more satisfactorily than they can be described. They evidently represent more or less disintegrated staminate aments, resembling those of *Alnus* or *Corylus*, and as leaves of *Corylus* are associated with them I have little hesitation in referring them to that genus. In all probability they belong with the leaf from the same locality that I have described under the name *Corylus evidens* (p. 86), but it would not be advisable, in the absence of definite proof, to do anything more than to suggest their probable specific relationship. Incidentally, however, in this connection, it may be of interest to refer to figures of similar remains from the Tertiary of Bohemia, which Engelhardt[71] referred to *Alnus kefersteinii* (Goeppert) Unger, on account of their association with leaves referred to that species, and also to a staminate ament[72] mentioned in connection with a leaf of *Corylus insignis* Heer[73] in regard to which Engelhardt remarked:[74] "Das wahrscheinlich hierher zu rechnen ist."

Locality: Kukak Bay, north side, 1 mile west of Cape Nukhshak, Alaska Peninsula (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3517).

Agents of Corylus sp.?

Plate 50, figures 6, 7

These specimens evidently represent the remains of aments, belonging to either *Betula*, *Alnus*, or *Corylus*. Similar remains were referred to *Betula* and *Alnus* (pp. 92–93 and 95), and those now under consideration are referred to *Corylus*, largely in deference to the disposition made by Heer[75] of what appear to be similar remains collected by Hjalmar Furuhjelm in the Cook Inlet region. These he included under *Corylus macquarrii* (Forbes) Heer, with the remark: "Tab. III, fig. 9, b, c, amenta masculina Coryli repraesentare puto."

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Feld Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 50, fig. 6). Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 50, fig. 7).

Genus BETULA Linnaeus

Betula brongniartii Ettingshausen

Plate 57, figure 8

Betula brongniartii Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 1, p. 12, pl. 1, fig. 18, 1851; vol. 1, pt. 3, no. 5, p. 5, pl. 1, figs. 4, 5, 1852.

The type specimen of this species and those subsequently figured by Ettingshausen were small and fragmentary; but other authors subsequently included leaves of larger size and considerable variation in shape, and the particular specimens with which ours may be compared are certain of those from Grinnell Land and Sakhalin, described and figured by Heer.[76] In some of these the bases of the leaves are represented as either cuneate or rounded, and in others as cordate. The base of our specimen may be described as rounded truncate.

Whatever may be thought of the identity of these leaves from the Arctic regions with those from Europe upon which the species was based, there can be but little doubt of the mutual specific identity of the former, including those from Alaska.

This is the first record of the species on the North American continent, and it is interesting to note that it relates to a territory that is midway between Grinnell Land to the east and Sakhalin to the west, and thus extends our knowledge of its geographic distribution to the intervening region.

Locality: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186).

[70] *Corylus macquarrii* (Forbes) Heer (p. 88), *C. kenaiana* Hollick (p. 87), *C. americana fossilis* Newberry (p. 86), *C. harrimani* Knowlton (p. 87), and *C. palachei* Knowlton (p. 89).

[71] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Wiss. Nova acta, vol. 48, no. 3, p. 317 (21), pl. 28 (21), figs. 9, 10, 12, 1885.

[72] Idem, fig. 1.

[73] Idem, fig. 28.

[74] Idem, p. 320 (24).

[75] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 30, pl. 3, figs. 9b, 9c, 1869.

[76] Heer, Oswald, Die Miocene Flora des Grinnell-Landes: Flora fossilis arctica, vol. 5, no. 1, p. 32, pl. 6, fig. 1; pl. 8, fig. 7, 1878; Miocene Flora der Insel Sachalin: Idem, no. 3, p. 32, pl. 6, fig. 4; pl. 15, fig. 5, 1878; Beiträge zur Miocenen Flora von Sachalin: Idem, no. 4, p. 6, pl. 2, fig. 2, 1878.

Betula confusa Saporta var. lata Hollick, n. var.

Plate 52, figure 1

This leaf differs so little from the species *Betula confusa* Saporta,[77] based upon specimens from the Miocene of France, that I am almost inclined to regard them as identical. Our specimen is merely larger and somewhat broader, with a less elongated apex, and the question may well be raised whether these slight differences should be regarded even as varietal.

I am also inclined to identify it with a leaf from the Miocene of Silesia, described and figured by Goeppert[78] under the name *Carpinites macrophyllus;* but the base is lacking in Goeppert's figure, and hence comparison with ours and with Saporta's cannot be satisfactorily made.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. E. Stanton and R. W. Stone in 1904 (lot 5821).

Betula prisca Ettingshausen

Plate 50, figure 3a; plate 52, figure 2

Betula prisca Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 1, p. 11, pl. 1, figs. 15–17, 1851.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 28, pl. 3, fig. 6; pl. 5, figs. 3, 4b, 5–7, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 221, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

It is almost impossible to believe that all the diverse leaf forms that have been referred to this species from time to time by various authors should be included in it, and doubtless some of these could as well be referred to certain other species. The specimens upon which Heer based his identification were collected by Hjalmar Furuhjelm at Ninilchik and Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, and they include both leaves and aments. Our specimens compare more or less satisfactorily with Ettingshausen's figures of the type specimens, but it is difficult to recognize a specific resemblance between those figures and Heer's figures 4b and 5, plate 5, which are referred to[79] as "folia juniora?"; and certain leaves referred to the species by other authors are even more widely divergent from the figures of the specific types.

It was recorded from British America by Penhallow,[80] but the identification was queried, and the specimens were not figured.

The only other record for the species on the North American continent was made by Ward,[81] in connection with a specimen from the Eocene (Fort Union formation) of Montana.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 50, fig. 3a). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 52, fig. 2).

Betula populoides Hollick, n. sp.

Plate 50, figure 10

Leaf lanceolate-deltoid, 6 centimeters in length, exclusive of the petiole, by 4 centimeters in width across the broadest part, tapering to the apex, broadly rounded to the base; petiole 2.5 centimeters in length; margin finely and irregularly serrate-dentate from the expanded basal portion upward, entire or minutely denticulate below; venation pinnate, craspedodrome; secondary veins irregularly disposed, diverging at acute angles from the midrib, the basal pair opposite or subopposite, slightly suprabasilar, branched from the under side, the upper ones branched in a similar manner near their extremities, each of the main veins and each of the branches terminating in a marginal tooth.

This species is of the same general type as the living *Betula populifolia* Marshall and *B. papyrifera* Marshall, and it is strikingly suggestive of *Betula deltoides* Knowlton,[82] from the Miocene of Florissant, Colo., from which it differs merely in the rounded instead of truncate base, and the finer marginal dentitions. These differences are so slight and the general resemblance is so marked that the idea of specific identity between them might well be entertained and might, perhaps, have been recognized if the two specimens had been included in the same collection. It is also very much like a leaf referred to *Betula prisca* Ettingshausen by Heer,[83] and if this leaf may properly be referred to that species then ours might be disposed of in the same way. I am inclined to think, however, that the resemblance of these deltoid leaves to the original figures of the type specimens of *Betula prisca*

[77] Saporta, Gaston de, Recherches sur la végétation du niveau Aquitanien de Manosque: Soc. géol. France Mém., Paléontologie, vol. 3, pt. 1, Mém. 9, p. 52, pl. 10 (14), figs. 5, 6; pl. 20 (16), figs. 6, 6a, 7, 7a, 1892.

[78] Goeppert, H. R., Beiträge zur Tertiärflora Schlesien's: Palaeontographica, vol. 2, p. 273 (17), pl. 34 (2), fig. 2, 1852.

[79] Heer, Oswald, op. cit. (1869), p. 29.

[80] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 40, 1908.

[81] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 551, pl. 40, fig. 1, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 31, pl. 14, fig. 2, 1887.

[82] Knowlton, F. H., A review of the fossil plants in the United States National Museum from the Florissant lake beds at Florissant, Colo.: U. S. Nat. Mus. Proc., vol. 51, p. 264, pl. 19, fig. 3, 1916.

[83] Heer, Oswald, Miocene baltische Flora, p. 70, pl. 18, fig. 9, Königsberg, 1869.

Ettingshausen [84] is so remote as to render it inadvisable to regard them as specifically identical.

Locality: Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Betula alaskana Lesquereux

Betula alaskana Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 446, pl. 6, fig. 14, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 258, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 221, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 885, 1896.

The specimen upon which Lesquereux based this species (U. S. Nat. Mus. no. 1399) was collected by W. H. Dall at Chignik Bay, Alaska Peninsula, in 1880. It has not been identified in any of the subsequent collections from Alaska, nor is there any record of its identification from elsewhere in the world.

Betula grandifolia Ettingshausen

Betula grandifolia Ettingshausen, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 26, p. 123, pl. 14, figs. 23, 24, 1866.

Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 5, fig. 8, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 221, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

Betula sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, p. 64, 1868.

This species, represented by a specimen collected at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, by Hjalmar Furuhjelm, and so identified and figured by Heer, has not been definitely identified in any of our collections, although certain more or less fragmentary leaf remains might be provisionally referred to it; nor has it been recorded from elsewhere in America.

Betula dubiosa Hollick, n. name

Betula macrophylla (Goeppert) Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 66, 1868; Miocene Flora von Island: Flora fossilis arctica, vol. 1, p. 146, pl. 25, figs. 11–19a, 1868. Not *B. macrophylla* Ettingshausen, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 9, p. 43 [7], pl. 3 [2], figs. 1, 2; pl. 4, fig. 1, 1852.

Alnus macrophylla Goeppert, Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 491, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 12, pl. 4, fig. 6; pl. 5, fig. 1, Görlitz, 1855.

Among the species of fossil leaves collected by Hjalmar Furuhjelm at Ninilchik, Kenai Peninsula, Heer [85] lists "*Betula macrophylla* Goeppert," evidently identifying it with *Alnus macrophylla* Goeppert. The name *Betula macrophylla*, however, was preoccupied, having been previously applied by Ettingshausen to certain leaf remains from the Tertiary of Austria that are too fragmentary for adequate identification, even generically. In transferring the Alaska species to the genus *Betula* it therefore becomes necessary to apply it to a new specific name, as above.

It is perhaps, significant that Heer did not subsequently mention or refer to the species in his Flora fossilis alaskana,[86] and it is possible that the Alaskan specimen or specimens originally identified as such were referred to and included by him among the leaf forms of some other species, as for example certain of the leaves from Ninilchik referred by him to *Corylus macquarrii*.[87]

Leaves from Iceland, Spitsbergen, and Canada that differ widely among themselves in size, shape, and marginal dentition were referred to the species by Heer;[88] but these appear to represent at least two distinct species, neither of which is apparently referable to the species as originally described and figured by Goeppert. It was also listed from British Columbia by Penhallow,[89] but as he identified his specimens with Heer's figures the probability is that they also are not properly referable to Goeppert's species. Recently, however, a leaf from the Tertiary of Japan was described and figured by Kryshtofovich [90] and referred to the species, which may very well be regarded as identical with it.

I have not been able to identify satisfactorily any of our Alaskan specimens with the species, although a critical revision of all the leaves here included in the allied genera *Corylus*, *Betula*, and *Alnus* might result in segregating certain ones that could be so referred.

Aments of Betula sp.?

Plate 9, figure 1b; plate 34, figures 1, 2; plate 50, figures 2, 3b, 4

What are evidently the woody remains of more or less disintegrated aments occur in several of our collections, associated with leaves of *Betula* and *Alnus*; but it is not always possible to determine satisfactorily to which of these genera certain of the remains belong, as may be appreciated by an examination of the figures.

[84] Ettingshausen, Constantin von. Fossile Flora von Wien: K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 1, p. 11, pl. 1, figs. 15–17, 1851.

[85] Heer, Oswald, op. cit. (Förh.), p. 66.

[86] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, 1869.

[87] Idem, pl. 4, figs. 2–4.

[88] Heer, Oswald, Miocene Flora von Island: Flora fossilis arctica, vol. 1, p. 146, pl. 25, figs. 11, 16–18, 18b, 19a, 1868; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 71, pl. 28, fig. 6a, 1877; Beiträge zur Miocenen Flora von Nord-Canada: Idem, vol. 6, pt. 1, no. 3, p. 14, pl. 2, figs. 3, 4, 1880.

[89] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 39, 1908.

[90] Kryshtofovich, African, A new fossil palm and some other plants of the Tertiary flora of Japan: Geol. Soc. Tokyo Jour., vol. 27, no. 322, p. 14, pl. 3, fig. 3, 1920.

Figure 3b, plate 50, shows one of the aments in close association with a leaf of *Betula prisca* Ettingshausen, (p. 91), and a similar association of leaves and aments was described and figured by Heer [91] in connection with specimens collected by Hjalmar Furuhjelm at Ninilchik and Port Graham, Kenai Peninsula, all of which Heer included under *Betula prisca*. It is quite probable that they are specifically identical and that it would be reasonable and justifiable to consider our specimens of closely associated leaves and aments in a similar light, but the conservative course would seem to be to restrict the specific name to the foliar organs and merely to note the more or less close association with them of the other remains.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 9, fig. 1b; pl. 34, fig. 1; pl. 50, fig. 2). Kachemak Bay, Kenai Peninsula, Bluff Point, 7 miles west of Homer, 30 feet below Bradley coal (original no. 910); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5820) (pl. 34, fig. 2). Kachemak Bay, Kenai Peninsula, Bluff Point, 7 miles west of Homer, 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 50, figs. 3b, 4).

Betula (branch) Knowlton

Betula (branch), Knowlton, Alaska, vol. 4, p. 153, pl. 24, fig. 2, Harriman Alaska Expedition, 1904.

This specimen is described as "a single fragment of a branch showing the lenticels characteristic of the genus."

Collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899 (U. S. Nat. Mus. no. 30076).

Genus ALNUS Gaertner

Alnus alnifolia (Goeppert) Hollick, n. comb.

Plate 47, figures 7b, 8; plate 51, figures 3, 4, 5b, 6, 7

Carpinus alnifolia Goeppert, Deutsche geol. Gesell. Zeitschr., vol. 4, p. 492, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 19, pl. 4, fig. 11, 1855.

There can be no question that considerable confusion exists in connection with the identification of certain fossil leaves referred to the genera *Alnus*, *Corylus*, and *Carpinus*, and it is more or less difficult to determine satisfactorily the names by which certain figures may best be designated. Characters utilized in determining generic and specific differences are frequently so slight in leaves of these genera that comparisons of figures are generally inconclusive, except in the rare event that every critical detail is depicted. It is with some hesitation, therefore, that I have ventured to refer our specimens to this species from the Eocene of the Old World, and to identify the genus as *Alnus* rather than *Carpinus*, which was the original generic appelation. The only apparent difference, however, between Goeppert's figure and those of the specimens from Alaska is that the dentition in the latter is somewhat finer. In this respect they more closely resemble *Alnus corrallina* Lesquereux,[92] from the Tertiary (Miocene?) of California, and if all the specimens representing these two species had been found at the same locality it would have been difficult to regard them otherwise than as specifically identical.

Comparison may also be made with *Alnus serrulata fossilis* Newberry,[93] from the Eocene of Oregon; [94] with *Corylus insignis* Heer, as figured by Abich [95] and Menzel; [96] and with *Carpinus betuloides* Unger.[97]

A number of other figures of species in these and allied genera in the Amentaceae might be cited for purposes of comparison, but those mentioned are sufficient to indicate the difficulties encountered in attempting to arrive at a satisfactory specific identification.

Localities: Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 47, fig. 7b; pl. 51, figs. 3, 4, 5b, 6, 7). Divide between Folger Creek and Nowitna River, 19.15 miles N. 35° E. of north butte of Twin Buttes, central Yukon region (original no. 2); collected by J. B. Mertie, Jr., in 1915 (lot 7007) (pl. 47, fig. 8).

Alnus corylina Knowlton and Cockerell

Plate 46, figure 1a; plate 49, figures 8, 9; plate 50, figure 1

Alnus corylina Knowlton and Cockerell, U. S. Geol. Survey Bull. 696, p. 63, 1919.

Alnus corylifolia Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 446, pl. 7, figs. 1–4, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 258, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894: Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896; Alaska, vol. 4, p. 155, Harriman Alaska Expedition, 1904.

This species does not appear to have been identified from elsewhere than Alaska and it is doubtful if it is distinct from *Alnus diluvianum* Unger,[98] from

[91] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 3, fig. 6; pl. 5, figs. 6, 7, 1869.

[92] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 243, pl. 51, figs. 1–3, 1883.

[93] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 66, pl. 46, fig. 6, 1898.

[94] Incidentally it may be remarked as somewhat peculiar that none of these three species (*Alnus alnifolia, A. corrallina,* and *A. serrulata fossilis*) appears to have been recognized, heretofore, from elsewhere than its type locality; nor, apparently, is there any record or mention of any one of the species elsewhere than in its original place of publication. If, therefore, the identification of the Alaska specimens with any one of these species is correct it is a matter of considerable interest.

[95] Abich, Hermann, Beiträge zur Paläontologie des asiatischen Russlands: Acad. imp. sci. St.-Pétersbourg Mém., sér. 6, Sci. math. et phys., vol. 7, p. 570 [34], pl. 7, fig. 3, 1858.

[96] Menzel, Paul, Ueber die Flora der Senftenberger Braunkohlen-Ablagerungen: K. preuss. geol. Landesanstalt Abh., n. ser., no. 46, p. 43, pl. 2, figs. 11, 12, 1906.

[97] Unger, Franz, Iconographia plantarum fossilium: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 4, p. 112, pl. 43, figs. 6–8, 1852.

[98] Idem, p. 106, pl. 39, figs. 16–18. 1851.

which certain of our smaller specimens, such as the one represented by figure 9, plate 49, can hardly be differentiated. The specimens upon which Lesquereux based the species were collected at Kachemak Bay, Kenai Peninsula, by W. H. Dall in 1880, and specimens identified by Knowlton (Harriman Alaska Expedition) were collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899. Fragmentary and imperfect specimens, however, are liable to be mistaken for certain forms of *Corylus macquarrii* (Forbes) Heer (see p. 88), which has an extensive geographic distribution, and it is possible that some of such figured specimens may have been erroneously referred to that species.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 50, fig. 1; pl. 46, fig. 1a; pl. 49, figs. 8, 9). Kachemak Bay, Kenai Peninsula, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Alnus alaskana Newberry

Plate 51, figure 8

Alnus alaskana Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 509, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 65, pl. 48, fig. 8, 1898.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

It may be noted that in the figure of our specimen referred to this species the dentition, although fine, is slightly coarser than in Newberry's figure, and that in ours three of the secondary veins are prominently forked; otherwise it agrees, essentially, with the specific type. Also, it may be seen to resemble the figure of a specimen from the Tertiary of Spitsbergen, referred by Heer [99] to "*Corylus macquarrii* Forbes sp."

Newberry [1] described the type locality as "Kootznahoo Archipelago, latitude 57°35′, longitude 134°19′", and the collector as the "United States steamer *Saginaw*, February 18, 1869", of which Commander (afterward Rear Admiral) Richard Worsam Meade was at that time in command.

The species does not appear to be definitely recognized from elsewhere than Alaska, although fragmentary specimens from British Columbia were referred to it by Penhallow,[2] but without description or figures.

Locality: West shore of Cook Inlet, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. 1); collected by C. A. Weaver in 1906 (lot 4130).

[99] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 72, pl. 15, fig. 1, 1876.
[1] Newberry, J. S., op. cit. (Mon. 35), p. 66.
[2] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 37, 1908.

Alnus kefersteinii (Goeppert) Unger

Plate 22, figure 5b

Alnus kefersteinii (Goeppert) Unger, Synopsis plantarum fossilium, p. 215, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxviii, pl. 33, figs. 1–4, Leipzig, 1845.
Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 28, pl. 3, figs. 7, 8, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept. 1895–96, pt. 1, p. 884, 1896.
Alnites kefersteinii Goeppert, Acad. imp. sci. St.-Pétersbourg Bull., vol. 2, p. 221, 1837.

A great variety of leaf forms have been described and figured under this specific name, from time to time, by various authors; but a number of these might equally well be referred to other species.

Our specimen resembles Unger's figure 4, plate 33, Chloris protogaea, only in a general way; and the same may be said of the Alaskan specimens figured by Heer. The particular figure with which ours may be most satisfactorily compared represents a specimen from Greenland described by Heer.[3] The close resemblance between these two constitutes my principal reason for referring our specimen to this species rather than to some other which it might be thought to resemble about as closely. In one or another of its many leaf forms and recognized varieties the species is one of the most abundant in the Tertiary of the Old World. It is represented in paleobotanic literature by no less than 180 figures, and to one or another of its forms have been applied the varietal names *alata* Renault,[4] *gracilis* (Unger) Engelhardt,[5] *latifolia* Heer,[6] *longifolia* Heer,[7] *parvifolia* Heer,[8] and *subglutinosa* Nathorst.[9]

In the North American continent, outside of Alaska, it was recorded by Lesquereux [10] from Wyoming and Colorado and provisionally by Knowlton [11] from Oregon.

Localities: Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519). Collected by Furuhjelm, fide Eichwald, at Ninilchik village, west shore of Kenai Peninsula, Matanuska-Cook Inlet region.

[3] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 80, pl. 95, fig. 1, 1883.
[4] Renault, Bernard, Plantes fossiles miocènes d'Advent-Bay (Spitzberg): Mus. hist. nat. Paris Bull., vol. 6, p. 321, 1900.
[5] Engelhardt, Hermann, Ein Beitrag zur Kenntniss der Flora des Thones von Preschen bei Bilin: K.-k. geol. Reichsanstalt Verh., 1879, p. 296.
[6] Heer, Oswald, Miocene baltische Flora, p. 68, pl. 19, fig. 7; pl. 20, figs. 1–4, Königsberg, 1869.
[7] Idem, pl. 19, figs. 9, 10; pl. 20, figs. 5–11.
[8] Idem, pl. 19, figs. 1–6, 8.
[9] Nathorst, A. G., Beiträge no. 2, zur Tertiärflora Japans: Bot. Centralbl., vol. 19, p. 86, 1884.
[10] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 140, pl. 18, figs. 6–8; pl. 64, fig. 11, 1878.
[11] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 43, 1902.

Alnus kefersteinii var. Heer

Alnus kefersteinii var. Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 28, pl. 5, fig. 9, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

This specimen represents one of the many leaf forms included within the species that differs conspicuously from the specific type. It was probably collected at Port Graham and Ninilchik, Kenai Peninsula, Matanuska-Cook Inlet region, by Hjalmar Furuhjelm, and may represent the specimen originally referred by Heer [12] to *Alnus nostratum* Unger, inasmuch as he discusses that species in connection with it. It appears more probably, however, to represent a specimen of *Corylus maecquarrii* (Forbes) Heer. (See p. 88.)

Alnus grandiflora Newberry

Alnus grandiflora Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 509, 1882 [1883].
Knowlton, Geol. Soc. America Bull., vol. 5, p. 582, 1894 [erroneously designated "*Alnus grandifolia*"]; U. S. Nat. Mus. Proc., vol. 17, p. 220, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 884, 1896.

This species, not subsequently referred to by Newberry or recognized by any other author, was collected, according to Newberry, by "Capt. Howard, United States Navy," [13] at Cook Inlet.

The specific description is as follows:

Leaves 4 to 5 inches in length by 3 inches in width, ovate, rounded or wedge-shaped at the base, blunt-pointed at the summit; margins coarsely dentate; nervation strong, crowded, 12 or more parallel branches on either side of the midrib, the intervals between these crossed by numerous parallel, mostly straight nervules, dividing the surface into oblong, quadrangular areoles.

Alnus sp. Grewingk

Alnus sp. Grewingk, Russ. k. mineral. Gesell. Verh., Jahrg. 1848–49, pp. 114, 364, 1850.

The specimen upon which this generic identification was based was stated to have come from Kenai Peninsula, but no definite locality was given.

Alnus sp. Knowlton

Alnus sp. Knowlton, Alaska, vol. 4, p. 155, pl. 28, fig. 2 [U. S. Nat. Mus. no. 30084]; pl. 33, fig. 4 [U. S. Nat. Mus. no. 30093], Harriman Alaska Expedition, 1904.

The specimens to which the figures above cited refer were collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899. They apparently represent pistillate catkins of a species of *Alnus*.

Pistillate aments of Alnus sp.?

Plate 50, figure 8

Specimens that undoubtedly represent the remains of aments are associated with leaves of *Corylus*, *Betula*, and *Alnus* in several of our collections. The larger ones were referred to the genus *Betula* (p. 92), and certain of the smaller ones to the genus *Corylus* (p. 90). The identification of certain of these remains, however, is not entirely satisfactory or conclusive, although they undoubtedly belong to one or another of the genera mentioned, and the specimen represented by figure 8, plate 50, almost certainly represents old pistillate aments of *Alnus*.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near entrance of Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Family FAGACEAE

Genus FAGUS Linnaeus

Fagus antipofii Abich

Plate 53, figures 1, 2

Fagus antipofii Abich, Acad. imp. sci. St.-Pétersbourg Mém., sér. 6, Sci. math. et phys., vol. 7, p. 572 (36), pl. 8, fig. 2, 1858.
Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 30, pl. 5, fig. 4a; pl. 7, figs. 4–8; pl. 8, fig. 1, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 218, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.
Fagus lancifolia Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 30, pl. 5, fig. 4a; pl. 7, figs. 4–8, 1869.
Fagus emarginata Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 30, pl. 8, fig. 1, 1869.

The specimens from Alaska upon which Heer based his identifications and descriptions of this species were collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. Heer's figures show a considerable diversity in the shape and size of the leaves, and our two specimens represent forms somewhat more elongated than his. Examination of the numerous published figures, however, shows that considerable foliar diversity has been recognized by the several authors who have had occasion to discuss the species. It appears to have been especially abundant in northern regions—Japan, Sakhalin, Siberia, Greenland, and Alaska—in Tertiary time, and it was also described and figured by Sordelli [14] from Italy; but it appears to be probable that

[12] Heer, Oswald, Utdrag ur ett bref af Prof. Oswald Heer rörande fossila vexter från Nordvestra Amerika: K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868.

[13] "The Captain Howard referred to was evidently Capt. W. A. Howard, of the U. S. Revenue Cutter Service. Shortly after the cession of Alaska to the United States in 1867 the revenue cutter *Lincoln* * * * was dispatched to Alaska * * * and Capt. W. A. Howard was in general charge of the expedition."—Extract from letter to Alfred H. Brooks from Capt. Commandant E. P. Bertholf, U. S. Revenue Cutter Service, dated Feb. 17, 1912.

[14] Sordelli, Ferdinando, Flora fossilis nesubrica, p. 118, pl. 17, figs. 2–6; pl. 18, figs. 7–13, Milan, 1896.

in Europe it has occasionally been confused with *Fagus pristina* Saporta [15] or vice versa. It is certainly very difficult, for example, to discern any characters that indicate a specific difference between *Fagus antipofii* as figured by Abich and Heer, and *F. pristina* as figured originally and subsequently [16] by Saporta.

Specimens referred to *Fagus antipofii* from the Miocene(?) of British Columbia were listed by Penhallow;[17] and from the Eocene of the Yellowstone National Park by Lesquereux,[18] but neither record was accompanied by a figure. Subsequently, however, Lesquereux [19] described and figured a fragmentary specimen from the Miocene of California, which he referred to the species, but its identity was questioned by Knowlton [20] in a revision of Lesquereux's paper, as follows:

This leaf, of which only the base is present, is strongly suggestive of both *Quercus olafseni* and *Q. nevadensis*, but seems to differ in being a thicker leaf with a heavier midrib and very numerous, close, strong nervilles.

Proof of the occurrence of *Fagus antipofii* on the North American continent, outside of Alaska, may therefore be regarded as based upon very slender evidence.

It is apparent that a critical revision of this and allied species of *Fagus*, in connection with species of similar aspect in the genera *Quercus* and *Castanea*, would be advisable before attempting to express definite conclusions in regard to their specific identities or actual generic relationships.

Locality: Kenai Peninsula, Matanuska-Cook Inlet region, station 116, 2½ miles southwest of Point Naskowhak (original no. 116); collected by G. C. Martin in 1911 (lot 6061).

Fagus feroniae Unger

Fagus feroniae Unger, Synopsis plantarum fossilium, p. 219, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxix, Leipzig, 1845; Idem, pt. 9, p. 106, pl. 28, figs. 3, 4, 1847.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 31, pl. 6, fig. 9, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 882, 1896.

A single specimen, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was described and figured and referred to this species by Heer, but its specific identity appears to be open to question. The figure is more suggestive of certain species of *Quercus*, and it is apparently specifically identical with a leaf from Kachemak Bay, Kenai Peninsula, that I have referred to *Q. olafseni* (pp. 99–100, pl. 52, fig. 3).

Three specimens from the Tertiary (Miocene?) of Nevada were described and figured and referred to the species by Lesquereux; [21] and it was recorded by Penhallow [22] as having been found in British Columbia; but a considerable diversity of leaf forms have been included in the species from time to time by various authors, and many of the specimens, such as those figured by Lesquereux, have only a remote resemblance to Unger's figures of the specific type.

There can be no question that more or less confusion exists in connection with the specific differentiation of the three species *Fagus antipofii* Abich (p. 95), *F. feroniae* Unger, and *F. deucalionis* Unger (p. 97), especially in connection with the last two. This subject was made the basis of a somewhat lengthy paper by Ettingshausen,[23] in which he described, figured, and named 15 varieties or forms of *F. feroniae*, relegating *F. deucalionis* to *F. feroniae plurinervia*.[24] This varietal or form name, however, has, of course, no validity in nomenclature, and in any event *F. deucalionis* has priority of place in publication and should be accepted as the specific designation with the name *feroniae* to designate a variety or form, if so identified.

The order of publication of the three species mentioned is as follows:

1. *F. deucalionis* Unger, Synopsis plantarum fossilium, p. 218, 1845; Chloris protogaea, pt. 6, p. lxxix, 1845; pt. 9, p. 101, pl. 27, figs. 1–6, 1847.
2. *F. feroniae* Unger, Synopsis plantarum fossilium, p. 219, 1845; Chloris protogaea, pt. 6, p. lxxix, 1845; pt. 9, p. 106, pl. 28, figs. 3, 4, 1847.
3. *F. antipofii* Abich, Beiträge zur Paläontologie des asiatischen Russlands: Acad. imp. sci. St.-Pétersbourg Mém., sér. 6, Sci. math. et phys., vol. 7, p. 572, pl. 8, fig. 2, 1858.

In any attempt, however, at a critical analysis or revision of fossil remains of the genus *Fagus* especial attention should be given to its great development in Japan in Tertiary time, as set forth by Nathorst,[25]

[15] Saporta, Gaston de, Études sur la végétation du sud-est da la France à l'époque tertiaire, pt. 3; Annales sci. nat. [Paris], sér. 5, Botanique, vol. 8, p. 69, pl. 6, figs. 1–3, 1867.

[16] Saporta, Gaston de, Recherches sur la végétation du niveau aquitanien de Manosque: Soc. géol. France Mém., Paléontologie, vol. 3, fasc. 2, Mém. 9, p. 60, pl. 12 (16), p. 60, 1892.

[17] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 54, 1908.

[18] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 403, 1873.

[19] 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. 3, pl. 2, fig. 13, 1878.

[20] Knowlton, F. H., Flora of the auriferous gravels of California: U. S. Geol. Survey Prof. Paper 73, p. 58, 1911.

[21] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 146, pl. 19, figs. 1–3, 1878.

[22] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 54, 1908.

[23] Ettingshausen, Constantin von, Die Formelemente der Europäischen Tertiärbuche (*Fagus feroniae* Unger): K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 61, pp. 1–16, pls. 1–4, 1894.

[24] Idem, p. 6, pl. 1, figs. 17, 18.

[25] Nathorst, A. G., Contributions à la flore fossile du Japon: K. svenska vet.-akad. Handl., vol. 20, no. 2, p. 43, pl. 1, fig. 1; pl. 4, figs. 11–24; pl. 5, figs. 1–11; pl. 6, figs. 1, 1883; Zur fossilen Flora Japan's; Palaeont. Abh., vol. 4, no. 3, pp. 202 (8), 204 (10), 210 (16), 211 (17), 216 (22), 222 (28), 223 (29), 227 (33), 231 (37), pl. 18 (2), fig. 3; pl. 19 (3), figs. 2, 3, 5; pl. 21 (5), figs. 2–4; pl. 25 (9), figs. 1, 2, 11; pl. 27 (11), figs. 2–7; pl. 28 (12), figs. 1–10, 1888.

who described and figured several new species and discussed their affinities with other fossil and certain living species. Apparently, despite numbers, there was little specific modification or differentiation in the foliar characters of the ancestral species of the genus, and for the most part, these differ little from their existing progeny, and some are, apparently, identical with certain living species.

Fagus deucalionis Unger

Plate 53, figure 3

Fagus deucalionis Unger, Synopsis plantarum fossilium, p. 218, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxix, Leipzig, 1845, pt. 1, p. 101, pl. 27, figs. 1–6, 1847.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 446, pl. 8, fig. 1, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 259, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

The first identification of this species as an element in the Tertiary flora of Alaska was that by Lesquereux, based on a specimen collected by W. H. Dall in 1880 at Kachemak Bay, Kenai Peninsula, in the Matanuska-Cook Inlet region. This specimen and ours are fairly representative of the species as originally figured by Unger (figs. 5, 6), and such a diversity of leaf forms were subsequently included in it by other authors that I have no hesitation in adding the Alaska specimens to the series.

The peculiar forked secondary nerve, depicted on the left-hand side of the figure of our specimen, is almost certainly a morphologic lesion in this particular leaf and is not a specific or varietal character or feature, although it is of interest to note that a similar peculiarity was depicted by Heer [26] in a leaf from Greenland that he referred to the species, but at the same time remarked on its resemblance to *Fagus antipofii* Abich. (See p. 95.)

The species has also been more or less confused with *Fagus feroniae* Unger (p. 96), but most of the specimens from the Arctic regions—Greenland, Iceland, and Spitsbergen—described and figured by Heer [27] can be readily recognized and differentiated from the more finely, sometimes doubly dentate leaves commonly referred to *Fagus feroniae*.

In America it does not appear to have been definitely identified from elsewhere than Alaska.

Locality: West shore of Cook Inlet, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. 1); collected by C. E. Weaver in 1906 (lot 4130).

Fagus alnitifolia Hollick, n. sp.

Plate 52, figures 5a, 7

Leaf lanceolate-cordate, with an attenuate, acute apex, about 6 centimeters in length by 3.75 centimeters in maximum width; margins undulate; venation pinnate, craspedodrome; secondary veins about 10 on each side, opposite or subopposite below, subopposite and alternate above, the basilar pair weak and bent downward, those next above leaving the midrib at obtuse angles of divergence, the upper ones diverging at more acute angles.

This species is apparently of the same general type of leaf as *Alnites subcordatus* Goeppert,[28] and the resemblance between them is so close that it is difficult to escape the idea of their near relationship, if not specific identity. It is also more or less suggestive of a leaf from Port Graham, Kenai Peninsula, collected by Hjalmar Furuhjelm and described and figured by Heer [29] under the name *Fagus antipofii* var., and of *F. emarginata*, which has a broadly cordate base similar to ours. A more perfect specimen than the one upon which our species is based might show characters that would serve to unite it with some previously described species, such as one of those above cited; but in the meantime it may be regarded as a distinct species.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot. 4129).

Fagus sp. Heer

Fagus sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868.

The generic identification above cited was recorded by Heer in his list of fossil plants collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. It is probably one of the several forms that he subsequently described and included under *Fagus antipofii* Abich.[30] (See p. 95.)

Genus CASTANEA Adanson

Castanea castaneaefolia (Unger) Knowlton

Plate 53, figures 4–6

Castanea castaneaefolia (Unger) Knowlton, U. S. Geol. Survey Bull. 152, p. 60, 1898.

Fagus castaneaefolia Unger, Synopsis plantarum fossilium, p. 218, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxix, pl. 28, fig. 1, Leipzig, 1845.

[26] Heer, Oswald, Nachträge zur Miocenen Flora Grönlands: Flora fossilis arctica, vol. 3, no. 3, p. 5, pl. 3, fig. 12, 1874.

[27] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 105, pl. 8, figs. 1–4; pl. 10, fig. 6; pl. 46, fig. 4, 1868; Miocene Flora von Island: Idem, p. 149, pl. 25, fig. 32; Miocene Flora von Spitzbergen: Idem, p. 159, pl. 31, fig. 3b; Nachträge zur Miocenen Flora Grönlands: Idem, vol. 3, no. 3, pp. 5, 11, pl. 3, figs. 11, 12, 1874; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 73, pl. 15, figs. 5b, 6; pl. 18, fig. 1b; pl. 31, fig. 7, 1876; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 1, no. 2, p. 10, pl. 4, figs. 2, 3, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 83, pl. 95, figs. 8–12, 1883.

[28] Goeppert, H. R., Beiträge zur Tertiärflora Schlesien's: Palaeontographica, vol. 2, p. 272 [14], pl. 33 [1], fig. 6, 1852.

[29] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 31, pl. 8, fig. 1, 1869.

[30] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 30, 1869.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis arctica, vol. 1, p. 106, pl. 10, fig. 8; pl. 46, figs. 1–3b, 1868.

Castanea ungeri Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 470, pl. 45, figs. 1–3; pl. 46, fig. 8, 1869; Flora fossilis alaskana: Idem, no. 2, p. 32, pl. 7, figs. 1–3b, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 581, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

The first specimens of this species recorded from Alaska were collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, and on Keku [Kuiu] Island, southeastern Alaska, and were identified, described, and figured by Heer, first under the name *Fagus castaneaefolia* Unger and subsequently under *Castanea ungeri* Heer.

The species is abundantly represented in the Tertiary flora of the Old World. It was recorded from Canada by Penhallow,[31] and specimens from the Miocene of California were described and figured by Lesquereux.[32] Its presence in the Tertiary flora of Alaska was to be expected, as it is a prominent element in the equivalent floras of Greenland, northern Japan, and Sakhalin.

Localities: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 53, fig. 4). Port Camden, about 3 miles southwest of Corn Island, Kuiu Island, southeastern Alaska (original no. 271); collected by A. F. Buddington in 1922 (lot 7580) (pl. 53, fig. 5). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 53, fig. 6).

Genus QUERCUS Linnaeus

Quercus pseudocastanea Goeppert

Plate 54, figures 4, 5

Quercus pseudocastanea Goeppert, Palaeontographica, vol. 2, p. 274 [16], pl. 35 (3), figs. 1, 2, 1852.

Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 32, pl. 6, figs. 3–5, 5b, 1869.

There apears to be no question that our specimens are specifically identical with those collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, and referred to the above Old World Tertiary species by Heer, but comparison with Goeppert's figures of the type specimens of the species indicates leaves somewhat smaller and with somewhat sharper lobate dentitions, and it may be that the Alaska specimens are not identical with the Old World *Q. pseudocastanea*. The differences are too slight, however, for specific differentiation. The species was recorded by Penhallow[33] from the upper Eocene of the Quesnel River region, British Columbia, but it has not been recognized from elsewhere in America.

Localities: Cache Creek, half a mile above Cache Creek Mining Co.'s camp, Yentna River, Matanuska-Cook Inlet region (original no. 1); collected by S. R. Capps in 1911 (lot 6063) (pl. 54, fig. 4). Nenana coal field, Tanana region, Coal Creek just west of Healy Creek Coal Corporation's mine (original no. 23AC7); collected by S. R. Capps in 1923 (lot 7622) (pl. 54, fig. 5).

Quercus furuhjelmi Heer

Plate 55

Quercus furuhjelmi Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 32, pl. 5, fig. 10; pl. 6, figs. 1, 2, 1869.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

This species was based by Heer upon specimens collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, and until the discovery of our specimen these were the only ones recorded in paleobotanic literature, so far as I am aware.

Our figure may be especially compared with Heer's figure 10, and, to judge from the thickness of the midrib, it was an even larger leaf than the one figured by Heer. Our specimen measures about 20 centimeters in length, and apparently only about half the leaf is represented.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Quercus etymodrys Unger

Plate 54, figures 6, 7

Quercus etymodrys Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 7, p. 175 (18), pl. 3, fig. 3, 1854.

This species has been recognized in a number of different forms from middle and upper Tertiary localities in the Old World but has not heretofore been recorded from the New World. The Alaskan specimen is difficult to differentiate from certain forms that have been referred to *Quercus pseudocastanea* Goeppert, described above, and as both species occur in the same collection from Alaska these might almost as well be regarded as specifically identical, or as varietal forms of the same species.

Massalongo[34] described and figured specimens of *Quercus etymodrys*, including four varieties, all from the Tertiary of eastern Italy; and a comparison of our specimens with certain of these fails to show any characters by means of which they may be definitely or even tentatively differentiated. Thus, our small-leaved form, represented by figure 6, may be compared

[31] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 43, 1908.

[32] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 246, pl. 52, figs. 1, 3–7, 1883.

[33] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 28, 1908.

[34] Massalongo, Abramo, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, pp. 178–181, pl. 22–23, figs. 3, 5, 7, 10, 11, 12, 14; pl. 31, fig. 5; pl. 42, fig. 12, Imola, 1859.

with Massalongo's figure 5, plate 22–23, which is designated var. *microdonta*, and our larger form, represented by figure 7, may be compared with his varieties *canonica* (pl. 22–23, figs. 3, 14), *amphypsia* (pl. 22–23, fig. 7; pl. 31, fig. 5), and *entelea* (pl. 22–23, figs. 10–12; pl. 42, fig. 12). Incidentally, also, it may be noted that he maintained *Q. pseudocastanea* as a distinct species (p. 177, pl. 22–23, fig. 6), although included in the same collection with *Q. etymodrys* and its varieties.

Locality: Nenana coal field, Tanana region, Coal Creek just west of Healy Coal Corporation's mine (original no. 23AC7); collected by S. R. Capps in 1923 (lot 7622).

Quercus grönlandica Heer

Plate 54, figure 3; plate 57, figure 6

Quercus grönlandica Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 2, p. 276, 1866; Flora fossilis arctica, vol. 1, p. 108, pl. 8, fig. 8; pl. 10, figs. 3, 4; pl. 11, fig. 4; pl. 47, fig. 1, 1868.

Newberry, U. S. Geol. Survey Mon. 35, p. 75, pl. 51, fig. 3 (in part); pl. 54, figs. 1, 2, 1898.

Although our specimen is shorter and relatively broader than nearly all of those figured by Heer and other authors, its specific identity can hardly be doubted, especially as a considerable variation in size was recognized by Heer [35] in connection with the specimens described and figured from the Arctic region.

Specimens from Cook Inlet, Alaska, figured by Newberry,[36] show an even greater diversity in size and shape than those figured by Heer, and Newberry's figure 2, plate 54, although representing only a fragment, indicates a short, broad leaf, of the same general type as ours.

The species has apparently been recorded from only three localities outside the Arctic region—the Isle of Mull, Scotland, by Gardner,[37] under the name *Quercites groenlandicus;* Upper Silesia, by Steger; [38] and Italy, by Paolucci.[39] In this connection, however, it may be pertinent to remark that certain specimens recorded in paleobotanic literature as *Fagus dentata* Goeppert, *Quercus furuhjelmi* Heer, *Quercus pseudocastanea* Goeppert, *Castanea atavia* Unger, *Castanea castaneaefolia* (Unger) Knowlton (=*Fagus castaneaefolia* Unger, *Castanea ungeri* Heer), *Planera ungeri* Ettingshausen, etc., are very difficult to separate from certain forms referred to *Quercus grönlandica*, and it seems probable that a thorough study and review of all the available material relating to these several species would result in more or less of a shifting and rearrangement of names and, possibly, in an enlargement of the geographic distribution of the species last named, as now recognized.

The generic relationship of our specimen is, apparently, with *Quercus*, and it is similar in type to the living *Q. prinus*, the rock chestnut oak.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, 2¼ miles northwest of United States locating monument no. 1, elevation 2,750 feet; collected by G. C. Martin in 1910 (lot 5899) (pl. 54, fig. 3). Eska Creek, Matanuska coal field; collected by Theodore Chapin in 1910 (lot 5897) (pl. 57, fig. 6).

Quercus nevadensis Lesquereux

Plate 54, figures 1, 2

Quercus nevadensis Lesquereux, Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 5, pl. 2, figs. 3, 4, 1878.

This species is peculiar in several respects, and our specimens, though fragmentary, appear to show not only the general characters of the species but also those that are more or less unique, particularly the unequal spacing of the secondary veins.

The species was based on specimens from the Miocene of California and, so far as I am aware, has not been recorded from elsewhere than the type locality until it was identified in the Alaska Tertiary flora.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

Quercus olafseni Heer

Plate 52, figure 3

Quercus olafseni Heer, Flora tertiaria Helvetiae, vol. 3, p. 319, 1859; Flora fossilis arctica, vol. 1, p. 109, pl. 10, fig. 5; pl. 11, figs. 7–12; pl. 46, fig. 10; p. 138, pl. 22, fig. 7, p. 149, pl. 26, fig. 6, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 471, pl. 46, fig. 2, 1869; Miocene Flora der Insel Sachalin: Idem, vol. 5, no. 3, p. 38, pl. 7, fig. 6; pl. 12, figs. 4, 5, 1878; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 1, no. 2, p. 10, pl. 4, fig. 9, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 90, pl. 91, fig. 3, 1883.

A number of somewhat diverse forms were included by Heer under this specific name. His first figured specimen (pl. 10, fig. 5) represents an ellipsoidal leaf with a broad cuneate base, similar to ours, whereas most of his other figures show tapering bases. Certain of the specimens, also, are not readily distinguishable from some that were referred to *Quercus grönlandica* Heer, described above; from which it is said by the author to differ in the character of the dentition—*Q. grönlandica* having a single series of teeth and *Q. olafseni* having a major and a minor series.

[35] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, p. 56, pl. 12, figs. 1–4, 1870; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 471, pl. 45, fig. 4, 1869; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 1, no. 2, p. 10, pl. 4, fig. 5, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 89, pl. 69, fig. 4; pl. 89, figs. 1, 2; pl. 91, figs. 1, 2, 1883.

[36] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 75, pl. 51, fig. 3 in part; pl. 54, figs. 1, 2, 1898.

[37] Gardner, J. S., On the leaf beds and gravels of Ardtun, Carsaig, etc., in Mull: Geol. Soc. London Quart. Jour., vol. 43, p. 291, pl. 14, fig. 2, 1887.

[38] Steger, Victor, Die schwefelführenden Schichten von Kokoschütz in Oberschlesien und die in ihnen auftretende Tertiärflora, p. 18, Ratibor, 1883.

[39] Paolucci, Luigi, Nuovi materiali e ricerche critiche sulle piante fossili terziarie dei gessi di Ancona, p. 49, pl. 7, figs. 50.C, 51.V, Ancona, 1896.

This distinction does not persist throughout, however, as certain specimens of the latter species, including ours, have single teeth above and are irregularly dentate below. A fragmentary specimen might therefore be identified as either one of the species.

Quercus olafseni may be regarded as a typical Tertiary species of the Arctic zone. It was originally described from Iceland, by Heer, and subsequently by the same author, from Greenland, the Mackenzie River region in British America, and the island of Sakhalin; hence its discovery as an element in the Tertiary flora of Alaska was to be expected. It has been recorded from localities outside the Arctic zone, but the identifications upon which the records were based are not conclusive. Two specimens were described and figured by Lesquereux [40]—one from the Eocene of North Dakota, the other from the Miocene of California; but the latter was relegated by Knowlton [41] to *Quercus nevadensis* Lesquereux,[42] and the former is open to question. The only other record of the species in America was by Knowlton,[43] based on specimens from the Eocene of the Yellowstone National Park. They were not figured, and he remarked, in connection with a brief description, that "they are undoubtedly the same as the leaves figured by Lesquereux"—referring to the two figures previously cited.

So far as I am aware the only published record of the species from any locality in the Old World was made by Steger,[44] in a list of identifications without any accompanying illustrations, of Tertiary plants from upper Silesia, included in an inaugural dissertation for a doctorate degree, presented before the faculty of philosophy of the University of Breslau, in 1883.

From an analysis of these records it may be seen that very meager evidence is available upon which to assume the occurrence of the species outside the Arctic region; although a closely similar species, from the Eocene of Belgium, was described and figured by Saporta and Marion [45] under the name *Quercus diplodon*, in connection with which the authors remarked [46] that "Le *Quercus olafseni* ressemble évidemment aux feuilles normales et moyennes du *Q. diplodon*. La double dentelure, la disposition des principales nervures * * * tout concorde pour rapprocher les deux espèces qui semblent avoir été tracées sur un modèle commun."

[40] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 224, pl. 48, fig. 4; p. 245, pl. 54, fig. 3, 1883.

[41] Knowlton, F. H., A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 195, 1898.

[42] 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. 5, pl. 2, figs. 3, 4; 1878.

[43] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 707, 1899.

[44] Steger, Victor, Die schwefelführenden Schichten von Kokoschütz in Oberschlesien und die in ihnen auftretende Tertiär flora, p. 17, Ratibor, 1883.

[45] Saporta, Gaston de, and Marion, A. F., Révision de la flore heersienne de Gelinden: Acad. roy. Belgique Mém. cour. et Mém. sav. étrangers, vol. 41, no. 3, p. 38, pl. 4, figs. 6, 7; pl. 5, figs. 1–9; pl. 6, figs. 1–6; pl. 7, fig. 1, 1878.

[46] Idem, p. 41.

Locality: Cook Inlet, west shore, south of Old Tyonek, Matanuska-Cook Inlet region; collected by C. A. Weaver September 14, 1906 (lot 4130).

Quercus steenstrupiana Heer

Plate 52, figures 5b, 6

Quercus steenstrupiana Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 109, pl. 11, fig. 5; pl. 46, figs. 8, 9, 1868; Contributions to the fossil flora of north Greenland: Idem, vol. 2, no. 4, p. 472, pl. 46, fig. 4, 1869; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 92, pl. 69, fig. 5, 1883.

These specimens belong to the general foliar type represented by *Quercus grönlandica* Heer (see p. 99, pl. 54, fig. 3; pl. 57, fig. 6) and *Q. steenstrupiana* Heer and the somewhat obscure but discernible minor denticulations between the major dentitions appear to identify it with the latter.

The only other record of the species in America, so far as I am aware, was by Lesquereux,[47] based upon a doubtful identification of a specimen from the Tertiary (Miocene) of California.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 52, fig. 5b). Bryant Creek, upper Yukon region (original no. 3AP 350); collected by L. M. Prindle in 1903 (lot 3229) (pl. 52, fig. 6).

Quercus platania Heer

Plate 44, figures 5, 6

Quercus platania Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 109, pl. 11, fig. 6; pl. 46, fig. 7, 1868.

Several specimens of this species were figured by Heer,[48] from localities in Greenland and Spitsbergen, in addition to the type specimens from Greenland, with most of which our two agree quite satisfactorily, although in each of them the apex is missing.

A specimen from Wyoming referred to this species by Lesquereux [49] was regarded by Knowlton,[50] with good reason, as erroneously identified and was given the new and more appropriate name *Platanus cordata*.

[47] Lesquereux, Leo, Report on the fossil plants of the auriferous gravels of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 59, 1878.

[48] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 472, pl. 46, fig. 5; pl. 55, fig. 3c, 1869; Die Miocene Flora und Fauna Spitzbergens: Idem, no. 3, p. 57, pl. 12, figs. 5, 6a, 7, 1870; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 74, pl. 16, fig. 1, 1876; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 91, pl. 68, fig. 1, 1878.

[49] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 160, pl. 21, fig. 1, 1878.

[50] Knowlton, F. H., A catalogue of the Cretaceous and Tertiary plants of North America: U. S. Geol. Survey Bull. 152, p. 169, 1898.

Another specimen, from Alberta, referred to the species by Dawson,[51] was also regarded by Knowlton[52] as erroneously identified and was renamed *Quercus dawsoni.*

The species does not appear to have been satisfactorily identified in America from elsewhere than Alaska; but specimens from Saxony, that appear to represent the species, were described and figured by Engelhardt.[53]

Our figures may be especially compared with those of Heer's Greenland specimens.[54]

Localities: Matanuska coal field, Matanuska-Cook Inlet region, 2¼ miles northwest of United States locating monument 1, elevation 2,750 feet; collected by G. C. Martin in 1910 (lot 5899) (pl. 44, fig. 5). Sheep Valley, Matanuska coal field, Matanuska-Cook Inlet region, arkose series; collected by G. C. Martin in 1910 (lot 5900) (pl. 44, fig. 6).

Quercus juglandina Heer?

Plate 42, figures 1a, 2; plate 43, figure 2

Quercus juglandina Heer, Die fossile Flora Grönlands, pt. 2: 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.

Heer's figures of this species include leaves that show a considerable variation in shape and size, although none are perfect. Our specimens also are all fragmentary, but they compare satisfactorily with certain of the similar fragmentary remains depicted by Heer. It must be admitted, however, that the species is not very well defined, and fragmentary remains are liable to be confused with similar remains of other species that resemble it more or less closely, especially when they occur in collections from the same locality. This is the condition that exists in connection with a large number of the specimens collected in the Matanuska region of Alaska, referred to species in the Juglandaceae and Fagaceae, as may be seen by a glance at the species of *Juglans*, *Hicoria*, and *Quercus* from that region described and figured in this paper; and inspection of the figures of the same and closely related species in the equivalent flora of the Upper Atane beds of Greenland, described by Heer,[55] will reveal the fact that a similar condition exists in connection with the flora of that horizon and region. Only tentative identifications can therefore be made of many of these specimens, and the discovery, at any time, of perfect specimens of species now represented only by fragments may result in either confirming or negativing their existing specific identifications.

Quercus juglandina does not appear to be recorded from elsewhere than Greenland and Alaska, but a species that resembles it very closely is *Quercus weedii* Knowlton,[56] from the Miocene of the Yellowstone National Park.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, 4,800-foot point on traverse of Matanuska River west from Moose Creek (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 42, figs. 1a, 2). Matanuska River, Matanuska-Cook Inlet region, 4,200 feet below Moose Creek (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 43, fig. 2).

Quercus conjunctiva Hollick, n. sp.

Plate 42, figures 3, 4a

Leaves lanceolate-ovate, 8 to 10 centimeters in length by 3.5 to 3.75 centimeters in maximum width, curved wedge-shaped at the base, tapering or more or less abruptly narrowed to the apex; margins irregularly sinuate-triangular dentate; venation pinnate, camptocraspedodrome; secondary veins irregularly disposed, flexuous, the lower ones diverging at acute angles from the midrib, the upper at angles successively more and more obtuse angles, all becoming camptodrome through connecting tertiary venation near the margins, forming irregular, angular loops to the marginal dentitions.

These leaves, which I have ventured to describe under a new specific name, combine the characters of *Quercus haidingeri* Ettingshausen, as depicted by Heer[57] from the Tertiary of Switzerland, especially his figures 8 and 14; *Q. singularis* Saporta,[58] from the Tertiary of France; *Q. doljensis* Pilar,[59] from the Tertiary of the Balkan region; *Q. chamissoni* Heer,[60] from Alaska (see p. 102); and *Q. yanceyi* Knowlton,[61] from the Yellowstone National Park.

Specimens from the Eocene of Wyoming that are apparently very closely similar to ours were described and figured by Ward[62] and referred to *Quercus doljensis;* but they appear to resemble *Q. chamissoni* more nearly than they do *Q. doljensis.*

[51] Dawson, J. W., On fossil plants collected by Mr. R. A. McConnell on Mackenzie River and by Mr. T. C. Weston on Bow River: Roy. Soc. Canada Trans., vol. 7, sec. 4, p. 72, pl. 11, 1890.

[52] Knowlton, F. H., op. cit., p. 191.

[53] Engelhardt, Hermann, Die Tertiärflora von Göhren: K. leop.-car. deutsch. Akad. Naturf. Nova Acta, vol. 36, no. 3, p. 22, pl. 11 [4], figs. 1, 2, 1873.

[54] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, pl. 46, fig. 5, 1869; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, pl. 68, fig. 1, 1883.

[55] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pls. 74–76, 1883.

[56] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 705, pl. 87, fig. 4, 1899.

[57] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 53, pl. 76, figs. 5, 7, 8, 10, 14, Winterthur, 1856.

[58] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, pt. 3, no. 1: Annales sci. nat. (Paris), sér. 5, Botanique, vol. 8, p. 68, pl. 5, figs. 5, 5a, 1867.

[59] Pilar, George, Flora fossilis susedana: Acad. sci. slav. merid. Acta, vol. 1, p. 37, pl 7., fig. 14, 1883.

[60] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 33, pl. 6, figs. 7, 8, 1869.

[61] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 707, pl. 89, fig. 2, 1899.

[62] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 551, pl. 36, figs. 9, 10, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 25, pl. 9, figs. 4, 5, 1887.

It may be that our specimens could be identified with some one or another of the species previously mentioned, but I found it impossible to do so and at the same time exclude some other species of similar characters from consideration. They are elements in a characteristic flora, represented in collections from the Matanuska region in southern Alaska, which includes many unique species of Fagaceae and Juglandaceae that are exceedingly difficult to differentiate satisfactorily from one another. A number of these species are identical with or closely related to certain species figured by Heer [63] from the Upper Atane beds of Greenland and to those of certain Tertiary horizons in Switzerland, and these elements in the floras of these regions are equally difficult to differentiate specifically with a feeling of certitude and satisfaction.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, 4,800-foot point on traverse of Matanuska River west from Moose Creek (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 42, fig. 3). Matanuska River, Matanuska-Cook Inlet region, 4,200 feet below Moose Creek (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 42, fig. 4a).

Quercus artocarpites Ettingshausen

Plate 43, figure 1; plate 56, figure 6

Quercus meriani Heer, Flora tertiaria Helvetiae, vol. 2, p. 53, Math.-naturwiss. Cl., Denkschr., vol. 29, p. 63, pl. 55, figs. 19, 19b, 1869.

This species has not been heretofore recorded from any locality in the New World, but the identity of our specimens with the type of the species as figured by Ettingshausen appears to be reasonably satisfactory.

It may be regarded as more or less closely related to *Quercus juglandina* Heer [64] but can generally be distinguished by the character of its margin, which is sharply triangular-denticulate instead of serrate-dentate.

Localities: Matanuska River, Matanuska-Cook Inlet region, 4,200 feet below Moose Creek (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 43, fig. 1). Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178) pl. 56, fig. 6).

Quercus meriani Heer

Plate 44, figure 1

Quercus meriani Heer, Flora tertiaria Helvetiae, vol. 2, p. 53, pl. 76, fig. 12, 1856.

Although our specimen is smaller than the one from the Miocene of Switzerland figured by Heer and differs from it slightly in minor details, I have little hesitation in regarding them as specifically identical. It is not figured elsewhere, so far as I have been able to ascertain, and apparently the only record for the species outside of Switzerland and Alaska is that by Meschinelli and Squinabol,[65] from the Tertiary (Pliocene?) of Italy.

Locality: Matanuska River, Matanuska-Cook Inlet region, 4,200 feet below Moose Creek (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

Quercus alaskana Trelease?

Plate 44, figure 2

Quercus alaskana Trelease, Brooklyn Bot. Gard. Mem., vol. 1, p. 499, 1918.

Quercus pandurata Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 33, pl. 6, fig. 6, 1869. Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

Not *Quercus pandurata* Humboldt and Bonpland, 1813.

The only previous records for this species were those by Heer, relating to an imperfect specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, upon which the species was founded; and the only published figure of the species is one of this particular specimen in his Flora fossilis alaskana under the name *Quercus pandurata*, a name which, unfortunately, had previously been applied to a living species.

In Heer's figure the upper part of the leaf is missing, and in ours the base is obliquely cut off, so that satisfactory comparison is impossible; but I am inclined to believe that they probably represent one and the same species and that both may possibly be leaf forms of *Quercus meriani* Heer (above), with which our specimen is associated in the same collection. It is also more or less suggestive of *Quercus gmelini* Alex. Braun as depicted by Heer,[66] and it is evident that we have in the Tertiary of Alaska a series of leaves of this general type that are either specifically identical with or closely related to a similar series of leaf forms or species that are abundantly represented in the Tertiary of Switzerland.

Locality: Matanuska River, Matanuska-Cook Inlet region, 4,200 feet below Moose Creek (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

Quercus chamissoni Heer

Quercus chamissoni Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 33, pl. 6, figs. 7, 8, 1869.

---

[63] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pls. 73–76, 1883; Flora tertiaria Helvetiae, vol. 2, pl. 76, 1856; vol. 3, pls. 130, 131, 1859.

[64] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: 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.

[65] Meschinelli, Aloysius, and Squinabol, X., Flora tertiaria italica, p. 223, Padua, 1893.

[66] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 53, pl. 76, figs. 1–4, Winterthur, 1856.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

Two specimens of this species, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, were described and figured by Heer as the type of the species, but it was not subsequently recorded from any other locality either by Heer or by any other author. It appears as if it might represent a leaf form that could be referred to one or another of several allied species, such as *Quercus meriani* Heer (p. 102) or *Q. firma* Heer.[67] A great variety of leaves of this same general type have been given distinct specific names by certain authors and have been interchanged between the several species by others. The entire group requires careful and critical revision in connection with a study of the type specimens. Comparison of figures only, especially of those that were drawn by hand, is not conclusive or completely satisfactory.

The species is here recognized, therefore, not because it is definitely so regarded, in the ordinary acceptation of the term, but in order that it may be recorded in its proper place in the Tertiary flora of Alaska.

Quercus dallii Lesquereux

Plate 52, figure 4

Quercus dallii Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 446, pl. 8, figs. 2–5, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 259, 1883.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 582, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 219, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 883, 1896.

The specimens upon which Lesquereux based this species were collected by W. H. Dall in 1880, somewhere on Cook Inlet, probably at Kachemak Bay, Kenai Peninsula. The four specimens figured bear the U. S. National Museum number 1388, and figure 4 is the one that compares most closely in size with our figure 4.

The only other published record of the species was made by Dawson,[68] in connection with which he gave a figure of a fragmentary leaf from British Columbia, but the identity of this specimen is open to question. The species that compares most closely with Lesquereux's figures is *Quercus undulata* Goeppert,[69] from the Tertiary of Silesia.

[67] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 51, pl. 77, fig. 6, Wintherthur, 1856.

[68] Dawson, J. W., On fossil plants from the Similkameen Valley and other places in the southern interior of British Columbia: Roy. Soc. Canada Trans., vol. 8, sec. 4, p. 85, fig. 17, 1890.

[69] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsche geol. Gesell. Zeitschr., vol. 4, p. 491, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 15, pl. 7, figs. 1, 2, Görlitz, 1855.

Locality: Matanuska-Cook Inlet region, west shore of Cook Inlet, half a mile south of Old Tyonek (original no. 1); collected by C. A. Weaver in 1906 (lot 4130).

Quercus oregoniana Knowlton?

Plate 50, figure 5

Quercus oregoniana Knowlton, U. S. Geol. Survey Bull. 204, p. 47, pl. 6, figs. 2, 3; pl. 7, fig. 1, 1902.

This specimen is too fragmentary for anything more than provisional identification. It is almost certainly a *Quercus* and is apparently referable to the same general type as *Quercus oregoniana* Knowlton, originally described from the upper Eocene (Clarno formation) of Oregon.

It may also be compared with *Quercus attenuata* Goeppert,[70] *Q. pseudoalnus* Ettingshausen as depicted by Engelhardt,[71] and *Q. goepperti* Lesquereux.[72]

Locality: Coal Bay, Port Graham, Kenai Peninsula, Matanuska-Cook Inlet region (original no. 908); collected by T. W. Stanton in 1904 (lot 3518).

Quercus? sp. Knowlton

Quercus? sp., Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 195, 1898.

It would be mere guesswork to try to identify the species listed as above by Knowlton with any of the specimens subsequently collected at or in the vicinity of Miller's [Drew] coal mine, on the north bank of the Yukon River, about 25 miles above Mynook Creek, in the central Yukon region, the locality cited for this specimen. It is included here merely as a matter of record. The original collection was made by J. E. Spurr and party in 1896.

Genus DRYOPHYLLUM Debey

Dryophyllum stanleyanum Dawson

Plate 56, figures 3–5

Dryophyllum stanleyanum Dawson, J. W., Roy. Soc. Canada Trans., ser. 2, vol. 1, sec. 4, p. 147, pl. 7, fig. 13, 1895.

Our specimens are apparently specifically identical with the more or less problematical foliar species from the Tertiary (Eocene) of Canada, described and figured under the above name by Dawson. In a general way the leaves resemble leaflets of the genera *Aesculus*, *Juglans*, and *Hicoria*, and perfect specimens might reveal characters that would tend to ally them definitely with one or another of these genera. They hardly appear to be referable to the genus *Dryophyllum* as generally recognized or as originally described

[70] Goeppert, H. R., Die tertiäre Flora von Schossnitz in Schlesien, p. 17, pl. 8, figs. 4, 5, Görlitz, 1855.

[71] Engelhardt, Hermann, Über Tertiärpflanzen vom Himmelsberg bei Fulda: Senckenb. naturf. Gesell. Abh., vol. 20, no. 3, p. 269, pl. 2, fig. 25, 1901.

[72] 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. 7, pl. 2, fig. 11, 1878.

and figured in connection with *D. subcretaceum* Saporta[73]; and Dawson[74] suggested, as probable, that they might be identical with the leaves identified as *Quercus furcinervis* Rossmässler by Lesquereux,[75] from the Eocene (Clarno formation) of Oregon.

Dawson said, in part, as follows:

Midrib and veins strong, sunken in the leaf, which swells between the veins. Veins proceeding from the midrib almost at right angles but bending upward toward the margin, where some of them seem to fork obtusely, though this is uncertain. Margin entire or slightly undulate, so as to give a denticulate appearance. * * * In venation it somewhat resembles *Quercus castaneopsis* of Lesquereux. * * * It seems doubtful if it is an oak, but perhaps may be referred for the present to the provisional genus *Dryophyllum*. It may eventually prove to be allied to the laurels or magnolias.

In view of the uncertainty in regard to the generic affiliation of the species and the fact that with the meager information now available any generic reference would merely reflect personal opinion, the original name is retained, especially as it serves the purpose of identification, irrespective of the actual systematic status of the specimens.

Localities: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 56, fig. 3). Yakutat-Copper River region, bed of creek flowing into head of Canyon Creek from Mount Chezum, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846) (pl. 56, fig. 4). Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 56, fig. 5).

Dryophyllum longipetiolatum Knowlton

Plate 42, figure 5

Dryophyllum longipetiolatum Knowlton, U. S. Geol. Survey Mon. 32, pt. 2, p. 719, pl. 88, figs. 6, 7, 1899.

In size, shape, and dentition of the margin our specimen agrees perfectly with the species described and figured by Knowlton from the Tertiary (Miocene?) of the Yellowstone National Park, but in the latter the secondary venation is depicted as strictly craspedodrome, whereas in the Alaska specimen it is distinctly campto-craspedodrome. The minute characters of the ultimate secondary venation in the marginal area are commonly relied upon to distinguish between the genera *Quercus* and *Dryophyllum*, and unless specimens are perfectly preserved these minor and often obscure characters might not be clearly apparent and would not be likely to be indicated in any but carefully executed illustrations. Critical examination of the actual specimens is often necessary for accurate and satisfactory determination of characters.

In our specimen the details of the venation are well defined, and the leaf is undoubtedly referable to the genus *Dryophyllum* and, at least surficially, cannot be distinguished from *D. longipetiolatum*.

Locality: Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392).

Dryophyllum aquilonium Hollick, n. sp.

Plate 43, figure 6

Leaf oblong-elliptical, 7.5 centimeters in length by 3 centimeters in maximum width, cuneate at the base, tapering to an elongated apex; margin triangular denticulate in the upper part, entire below, the denticulations becoming smaller and finally disappearing below the middle of the leaf; venation pinnate, campto-craspedodrome; secondary veins about 12 on each side, irregularly disposed, diverging at angles of about 45° from the midrib, curving upward and becoming camptodrome in a series of angular loops, with veinlets extending from the angles of the loops to the marginal denticulations.

This leaf, which I have ventured to describe as a new species, is apparently specifically identical with certain leaves from Greenland that Heer[76] referred to *Quercus laharpi* Gaudin;[77] but a comparison of Heer's figures with Gaudin's figures of the type of the species reveals only a very remote resemblance—hardly sufficient, apparently, to warrant placing them in the same genus.

A species that appears to be closely related, however, to both Heer's specimens and to ours, is *Dryophyllum bruneri* Ward,[78] originally described and figured by Ward from the Upper Cretaceous (Laramie?) of Wyoming, and subsequently by Knowlton[79] from the Upper Cretaceous (Vermejo formation) of Colorado, and generic relationship between them all appears to be indicated beyond question.

This species is another example of the interesting identity between the flora of the Matanuska region in Alaska and that of the Upper Atane beds of Greenland during early Tertiary time.

Locality: Matanuska coal field, Matanuska-Cook Inlet region, 4,800-foot point on traverse of Matanuska River west from Moose Creek (original no. 4); collected by Theodore Chapin in 1910 (lot 5901).

[73] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, no. 3, p. 347 (59), pl. 26 (5), figs. 1–3; text fig. 10, p. 348 (60), 1868.

[74] Dawson, J. W., op. cit., p. 148.

[75] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 244, pl. 53, figs. 10–12, 1883, =*Q. clarnensis* Trelease, William, Brooklyn Bot. Guard. Mem., vol. 1, p. 499, 1918.

[76] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 92, pl. 74, figs. 1–3, 1883.

[77] Gaudin, C. T., Contributions à la flore fossile italienne: Soc. helv. sci. nat. Nouv. mém., vol. 17, no. 4, p. 45, pl. 4, figs. 1, 6, 1860.

[78] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 551, pl. 37, figs. 6–9, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 27, pl. 10, figs. 5–8, 1887.

[79] Knowlton, F. H., op. cit. (U. S. Geol. Survey Bull.), p. 169.

Order URTICALES

Family ULMACEAE

Genus ULMUS Linnaeus

Ulmus braunii Heer?

Plate 58, figures 6–12

Ulmus braunii Heer, Flora tertiaria Helvetiae, vol. 2, p. 59, pl. 79, figs. 14–21, Winterthur, 1856.
Knowlton, Alaska, vol. 4, p. 155, Harriman Alaska Expedition, 1904.

Specimens collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1899, were discussed by Knowlton, as follows:

> I have some doubt as to the correctness of referring these leaves to *Ulmus*, but the examples in hand are not to be distinguished from certain specimens from Spitsbergen and other localities that have been so referred by Heer, and I have thus regarded them.

Unfortunately the specimens were not figured, and the record above cited is the only one heretofore published relating to this species as an element in the fossil flora of Alaska.

In connection with the original description of this species, based on specimens from the Tertiary of Switzerland, Heer included figures of a considerable variety of leaf forms, and subsequently he and other authors referred yet other forms to the species, until it finally came to include at least half a dozen more or less well-defined foliar varieties or forms, some of which were treated and named as such and others were shifted about and referred to other species.

Our specimens are more or less fragmentary, and, if the species had not been made to include a great diversity of forms, I might be inclined to regard them as representing a new species. In the circumstances, however, I have decided to include them all, tentatively, under *Ulmus braunii* Heer.

Specimens from the Miocene of Colorado, that included a wide diversity of forms, were described and figured by Lesquereux,[80] but otherwise it appears to have been recognized only as an Old World species.

Localities: Cape Douglas, Alaska Peninsula, cape west of cabin (original no. 5); collected by R. W. Stone in 1904 (lot 3526) (pl. 58, figs. 6, 12). Summit of mountain 1 mile southwest of forks of Pumicestone Creek, Alaska Peninsula (original no. P. 23); collected by W. R. Smith in 1922 (pl. 58, figs. 7–11).

Ulmus pseudobraunii Hollick, n. sp.

Plate 58, figures 1–3

Leaves inequilateral, 6 to 8 centimeters in length by 2.5 to 3.5 centimeters in maximum width, tapering above to a bluntly acuminate cuneate apex, oblique below on one side, rounded on the opposite side, short petiolate; margin finely and uniformly denticulate; venation simply pinnate, craspedodrome; secondary veins numerous, strong and conspicuous, diverging at acute angles from the midrib on the oblique side of the leaf and obtuse angles on the rounded side, the lower ones pointing downward, nearly all branched or forked distad, the branches or forks often subdividing dichotomously, each vein and subdivision terminating in one of the dentitions.

These leaves are not altogether unlike some that have been included in *Ulmus braunii* Heer, the species last described; but the narrow, elongated shape, the fine, uniform denticulations, and the more numerous secondaries and their more conspicuous dichotomous forking serve to distinguish them from any of the figures that represent the original specimens upon which the type of the species was based.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Ulmus plurinervia Unger

Ulmus plurinervia Unger, Synopsis plantarum fossilium, p. 221, Leipzig, 1845; Chloris protogaea, pl. 6, p. lxxx; pt. 8, p. 95, pl. 25, figs. 1–4, Leipzig, 1845 [1847].
Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 34, pl. 5, fig. 1, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.

A single leaf, described and figured and referred to this species by Heer, was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. It has not been identified in any of our collections, and its only recorded occurrence on the North American Continent outside of Alaska was based on a single specimen from the Miocene of Oregon.[81] This specimen, however, was not figured.

Ulmus carpinoides Goeppert

Plate 51, figures 1, 2

Ulmus carpinoides Goeppert, Die tertiäre Flora von Schossnitz in Schlesien, p. 28, pl. 13, figs. 4–9 (excl. pl. 14, fig. 1), Görlitz, 1855.

This species, or the leaf form to which this specific name has been applied, has not been heretofore recorded from America, and although our specimens are not exactly comparable with the figures of the type specimens from the Tertiary of Silesia, as originally defined by Goeppert, they compare very closely with certain leaves subsequently included in the species by other authors, notably Menzel,[82] who relegated a great

[80] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 161, pl. 27, figs. 1–4, 8, 1883.

[81] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 55, 1902.

[82] Menzel, Paul, Über die Flora der Senftenberger Braunkohlen-Ablagerungen: K. preuss. geol. Landesanstalt Abh., new ser., no. 46, p. 67, pl. 4, figs. 5–7, 9–15, 16a, 1906.

variety of leaf forms to the species. The particular forms with which our specimens seem to compare most closely are represented by Menzel's figures 6 and 15, and any description of our specimens could hardly be made to differ in any particular from a description of these figures.

Whether or not this species is properly referable to the genus *Ulmus* is more or less questionable. The bases of the leaves in our specimens are only slightly oblique, and the nervation might be identified with that of *Ulmus*, *Betula*, or *Carpinus*, according to the individual leaf that might be the subject of study and comparison; and incidentally it may be remarked that other authors have also had difficulty in satisfactorily determining the generic relationship of similar leaves. Heer,[83] for example, in his discussion of *Carpinus grandis* Unger, included *Betula carpinoides* Goeppert, *Ulmus longifolia* Unger, *U. carpinoides* Goeppert, *U. pyramidalis* Goeppert, and *U. urticaefolia* Goeppert [84] as synonyms, and Gaudin,[85] in his discussion of *Carpinus* [*Ulmus*] *pyramidalis* (Goeppert), arrived at a similar conclusion. Other authors have also discussed the probable generic and specific relationships of these and other similar leaf forms in the Betulaceae and Ulmaceae, and it is evident that identification and interpretation of characters must be regarded largely as matters of individual opinion.

Our specimens are associated in the same pieces of matrix with leaves that have been determined as belonging in the genera *Carpinus*, *Alnus*, and *Corylus;* but if new material with more perfect specimens should be brought to light in the future, any or all of these determinations might be subjected to specific and generic changes.

Locality: Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651).

Ulmus sorbifolia Goeppert

Plate 57, figures 3–5

Ulmus sorbifolia Goeppert, Deutsche geol. Gesell. Zeitschr., vol. 4, p. 492, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 30, pl. 14, fig. 10, Görlitz, 1855.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 3, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 260, 1883.

Knowlton, Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.

It seems somewhat remarkable that this well-defined species should be recorded only from the type locality in the Old World, in Silesia, and from Alaska. The first specimens from Alaska were collected by W. H. Dall in 1880, at "Chugachik" or "Cuyachick" [Kachemak] Bay, Kenai Peninsula, and it has since been identified in several of the collections from that region, but not from elsewhere.

Localities: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 3652) (pl. 57, fig. 3). West side of Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 57, fig. 4). Kachemak Bay, Kenai Peninsula, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131) (pl. 57, fig. 5).

Ulmus borealis Heer

Plate 57, figures 1, 2

Ulmus borealis Heer, Die Miocene Flora des Grinnell-Landes: Flora fossilis arctica, vol. 5, no. 1, p. 35, pl. 5, fig. 10; pl. 7, figs. 1–4; pl. 9, figs. 2–5, 1878.

Our specimens are apparently referable to certain of those described and figured by Heer under the above specific name, but whether or not the species is a valid one, distinct from certain forms of *Ulmus diptera* Steenstrup (see p. 107), may perhaps be regarded as an open question. Our figure 1 might be compared with Heer's figure 4, plate 7, representing *Ulmus borealis* from Grinnell Land, and with *Ulmus diptera* Steenstrup as figured by Heer,[86] from Iceland. Our figure 2 is most nearly like *Ulmus borealis* as represented by Heer's figure 1, plate 7, which depicts a specimen from Grinnell Land.

The marginal dentition is in most specimens somewhat coarser in *U. borealis* than in *U. diptera*, but an examination of all of Heer's figures of the two species indicates that this is a feature that cannot be relied upon for specific differentiation.

The only other described fossil species that might be regarded as belonging to the same general type of leaf is *Ulmus orbiculata* Ward.[87] This species is particularly characterized by conspicuously curved secondary veins—especially the upper ones. This same feature is shown in our figure 1, and in Heer's figure 4, plate 7, of *Ulmus borealis;* but it is significant that in each specimen the upper part of the leaf is missing and the part immediately below is mutilated and more or less distorted. Ward suggested that the curving of the secondaries in his *Ulmus orbiculata* might be due to injury and might not represent a normal specific character, and this suggestion may be considered in connection with the figures mentioned of *Ulmus borealis.*

[83] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 40, pl. 71, figs. 19b–19e; pl. 72, figs. 2–24; pl. 73, figs. 2–4, Winterthur, 1856.

[84] Goeppert, H. R., Die tertiäre Flora von Schossnitz in Schlesien, pp. 12, 28–30, pl. 3, fig. 16; pl. 13, figs. 1–3, 4–9, 10–12; pl. 14, fig. 1, 2–3, Görlitz, 1855.

[85] Gaudin, C. T., Mémoire sur quelques gisements de feuilles fossiles de la Toscane: Soc. helvétique sci. nat. Nouv. mém., vol. 16, no. 3, p. 30, pl. 4, figs. 7–13; pl. 5, fig. 7, 1858.

[86] Heer, Oswald, Miocene Flora von Island: Flora fossilis arctica, vol. 1, pl. 27, fig. 2.

[87] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 553, pl. 46, fig. 6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 46, pl. 23, fig. 6, 1887.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region. Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821).

Ulmus diptera Steenstrup?

Plate 48, figure 4a

Ulmus diptera Steenstrup, in Heer, Flora tertiaria Helvetiae, vol. 3, p. 319, Winterthur, 1859.

Our specimen appears to belong to this species as described and figured by Heer [88] in connection with specimens from the Tertiary of Iceland. It has not been heretofore recorded from America and has been but sparingly recorded from the Old World.

The species is difficult to differentiate from *Ulmus borealis* Heer (p. 106), and I am inclined to believe that the two may ultimately be regarded as slightly different leaf forms of one and the same species.

Locality: Copper Basin, half a mile east of Gakona glacier, Yakutat-Copper River region (original no. 1948); collected by W. C. Mendenhall in 1902 (lot 3021).

Ulmus longifolia Unger

Plate 58, figure 4

Ulmus longifolia Unger, Chloris protogaea, pt. 6, p. lxxx, Leipzig, 1845; pt. 8–10, p. 101, pl. 26, fig. 5 [leaf], fig. 6 [fruit], 1847.

This specimen appears to agree in all its essential characters with *Ulmus longifolia* as originally described and figured by Unger from the Miocene of Bohemia, and I have but little hesitation in so referring it. The species is not rare in the Old World, but it does not appear to have been heretofore definitely recognized in connection with any New World collections. One specimen, however, from the Miocene of Colorado, described and figured by Lesquereux [89] under *Ulmus braunii* Heer appears to be more properly referable to *U. longifolia* and to be specifically identical with our specimen from Alaska.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Genus PLANERA Gmelin

Planera aquaticiformis Hollick, n. sp.

Plate 57, figure 7

Leaf 7 centimeters in length by about 4.25 centimeters in maximum width, ovate-lanceolate, rounded (and slightly cordate?) at the base, tapering from the middle to an acute cimeate apex; margin finely crenate-serrate-dentate; venation simply pinnate, craspedodrome; secondary veins 11 on each side of the midrib; irregularly spaced and disposed, mostly alternate, diverging at obtuse angles from the midrib, the lowest two branched from the under side, the upper ones forked and branched distad, each fork and branch terminating in one of the marginal dentitions; tertiary venation bent and wavy, mostly subtending right and obtuse angles with their supporting secondaries.

This beautiful specimen, except for its larger size, is practically identical in every surficial detail with many of the leaves of the existing *Planera aquatica* (Walter) Gmelin, a species which ranges from southern Illinois and Missouri southward to the Gulf of Mexico. Incidentally, also, this species is now the only known representative of the genus, although several Cretaceous and Tertiary species have been described, mostly from the western United States, and *Planera aquatica* has been recognized as an element in the Tertiary flora of New Jersey by me [90] and in the Pleistocene floras of the southeastern United States by Lesquereux [91] under the name *Planera gmelini* (Michaux) and by Berry.[92]

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Planera ungeri Ettingshausen

Plate 58, figure 5

Planera ungeri Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 1, pt. 3, p. 14, pl. 2, figs. 5–18, 1851.
Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 34, pl. 5, fig. 2, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.

A single fragment of a leaf of this species, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, was described and figured by Heer, and we have, in our collections, only one fragmentary specimen from elsewhere in Alaska. The latter, however, is sufficiently well defined to be recognized as specifically identical with the specimen represented by Heer's figure; but each of them is much larger than any of the diverse forms figured by Ettingshausen, and the only one with which the Alaskan specimens may be compared at all

[88] Heer, Oswald, Miocene Flora von Island: Flora fossilis arctica, vol. 1, p. 149, pl. 27, figs. 1–3, 1868.

[89] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 161, pl. 27, fig. 4, 1883.

[90] Hollick, Arthur, Paleobotany of the Yellow gravel [originally regarded as Pleistocene] at Bridgeton, N. J.: Torrey Bot. Club Bull., vol. 19, p. 332, 1892.

[91] Lesquereux, Leo, On some fossil plants of recent formations: Am. Jour. Sci., 2d ser., vol. 27, p. 365, 1859.

[92] Berry, E. W., Contributions to the Pleistocene flora of North Carolina: Jour. Geology, vol. 15, p. 343, 1907; The Mississippi River bluffs at Columbus and Hickman, Ky., and their fossil flora: U. S. Nat. Mus. Proc., vol. 48, no. 2074, p. 300, 1915; The Pliocene Citronelle formation of the Gulf Coastal Plain and its flora: U. S. Geol. Survey Prof. Paper 98, p. 201, pl. 47, figs. 1–4, 1916.

satisfactorily is represented by Ettingshausen's figure 13. An even wider diversity of forms, however, was depicted by Heer [93] from the Tertiary of Switzerland, and among the larger ones are several that are fully as large as ours.

It is a common, widely distributed Miocene species throughout Europe and occurs as an Eocene species in Japan, Sakhalin, Iceland, and Greenland. In one or another of its forms it has also been recorded by Lesquereux [94] from the Miocene of Colorado and Oregon, by Berry [95] from the Miocene of Virginia, and by me [96] from the Pleistocene of Maryland.

It may well be considered doubtful if all these diverse forms, ranging stratigraphically from Eocene to Pleistocene, and distributed practically throughout the northern hemisphere, should be regarded as representing a single species; but it can hardly be questioned that our specimen from Alaska is specifically identical with many of the forms identified by Heer [97] from Arctic and sub-Arctic regions.

Locality: Port Camden, about 3 miles southwest of Corn Island, Kuiu Island, southeastern Alaska (original no. 271); collected by A. F. Buddington in 1922 (lot 7580).

Family MORACEAE

Genus ARTOCARPUS Forster

Artocarpus ordinarius Hollick, n. sp.

Plate 56, figures 1, 2

Leaves oblong-lanceolate to oblong-ovate, 9 centimeters in length by 5.5 centimeters in maximum width, base rounded-truncate or broadly cordate; margin entire; venation simply pinnate, camptodrome; secondary veins numerous, irregularly disposed and spaced, subparallel, leaving the midrib at obtuse angles of divergence, abruptly bent upward toward their extremities and becoming camptodrome close to the margin; tertiary venation fine, approximately at right angles to the secondaries throughout, curved or flexed and occasionally forked.

These leaves are somewhat suggestive of certain species that have been described under or referred to the genus *Ficus*,[98] but in nearly every such case the generic resemblance to *Artocarpus* appears to be about as close as to *Ficus;* and comparison with numerous leaves of existing species in both genera has led me to believe that, at least insofar as concerns the specimens from Alaska, they may be referred to the genus *Artocarpus* rather than to *Ficus.*

The existing species of the genus are restricted in their distribution to the tropical regions of the Old World; but the genus appears to have been widely distributed in both the Old World and the New in Cretaceous and Tertiary time, and one well-defined species (*Artocarpus dicksoni* Nathorst [99]) was found as far north as Greenland. This and most of the other described species are lobed-leaved forms and are readily identifiable as belonging to the genus, but the entire-leaved forms cannot be generically identified with equal confidence or satisfaction.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

Genus ARTOCARPIDIUM Unger

Artocarpidium alaskanum Hollick, n. sp.

Plate 59, figures 1–5

Leaves asymmetric, petiolate, varying in shape and size, inequilaterally lanceolate to lanceolate-ovate, 7 to 9 centimeters in length by 4 to 6 centimeters in maximum width, obliquely cuneate-truncate and rounded at the base, tapering to the acuminate apex; petiole 1 to 1.5 centimeters in length; margin wavy-dentate above, undulate and entire toward and at the base; venation pinnate, craspedodrome; midrib curved or flexuous; secondary veins irregularly disposed and spaced, those on the rounded side at obtuse or right angles with the midrib, those on the opposite or cuneate side at acute angles, the former curving sharply upward toward their extremities, the latter more gently curved or flexuous, each one terminating either in a marginal dentition in the upper part of the leaf or close to the margin in the lower, entire part.

These leaves are closely comparable with *Artocarpidium olmediaefolium* Unger,[1] from the Miocene of Styria, but they are relatively shorter and broader and not so conspicuously narrowed and elongated toward the apex. *A. olmediaefolium* was tentatively identified by Lesquereux,[2] on the basis of a specimen from the Eocene of Colorado; but the specimen was subsequently redescribed and figured under the name *Celastrinites artocarpidioides* Lesquereux; [3] and a com-

[93] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 60, pl. 80, figs. 1–23, Winterthur, 1856.

[94] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 190, pl. 27, fig. 7, 1878; Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 19, 1888.

[95] Berry, E. W., A Miocene flora from the Virginia Coastal Plain: Jour. Geology, vol. 17, p. 25, text fig. 4, 1909.

[96] Hollick, Arthur, Systematic paleontology of the Pleistocene deposits of Maryland: Maryland Geol. Survey, Pliocene and Pleistocene, p. 229, pl. 71, figs. 14, 15, 1906.

[97] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 40, pl. 9, fig. 10, pl. 10, figs. 1, 2, 1878; Beiträge zur Miocenen Flora von Sachalin: Idem, no. 4, p. 9, pl. 4, fig. 4a, 1878.

[98] *Ficus ungeri* Lesquereux, U. S. Geol. Survey Terr. Ann. Rept. for 1871, Suppl., p. 7, 1872; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 195, pl. 30, fig. 3, 1878; The Cretaceous and Tertiary floras: Idem, vol. 8, p. 163, pl. 44, figs. 1–3, 1883.

[99] Nathorst, A. G., Ueber die Reste eines Brotfruchtbaums, *Artocarpus dicksoni* n. sp., aus den Cenomanien Kreideablagerungen Grönlands: K. svenska vet.-akad. Handl., vol. 24, no. 1, pp. 1–10, pl. 1, figs. 1–4, 1890.

[1] Unger, Franz, Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 166 (36), pl. 35 (14), figs. 1, 2, 1850.

[2] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1873, p. 400, 1874.

[3] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 268, pl. 35, fig. 3, 1878.

parison of this figure with ours and Unger's fails to show any characters that would indicate specific identity or even generic relationship.

The only other recognized representative of the genus in America is *Artocarpidium cretaceum* Ettingshausen,[4] an entire-leaved species, originally described from the Cretaceous of the Old World and subsequently identified by Lesquereux[5] in the Dakota Cretaceous of Kansas.

The discovery of a species in Alaska that is closely similar to Unger's species from the Tertiary of Europe and the fact that no Tertiary species of the genus has been heretofore definitely recorded from America are interesting. The genus is supposed to be related to the Artocarpae, the tribe to which the breadfruit and other allied tropical plants belong, and thus another presumably tropical element is introduced into the Tertiary flora of the Arctic region of North America.

Localities: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 59, figs. 1–4). Fairbanks district, Tanana region (original no. 31); collected by L. M. Prindle and H. B. Blair in 1906 (lot 7476) (pl. 59, fig. 5).

Genus FICUS Linnaeus

Ficus? alaskana Newberry

Ficus? alaskana Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 512, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 84, pl. 51, fig. 1; pl. 52, fig. 1; pl. 55, figs. 1, 2, 1898.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 222, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896; U. S. Geol. Survey 18th Ann. Rept., pt. 3, pp. 194, 195, 1898.

Four specimens, collected in 1867 at Cook Inlet and at Admiralty Island, southeastern Alaska, by Capt. W. A. Howard, of the United States Revenue Cutter Service, were described and figured under the above name by Newberry,[6] with a query after the generic designation. It is evident, from a comparison of figures, that they should be referred to the genus *Dombeyopsis* and apparently to *D. decheni* Weber, from the Miocene of Europe;[7] but this obvious generic and close specific identity was not mentioned by Newberry.

I have not found, in the more recent collections of fossil plants from Alaska, a single specimen that has any specific resemblance to any of the figures cited of either *Ficus? alaskana* or *Dombeyopsis decheni;* but Knowlton[8] identified the former species in three collections made in the Yukon Valley in 1896, by J. E. Spurr, H. B. Goodrich, and F. C. Schrader (lot 1555). In connection with two of the collections, however, designated as "below Mission Creek" and "25 miles above Mynook Creek, Miller's coal mine," the identification was queried, and it is significant that the locality first mentioned represents an area where only Cretaceous plants were subsequently found. The species was not queried, however, in the collection from the third locality, designated as "just above or north of Mynook Creek." This locality is probably identical with Collier's 2AC 146 (Yukon River, south bank, about 1½ miles above Rampart) and Hollick's 3AH 10 (Yukon River, south bank, just above Rampart). Miller's coal mine, above cited, is probably identical with what was later known as Drew's mine, represented by Collier's 2AC 140a (Yukon River, north bank, opposite Hess Creek), and Hollick's 3AH 9a, 9b, 9c (Yukon River, north bank, at Drew's mine).

Ficus menzeli Hollick, n. sp.

Plate 60, figure 6

Leaf asymmetric, trilobate, about 8 centimeters in length by 5 centimeters in maximum width, obliquely subcordate at the base, obtusely apiculate at the apex; margin entire except for a single large blunt tooth (or occasionally more than one) in connection with each lobe; nervation tripalmate from the base; lateral primaries ascending, each one terminating in the apex of one of the lateral lobes and giving off branches from the outer sides that are either camptodrome or individually craspedodrome to each of the marginal teeth; secondary nerves irregularly spaced and disposed, those on the narrower side of the leaf, in common with the adjacent lateral primary, subtending angles with the midrib more acute than those on the broader side, craspedodrome in connection with each marginal tooth, otherwise camptodrome.

This specimen is apparently generically related to one of four leaves from southern Alaska described and figured by Newberry[9] under the name *Ficus? alaskana.* Its close relationship to any except the one specimen represented by Newberry's figure 1, plate 51, is not, however, obvious. I am also inclined to regard

[4] Ettingshausen, Constantin von, Die Kreideflora von Niederschoena in Sachsen: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 55, pt. 1, p. 251, pl. 2, fig. 4, 1867.

[5] Lesquereux, Leo, The flora of the Dakota group: U. S. Geol. Survey Mon., vol. 17, p. 86, pl. 50, fig. 7, 1891.

[6] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, pl. 51, fig. 1 [U. S. Nat. Mus. no. 7105]; pl. 52, fig. 1 [no. 7112]; pl. 55, fig. 1 [no. 7106]; pl. 55, fig. 2 [no. 7111], 1898.

[7] Weber, C. O., Die Tertiärflora der Niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 193 (79), pl. 21 (4), fig. 10, 1851 (1852). Ludwig, Rudolph, Fossile Pflanzen aus der ältesten Abtheilung der Rheinisch-Wetterauer Tertiär-formation: Palaeontographica, vol. 8, p. 126, pl. 49, figs. 1, 1a [?]; pl. 61, fig. 4, 1859.

[8] Knowlton, F. H., Report on a collection of fossil plants from the Yukon River, Alaska: U. S. Geol. Survey 18th Ann. Rept., pt. 3, pp. 194, 195, 1898.

[9] Newberry, J. S., Brief descriptions of fossil plants, chiefly Tertiary, from western North America: U. S. Nat. Mus. Proc., vol. 5, p. 512, 1882 [1883]; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 84, pl. 51, fig. 1 [excl. pl. 52, fig. 1, and pl. 55, figs. 1, 2], 1898.

it as more closely related to *Phyllites* sp. Menzel,[10] from the Tertiary brown coal of northern Germany, for the possible relationship of which he suggested, comparison with *Passiflora*, *Lindera*, and other genera in the Menispermaceae and Icacinaceae. After comparison with leaves of numerous species in these and other genera, however, the genus *Ficus* appeared to be as satisfactory a reference as any for our specimen and for Menzel's figure, and apparently also for Newberry's.

If specific relationship should be recognized between our specimen and Menzel's the specific name here adopted would be pertinent and appropriate.

Locality: Matanuska coal field, Matanuska-Cook Inlet region, Chickaloon River, shales overlying 15-foot coal near Watson's tunnel 2 (original no. 1); collected by G. C. Martin in 1905 (lot 3672).

Ficus overbecki Hollick, n. sp.

Plate 60, figure 7

Leaf apparently oblong-orbicular, about 9 centimeters in length by 7 to 8 centimeters in maximum width; base broadly cordate (auriculate?); margin entire; venation pinnate-subpalmate, camptodrome; secondaries 5 or 6 on each side, somewhat flexuous, irregularly spaced and disposed, subtending angles of about 45° with the midrib, the lower two opposite, arising from the base, simulating lateral primaries, each with 8 or 10 branches that spring from the under side; upper secondaries branched once or twice from the under side distad.

This figure evidently represents a distorted leaf, disrupted on the right-hand side, thus giving to it an exaggerated inequilateral appearance. The base is apparently somewhat unsymmetrical or oblique, but this appearance may be due, at least in part, to distortion. It belongs, as far as surficial characters are concerned, to the general type of leaf represented by *Ficus speciosissima* Ward[11]—an Upper Cretaceous species—and *F. sordida* Lesquereux,[12] from the Miocene of California; but our specimen has neither the conspicuously auriculate base of the former nor the broadly rounded subcordate base of the latter, and the several weak, intermediate secondary nerves that merge into the tertiary cross nervation in our leaf are not indicated in either of the other species mentioned.

The specific name is given in recognition of the valuable contributions to the paleobotany of the region by the collector, Mr. R. M. Overbeck, of the United States Geological Survey.

[10] Menzel, Paul, Über die Flora der Senftenberger Braunkohlenablagerungen: K. preuss. geol. Landesanstalt Abh., n. ser., no. 46, p. 125; pl. 8, fig. 24, 1906.

[11] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 552, pl. 45, fig. 1, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 39, pl. 21, fig. 3, 1887.

[12] Lesquereux, Leo, Report on fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Coll. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 17, pl. 4, figs. 6, 7, 1878.

Locality: Nenana coal field, Tanana region, Lignite Creek, north side, bluff between two creeks in eastern part of sec. 30, T. 12 S., R. 6 W., burned beds overlying coal (original no. 7); collected by R. M. Overbeck in 1916 (lot 7266) (pl. 60, fig. 7).

Ficus stantoni Hollick, n. sp.

Plate 119, figure 4

Leaf oblong-ovate, about 12 centimeters in length by 6 centimeters in maximum width at about the middle of the leaf, apparently inequilateral, cordate at the base; margin entire; midrib curved to one side distally; venation pinnate, camptodrome; lower two secondaries opposite, basilar, ascending, diverging at angles of about 45° from the midrib, gently curved upward, branched from the under sides; upper secondaries rather regularly arranged in closely approximated but not opposite pairs, all ascending, at more or less acute angles with the midrib, the lower two branched from their under sides distally, all main veins and their branches thinning out and becoming camptodrome close to the margin.

It is unfortunate that this specimen is not completely preserved, as it appears to represent a very distinct and heretofore undescribed species. In its entirety the leaf was apparently inequilateral, bent to one side at the apex and cordate or cordate-truncate at the base. In a general way it is somewhat suggestive of the type represented by *Ficus subtruncata* Lesquereux,[13] from the Eocene of Colorado, more especially of his figure 9; but ours is a much larger leaf. It may also be compared in shape and in connection with the laterally curved or bent apex and the regularly disposed and spaced secondaries with *Ficus schimperi* Lesquereux as depicted by Knowlton,[14] based on a specimen from the Eocene of New Mexico. This particular leaf, however, does not appear to have any specific relationship with *Ficus schimperi* as originally described and figured by Lesquereux.[15]

I take pleasure in naming the species for Dr. T. W. Stanton, to whom we are indebted for the collection of the specimen and of a large amount of other paleobotanic material in the region.

Locality: Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519).

Ficus dalli Cockerell

Ficus dalli Cockerell, Torreya, vol. 10, p. 224, 1910.

Ficus membranacea Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 512, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 87, pl. 59, fig. 2, 1898.

[13] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 205, pl. 30, figs. 7–9, 1878.

[14] 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. 304, pl. 75, fig. 4, 1917 [1918].

[15] Lesquereux, Leo, On species of fossil plants from the Tertiary of the State of Mississippi: Am. Philos. Soc. Trans., vol. 13, p. 417, pl. 18, figs. 1–3, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 223, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.
Not *Ficus membranacea* Wright, 1873.

A leaf collected at Cook Inlet in 1867, by Capt. W. A. Howard, of the United States Revenue Cutter Service, was described and figured as a new species by Newberry under the name *Ficus membranacea* [U. S. Nat. Mus. no. 7102]. This name, however, was preoccupied, having been previously applied to a living species, and the name *F. dalli* was given to it by Cockerell.

It has not been recognized in any of the subsequent collections made in Alaska.

Genus PROTOFICUS Saporta

Protoficus inaequalis Newberry?

Plate 118, figure 2

Protoficus inaequalis Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 512, 1883; U. S. Geol. Survey Mon. 35, p. 89, pl. 58, fig. 2; pl. 60, fig. 1, 1898.

Our specimen bears so close a general resemblance to those from the Eocene of Montana, described and figured by Newberry under the above name, that it does not seem possible to differentiate between them, except that ours is smaller and the margin is entire throughout or only obscurely undulate on one side. In his description Newberry said: "Margin entire or in part undulate"; and the latter character appears to be unduly emphasized in his figures, especially in figure 1, plate 60, in which the irregular, ragged margin, as depicted, can hardly represent its normal character. I am inclined to regard our specimen, at least tentatively, as probably an immature leaf of the species.

Locality: Matanuska coal field, Matanuska-Cook Inlet region, Kings River, east bank, at coal camp 7 miles above mouth, talus slope at base of cliff; collected by F. J. Katz in 1910 (lot 5895).

Family PROTEACEAE

Genus GREVILLEA R. Brown

Grevillea alaskana Hollick, n. sp.

Plate 60, figures 3–5

Leaves oblong-elliptical, entire, coriaceous; venation pinnate, obscurely camptodrome; secondary veins irregularly spaced and disposed, branched, the branches mostly ascending and merging into the tertiary venation, for the most part extending subparallel or somewhat oblique to the midrib, enclosing irregular, more or less vertically arranged areas.

These leaves were evidently thick and coriaceous, as shown, in some places by the reflexed or curled margin and in others by the surface depressions and elevations. Upper surfaces are represented in figures 3 and 4 and an under surface in figure 5. The most interesting feature is the prevailing ascending character of the tertiary veins, which gives to the system of venation in general a peculiar vertical appearance. This system is peculiarly characteristic of certain existing species in the Proteaceae, especially in the genus *Grevillea*, which is represented in our existing flora by a large number of species, natives of Australia. It has not before been recognized in the fossil form in the New World but is abundantly represented in the Cretaceous and Tertiary floras of the Old World. Our species is similar to though much larger than *Grevillea coriacea* Saporta,[16] from the Tertiary of France, and their generic identity is unmistakable. Generic identity may also be noted in connection with *Grevillea parisiensis* Watelet,[17] from the Tertiary of France, which appears to be specifically identical with *G. coriacea* Saporta. Our specimens resemble the existing *G. laurifolia* Sieber more or less closely.

The identification of this genus as an element in the Tertiary flora of Alaska is interesting, especially in view of its present geographic distribution.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 60, figs. 4, 5). Kachemak Bay, Kenai Peninsula, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine; collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 60, fig. 3).

Genus HAKEA Schrader

Hakea alaskana Hollick, n. sp.

Plate 116, figure 8

Leaf spatulate (?), with a long attenuated base, about 4.5 centimeters in length by 1.8 centimeters in maximum width, entire; primary venation all of equal rank, consisting of a midvein and two lateral primaries on each side that start from the base and extend upward, apparently acrodrome, the outer pair weak and merging into the secondary venation given off from the outer sides of the stronger inner pair.

This specimen apparently belongs to the Old World type of fossil leaf in connection with which there have been described a number of species referred to the genus *Hakea* that resemble ours more or less closely, such as *H. spatulata* and *H. myrtilloides* Schmalhausen,[18] from the Eocene of Russia; *H. stenocarpifolia* Ettingshausen,[19] from the Tertiary of Croatia;

[16] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, pt. 2, no. 2: Annales sci. nat. [Paris], sér. 4, Botanique, vol. 17, p. 251 [98], pl. 8, figs. 9, 9a [pl. 7, fig. 13, error in text], 1863.

[17] Watelet, Adolphe, Description des plantes fossiles du bassin de Paris, p. 192 (text), pl. 53, figs. 3, 3a (atlas), Paris, 1866.

[18] Schmalhausen, Johannes, Beiträge zur Tertiär-Flora südwest Russlands: Palaeont. Abh., vol. 1, no. 4, 306 (24), pl. 35 (8), figs. 2–6, 10, [=*H. spatulata*]; p. 307 (25), pl. 33 (6), fig. 14; pl. 35 (8), figs. 11–17 [=*H. myrtilloides*], Berlin, 1884.

[19] Ettingshausen, Constantin von, Die Proteaceen der Vorwelt: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 7, p. 722 (14), pl. 30 (1), figs. 15, 16, 1851.

and *H.? arctica* Heer,[20] from the Eocene of Greenland, with none of which, however, may ours be regarded as specifically identical. The genus, in the fossil form, has not heretofore been recorded from America, so far as I am aware, but in view of the occurrence of a species in the Tertiary of Greenland the discovery of one of equivalent geologic age in Alaska was not unexpected. In our existing flora the genus is confined to Australia.

Consideration should also be given to a leaf described and figured by Heer [21] under the name *Coriaria loclensis*, from the Miocene of Switzerland. Unfortunately, however, this figure lacks the base of the specimen and ours lacks the apex, hence satisfactory comparison is impossible.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Genus MACCLINTOCKIA Heer

Macclintockia chignikensis Hollick, n. sp.

Plate 25, figure 56

Leaf of unknown shape and dimensions, petiolate, narrowed to a rounded cuneate base; strongly palmately triple-veined from the summit of the petiole, and with also a slender outer pair forming obscure marginal primaries, all ascending, connected by a series of fine veins of uniform rank between that form approximately right angles with the midrib and primaries and are connected with others by cross venation, forming laterally elongated areolae throughout the intervening areas. From the outer sides of the main lateral primaries occasional secondary veins diverge at acute angles and connect with the marginal primaries.

This fragmentary specimen apparently possesses the peculiar acrodrome venation that characterizes the genus *Macclintockia*, but I have been unable to identify it as any described species. It was apparently obovate-elliptical, with entire margin, at least in its lower part.

Locality: Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Order POLYGONALES

Family POLYGONACEAE

Genus COCCOLOBIS P. Browne, 1756 (=COCCOLOBA Linnaeus 1764)

Coccolobis chapini Hollick, n. sp.

Plates 121, 122

Pterospermites sp. Hollick, U. S. Geol. Survey Bull. 500, p. 51, 1912.

Leaf obovate, entire, with wavy margin, inequilateral and deeply cordate-auriculate at the base, 40 centimeters in length by 30 centimeters in width a little above the middle, and 15 centimeters in width at the base of the midrib; nervation pinnate; midrib rather abruptly thickened near the base; secondary veins about 11 on each side, irregularly spaced, varying in angles of divergence from the midrib, the upper ones acutely, the lower ones obtusely divergent, all (except the curved basilar pair) more or less flexuous and forked or branched, especially toward their extremities, where they thin out, merge into the tertiary veins, and form a fine camptodrome network near the border; tertiary venation irregular, forming polygonal areolae of diverse shapes and dimensions.

The two figures of this species represent partial counterparts of one and the same specimen. Plate 121 shows the upper surface of the basal portion. A reversed outline drawing of this portion is included in plate 122 in order to complete the outline of the leaf as far as possible.

There can be little doubt in regard to the generic relationship of our specimen, and it is closely similar to the living *Coccoloba pubescens* Linnaeus. The genus includes about 125 species, natives of Florida, Bermuda, the West Indies, Mexico, and tropical South America.

Three Tertiary species—*Coccoloba laevigata* Lesquereux,[22] *Coccolobis eolignitica* Berry,[23] and *Coccolobis uviferafolia* Berry [24]—have been elsewhere recorded from localities in the United States, and one Cretaceous species—*Coccolobites cretaceus* Berry [25]—in the closely allied if not synonymous genus *Coccolobites*.[26] These are all small-leaved species, however, quite different in size as well as in other features from our specimen. Similar fragmentary remains are also described and figured by Engelhardt [27] under the name *Phyllites coccolobaefolia*, from the Tertiary of Chile.

Six European species—*Coccolobites massalongiana* Visiani,[28] *C. morindioides* Massalongo,[29] *C. muz-*

[20] Heer, Oswald, Ueber den versteinerten Wald von Atanekerdluk in Nordgrönland: Naturf. Gesell. [Zurich] Vierteljahrsschr., vol. 11, p. 277, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 113, pl. 15, figs. 5, 6, 1868.

[21] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 63, pl. 121, fig. 21, Winterthur, 1859.

[22] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 387, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 8, p. 208, pl. 35, fig. 7, 1878.

[23] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 212, pl. 38, fig. 4, 1916.

[24] Idem, pl. 87, fig. 5.

[25] Berry, E. W., Contributions to the Mesozoic flora of the Atlantic Coastal Plain, X, Maryland: Torrey Bot. Club Bull., vol. 41, p. 298, 1914; Maryland Geol. Survey, Upper Cretaceous, p. 830, pl. 58, fig. 1, 1916.

[26] Berry used *Coccolobites* as a new generic name, apparently being unaware of its previous use by Visiani (Piante fossili della Dalmazia: R. Ist. veneto sci., lett. ed arti Mem., vol. 7, p. 440, 1858) for a fossil leaf of similar generic type, allied to *Coccolobis*.

[27] Engelhardt, Hermann, Ueber Tertiärpflanzen von Chile: Senckenb. naturf. Gesell. Abh., vol. 16, p. 683, pl. 4, fig. 8b; pl. 12, fig. 6, 1891.

[28] Visiani, Roberto de, Piante fossili della Dalmazia: R. Ist. veneto sci., lett. ed arti Mem., vol. 7, p. 440 (20), pl. 4, fig. 1, 1858.

[29] Massalongo, Abramo, Sulla piante fossili di Zovencedo e dei Vegroni (lettera al Prof. Roberto de Visiani), p. 7, Verona, 1858, = *Coccoloba morindioides* (Massalongo), Meschinelli, A., and Squinabol, X., Flora tertiaria italica, p. 295, Padua, 1893.

zolonica Massalongo,[30] *Coccoloba bilinica* Ettingshausen,[31] *C. acutangula* Ettingshausen,[32] and *C.* sp. ? Marty[33]—all of Tertiary age, have been described and some of them figured. All are small, compared with ours, except, apparently, *C. muzzolonica*, which is described as "folium probabiliter longum 155 centim., latum 140 cent., *Coccolobae pubescenti* maxime proximum." This indicates a leaf about four times the size of ours and a mutual resemblance to the living *Coccolobis pubescens*.

The specific name given to our specimen is in honor of Mr. Theodore Chapin, the collector.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Order RANALES

Family NYMPHAEACEAE

Genus NELUMBO Adanson

Nelumbo protolutea Berry?

Plate 61, figures 1–3

Nelumbo protolutea Berry, U. S. Geol. Survey Prof. Paper 108, p. 64, pl. 24, figs. 1, 2; pl. 25, figs. 1–4, 1917.

The probability appears to be that our specimens are referable to this species, first described and figured by Berry, based on specimens from the Eocene of Mississippi; but they are too fragmentary for anything more than provisional identification. A central portion of a leaf, represented by our figure 1, is so closely similar to Berry's figure 4, plate 25, that they might almost be mistaken for counterparts, and the primary and secondary venation, shown in our figure 1 and in Berry's figure 2, plate 24, are identical in all their characters. In none of our specimens, however, is any portion of the marginal area preserved, and the lack of this important feature renders definite identification impossible.

The thickness of the primary veins, as shown in our figures 1 and 3, indicates that these fragmentary remains represented leaves of large size—apparently about 35 to 40 centimeters in diameter—which is approximately the size of the larger of the specimens from Mississippi, as estimated by Berry.[34] No other described American fossil species of the genus is comparable with this in size, except the Cretaceous species *Nelumbo kempii* (Hollick) Hollick,[35] from Long Island, New York, which may be compared with *N. provinciale* =*Nelumbium provinciale* Saporta,[36] from the Cretaceous of France; but a comparison of the venation of either of these species with that of the species under discussion shows distinguishing characters that are quite obvious.

The discovery of a large-leaved, well-defined species of the genus *Nelumbo* in the Tertiary flora of Alaska is of considerable interest, not only for the reason that it adds a new locality to the previously known area of distribution of the genus in past time but also because it represents an extension of its former distribution in America to a region farther north than was heretofore recorded and affords, as in connection with the cycadaceous genera, an excellent index of the semitropical or temperate climatic conditions that must have prevailed in Alaska during early Tertiary time.

As far as our present knowledge is concerned the former geographic distribution of the genus, represented by about 20 recognized and doubtful species, embraced northern Africa, central and western Europe, Greenland, the southern and western United States, western Canada, and Alaska. Throughout all these regions, except the southern United States, it is no longer represented in the living native flora. As a living genus it includes only two species, each of restricted geographic distribution—*Nelumbo nelumbo* (Linnaeus) Karsten, found in the southern and southeastern Asiatic region from southern Japan to northern Australia and westward to the Caspian Sea, and *Nelumbo lutea* (Willdenow) Persoon, which ranges from the eastern United States southward to Brazil. An excellent map, showing the former and present distribution of the genus, is included in Berry's paper.[37]

None of the American Tertiary species, other than *Nelumbo protolutea*, are comparable in size with certain of the European species of equivalent age. *N. lakesiana* (=*Nelumbium lakesii* Lesquereux[38]) and *N. tenuifolia* (=*Nelumbium tenuifolium* Lesquereux[39]), from Colorado—the former with a maximum diameter not exceeding 20 centimeters—are the largest, whereas certain European Tertiary species, such as *N. protospeciosum* (=*Nelumbium protospeciosum* Saporta[40]), from France, are represented by leaves with diameters of 30 centimeters or more. Berry[41] notes the resem-

[30] Massalongo, Abramo, Syllabus plantarum fossilium, p. 56, Verona, 1859.

[31] Ettingshausen, Constantin von, Die fossile Flora des Tertiärbeckens von Bilin: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 26, p. 164, pl. 30, fig. 1, 1867.

[32] Idem, p. 165, pl. 30, fig. 2.

[33] Marty, Pierre, Flore miocène de Joursac (Cantal), p. 50, pl. 9, figs. 13, 14, Paris, 1903.

[34] Berry, E. W., op. cit., p. 65.

[35] Hollick, Arthur, Additions to the paleobotany of the Cretaceous formation on Long Island: New York Bot. Garden Bull., vol. 3, p. 412, pl. 74, figs. 1, 2; pl. 75; pl. 76; pl. 77, fig. 1, 1904, =*Serenopsis kempii* Hollick, Arthur, A new fossil palm from the Cretaceous formation at Glen Cove, Long Island: Torrey Bot. Club Bull., vol. 20, p. 169, pl. 149; p. 334, pl. 166, 1893.

[36] Saporta, Gaston de, Le *Nelumbium provinciale* des lignites crétacés de Fuveau en Provence: Soc. géol. France Mém., Paléontologie, no. 5, p. 5, pl. 12 [1], fig. 1; pl. 13 [2], fig. 1; pl. 14 [3], figs. 1–6a, 1890.

[37] Berry, E. W., op. cit., p. 67.

[38] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 252, pl. 46, figs. 1, 2, 1878.

[39] Idem, p. 253, pl. 46, fig. 3.

[40] Saporta, Gaston de, Recherches sur la végétation du niveau aquitanien de Manosque: Soc. géol. France Mém., Paléontologie, no. 9, p. 17, pl. 3 [1], figs. 2, 3; pl. 6 [4], figs. 1, 1a–1e, 2, 1891.

[41] Berry, E. W., op. cit., p. 65.

blance between *N. protospeciosum* and *N. protolutea* and also suggests resemblance between *N. protolutea* and *N. buchii* (=*Nelumbium buchii* Ettingshausen [42]), from the Tertiary of Dalmatia; but *N. buchii* clearly represents a species of either *Castalia* or *Nymphaea* and may be disregarded in connection with any discussion of the genus *Nelumbo*.

Our specimens were found with numerous other fragmentary remains of the species, thickly packed in layers in a fine gray shaly sandstone, and few other plant remains were found associated with them. The *Nelumbo* layers apparently represented a localized deposit.

Locality: Yukon River, north bank, 10 miles below rapids below Rampart, central Yukon region (original no. 16); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4632).

Family MAGNOLIACEAE

Genus MAGNOLIA Linnaeus

Magnolia inglefieldi Heer

Plate 9, figure 4c; plate 62, figures 1–4

Magnolia inglefieldi Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 278, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 120, pl. 3, fig. 5c; pl. 16, figs. 5, 6, 8b; pl. 18, figs. 1, 2, 3a, b, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 2, p. 478, pl. 44, fig. 5b; pl. 51, figs. 2, 3, 3b, 4–7, 1869; (Die fossile Flora Grönlands), pt. 2: Idem, vol. 7, p. 121, pl. 69, fig. 1; pl. 85, fig. 3; pl. 86, fig. 9, 1883.

A considerable variation in size and more or less variation in shape are represented in Heer's figures of this species, and the particular one with which ours may be most satisfactorily compared is figure 1, plate 69, volume 7 of Flora fossilis arctica.

Prior to the identification of our specimens from Alaska the species had not been conclusively identified outside of Greenland, although a specimen was identified by Lesquereux,[43] with reservation, and included in a list of fossil plants from the Miocene of the John Day Valley, Oregon; and this identification was subsequently recognized by Knowlton [44] in his elaboration of the fossil flora of that locality, with the following conservative statement: " This is certainly different from the last [*Magnolia culveri* Knowlton] and may well be Heer's species. It is not contained in recent collections." The specimen, however, was not figured.

In 1911 Knowlton,[45] in a review of Lesquereux's descriptions of fossil plants from Miocene auriferous gravel of California, identified *Magnolia californica* Lesquereux [46] as specifically identical with *Magnolia inglefieldi* Heer; and it may be remarked that his identification might be regarded as warranted if comparison is made with certain of the broad forms of the species figured by Heer. Our specimens are all of the long and narrow form.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 9, fig. 4c). Near head of Hamilton Bay, Kupreanof Island (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 62, fig. 1). Matanuska coal field, Matanuska-Cook Inlet region, Moose Creek, 25 feet above 11-foot seam, 100 yards below cabin; collected by Sidney Paige in 1906 (lot 3954) (pl. 62, fig. 2). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 62, fig. 3). Matanuska coal field, 4,800-foot point on traverse of Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1919 (lot 5901) (pl. 62, fig. 4).

Magnolia ovalis Lesquereux

Plate 63, figures 1, 2

Magnolia ovalis Lesquereux, Am. Philos. Soc. Trans., vol. 13, p. 422, pl. 21, figs. 3, 4, 1869.

More or less confusion of generic and specific names prevails in connection with leaves of the general type represented by the specimens from the Eocene of Mississippi described and figured by Lesquereux as *Magnolia ovalis*, and certain other closely similar leaves described and figured by the same author [47] under the name *Magnolia cordifolia*. These two species or forms were included in a single species and relegated to the genus *Combretum* by Berry,[48] under the name *Combretum ovalis* (Lesquereux) Berry. Whether or not the two species should be combined may be regarded as an open question, as may be also the matter of the generic name that may best be accepted and applied. Knowlton,[49] on the basis of studies of specimens from the Eocene (Raton formation) of Colorado, compared with those from Mississippi described and figured by Lesquereux and Berry, expressed the opinion that Berry was in error in regarding *Magnolia ovalis* and *M. cordifolia* as

[42] Ettingshausen, Constantin von, Die Eocene Flora des Monte Promina: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 8, p. 36 [20], pl. 10, figs. 2, 3; pl. 11, fig. 1; pl. 12, 1854 [1855].

[43] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 13, 1888.

[44] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 58, 1902.

[45] Knowlton, F. H., Flora of the auriferous gravels of California: U. S. Geol. Survey Prof. Paper 73, p. 60, 1911.

[46] 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. 25, pl. 6, figs. 5, 7, 1878.

[47] Lesquereux, Leo, op. cit., pl. 22, figs. 1, 2.

[48] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 321, pl. 93, fig. 1; pl. 94, fig. 1, 1916.

[49] 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. 315, pl. 86; pl. 88, fig. 1, 1917 [1918].

conspecific, and remarked:[50] "In general appearance these leaves appear quite different, and at least for the present I propose to maintain them as distinct." The Colorado specimens were referred by Knowlton to *M. cordifolia*, but he did not express any opinion on the validity of the reference of the two species by Berry to the genus *Combretum.*

It is unfortunate that in one of our specimens both base and apex are missing and that in the other only the base is preserved; but this feature has more the character of *Magnolia ovalis* than of *M. cordifolia* as depicted by Lesquereux. The general shape of our two specimens may also be seen to agree more closely with Lesquereux's two figures of *M. ovalis* than with those of M. *cordifolia*, and I am inclined to agree with Knowlton that the two species may better, at least for the present, be recognized as distinct entities.

In regard to the relative claims of the genera *Magnolia* and *Combretum* for recognition, the facts and arguments do not appear to be conclusive for either, and if any further change in the generic name might seem advisable I should be inclined to favor reference to the genus *Coccoloba.* Specimens more complete, however, are necessary for comparison in order to arrive at any satisfactory conclusion in regard to the generic name that might best be applied to our specimens, and in the meantime it would seem best to describe and discuss them under the original name given to the figured specimens with which they are here identified.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Magnolia nordenskiöldi Heer

Magnolia nordenskiöldi Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 82, pl. 21, fig. 3; pl. 30, fig. 1, 1876.
Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 448, pl. 10, figs. 7–9, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 262, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 230, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 890, 1896.

Specimens of this species, collected by W. H. Dall in 1880 at Chignik Bay, Alaska Peninsula, were identified, described, and figured by Lesquereux, but it has not been identified in any of the subsequent collections of fossil plants from Alaska. Heer[51] expressed the opinion that among fossil species it approaches most nearly *Magnolia ovalis* Lesquereux, the species last described.

[50] Knowlton, F. H., op. cit., p. 316.
[51] Heer, Oswald, op. cit., p. 83.

Magnolia wormskioldi Heer

Plate 63, figure 3

Magnolia wormskioldi Heer, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 123, pl. 101, fig. 6, 1883.

This species was heretofore represented only by the type specimen from Greenland, described and figured by Heer. In this, as in our specimen, the upper part of the leaf is missing, and their identity is therefore predicted upon the similarity of characters in their basal parts. In many respects these leaves resemble certain others that were subsequently described and figured by the same author under the genus *Apeibopsis*, especially *A. deloesi* (Gaudin) Heer,[52] but as he made no mention of any apparent resemblance between the two species we may assume that he regarded them as specifically distinct.

Locality: Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 141); collected by R. S. Tarr in 1905 (lot 3879).

Family LAURACEAE

Genus CINNAMOMUM R. Brown

Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb.

Plate 64, figure 2

Phyllites cinnamomeus Rossmaessler, Beiträge zur Versteinerungskunde, vol. 1, p. 23, pl. 1, fig. 1 (excl. figs. 2–8), 1840.
Phyllites cinnamomeifolia Brongniart, Prodrome d'une histoire des végétaux fossiles, p. 200 (209), Paris, 1828 (nomen nudum?).
"*Laurus cinnamomiformis* (*Phyllites cinnamomiformis*) Brongniart." C. F. W. Braun, Verzeichniss der in der Kreis-Naturalien-Sammlung zu Bayreuth befindlichen Petrefacten, p. 104, 1840 (nomen nudum).
Ceanothus polymorphus Alex. Braun, Neues Jahrb., 1845, p. 171 [=*Rhamnus terminalis* Alex. Braun, in Buckland, Geology and mineralogy, vol. 1, p. 513, London, 1836, fide Braun, op. cit. (nomen nudum)].
Daphnogene cinnamomeifolia (Brongniart?) Unger, Synopsis plantarum fossilium, p. 227, Leipzig, 1845.
Daphnogene polymorpha (Alex. Braun) Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, p. 16, pl. 2, fig. 23 (excl. figs. 24, 25), 1851.
Cinnamomum polymorphum (Alex. Braun) Heer, Flora tertiaria Helvetiae, vol. 2, p. 88, pl. 93, figs. 25–28; pl. 94, figs. 1–26, 1856 [=*Camphora polymorpha* Heer, idem, p. 112, pl. 1, fig. 11 in part, 1855?].

It is with considerable hesitation that I have decided to add another to the numerous names under which this species is known. In recent years it has been generally listed, described, and figured under the name *Cinnamomum polymorphum;* but an analysis of the synonymy shows that, under the accepted rules of nomenclature, the first valid name for the species was

[52] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 41, pl. 109, figs. 9–11, Winterthur, 1859.

Phyllites cinnamomeus of Rossmaessler, who was the first author to describe and figure it.

A great variety of forms have been included under the species from time to time by Old World authors, and, if all of the specimens accredited to it are to be recognized as such, the species was widely distributed in Europe in Tertiary time. In America, however, it is but little known, and apparently has been recorded heretofore from only one horizon and locality—the Eocene of Colorado—by Lesquereux.[53] The validity of the species in connection with these two specimens has, however, been questioned by Knowlton,[54] and it might be that our one specimen from Alaska, if compared with more perfect specimens, would not be regarded as properly referable to the species.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Cinnamomum ficoides Hollick, n. sp.

Plate 64, figure 1

Leaf ovate-elliptical, about 12 centimeters in length by 6.75 centimeters in maximum width, tapering to base and apex; margin entire; venation tripalmate from a distance of about 0.5 centimeter above the base, camptodrome, midrib straight, lateral primaries forming angles of about 25° with the midrib, arched slightly outward, ascending and thinning out close to the margin in the upper part of the leaf; main secondary veins 3 or 4 on each side of the midrib, irregularly disposed and widely spaced, the lowest one starting at a distance of about 6 centimeters from the base of the leaf, all diverging at angles of about 45° from the midrib, ascending, curving upward and becoming finely camptodrome close to the margin; minor secondary veins numerous, on the marginal sides of the lateral primaries, with various angles of divergence, irregularly disposed and spaced, becoming camptodrome and connected by a series of loops in the marginal region; tertiary venation either simple or occasionally forked, either nearly straight or more or less bent and angled, uniformly subhorizontal or at right angles to the midrib, lateral primaries, and secondaries throughout.

This specimen, almost perfectly preserved and with characters well defined, is nevertheless difficult to differentiate satisfactorily as either a *Cinnamomum* or a *Ficus*, if comparison is made with published descriptions and figures of certain fossil species that have been referred to those genera. A great variety of leaf forms from the Tertiary of the Old World are included under *Cinnamomum spectabile* Heer,[55] for example, some of which resemble our specimen very closely, especially the larger forms represented by Heer's figures 2 and 3. Only one specimen from the New World, however, has been referred to the species,[56] and this reference is of doubtful validity, if the figure correctly depicts the specimen.

Another species that merits attention in connection with our specimen and in comparison with the species last cited is *Ficus pseudopopulus* Lesquereux,[57] based on specimens from the Eocene of Wyoming, in the original description of which Lesquereux said: "A remarkable species, resembling a *Cinnamomum* by the nervation of its leaves * * *." Lesquereux's figures resemble many of *Cinnamomum spectabile* very closely and are difficult to differentiate from ours; but the same cannot be said in connection with certain specimens referred to *Ficus pseudopopulus* by other authors,[58] which present an even wider range of form diversity than is to be found under *Cinnamomum spectabile*. It is evident that these two species require critical study and revision, and in the meantime, and in view of all the facts and circumstances, I have deemed it best to describe our specimen under a new specific name, although it may eventually be regarded as merely a varietal form of one or the other of the above-mentioned species.

Locality: Summit of mountain half a mile east of head of north branch of Russel Creek, Alaska Peninsula (original no. P-24); collected by W. R. Smith in 1922.

Genus PERSEA Gaertner

Persea spatiosa Hollick, n. sp.

Plate 65, figure 1

Leaf obovate-elliptical, slightly asymmetric, 14 centimeters in length by 8 centimeters in maximum width, bluntly cuneate at the apex, tapering to the base; margin entire; venation pinnate, camptodrome; secondary veins irregularly spaced and disposed, those on the broader side of the leaf more flexuous and forming more acute angles of divergence with the midrib than those on the opposite side, all more or less forked toward their extremities and connected in the marginal region in a series of broad, irregular, more or less angled loops with tertiary veins extending from the

[53] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 221, pl. 37, fig. 6 (excl. fig. 10), 1878.

[54] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 168, 1919.

[55] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 91, pl. 96, figs. 1–8, Winterthur, 1856.

[56] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 727, pl. 94, fig. 1, 1899.

[57] Lesquereux, Leo, On some new species of fossil plants from the lignitic formations: U. S. Geol. and Geog. Survey Terr. Bull., vol. 1, 2d ser., no. 5, p. 387, 1876; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 204, pl. 34, figs. 1a, 2, 1878.

[58] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 200, pl. 37, figs. 3–5; pl. 113, fig. 3, 1916. 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. 304, pl. 72, figs. 2–4; pl. 73, figs. 1, 2; pl. 112, fig. 3, 1917 [1918].

exterior angles, the tertiaries connected at their extremities by continuous, wavy, submarginal veins, that together form a marginal series of irregular, polygonal areolae.

This specimen is similar to but much larger than *Persea guiscardi* (Gaudin) Schimper (=*Laurus guiscardi* Gaudin [59]) and *Laurus fürstenbergii* Alex. Braun, fide Heer [60]—Old World species that range from the Miocene to the Pliocene. It is also suggestive of certain leaves that have been referred to the genus *Magnolia*, such as *M. californica* Lesquereux,[61] from the Miocene of California, and *M. pulchra* Ward,[62] from the Upper Cretaceous (Montana group) of Wyoming. Our specimen, however, is more distinctly asymmetric than either of the two species last mentioned, and there appears to be but little doubt that it may be regarded as belonging in the Lauraceae.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Genus SASSAFRAS Nees

Sassafras alaskanum Hollick, n. sp.

Plate 64, figure 5

Leaf elliptical-obovate, petiolate, about 14 centimeters in length, exclusive of the petiole, by about 5.75 centimeters in maximum width at a distance of 8.5 centimeters from the base, tapering above to the apex and below to the narrow cuneate base; margin entire; venation pinnate, camptodrome; secondary veins irregularly arranged and spaced, the lower two subopposite, suprabasilar at a distance of about 1.5 centimeters, forming acute angles with the midrib, ascending parallel with the margin to about the middle of the leaf, the upper ones subtending obtuse angles with the midrib, curving upward, all joining in a series of loops in the marginal region; tertiary veins flexed, curved, or bent, making approximately right angles with the midrib and supporting secondaries.

At first glance it might appear difficult to differentiate between this leaf and certain leaves of *Malapoenna magnifica*, the species next described; but the symmetry of our *Sassafras* leaf, its long tapering, acutely cuneate base, the marginal character of the lowest two secondaries, and the obtuse angles subtended by the upper secondaries in connection with the midrib serve to distinguish it from *Malapoenna* and indicate relationship with *Sassafras* rather than with other lauraceous genera with which it might be compared, such as *Litsea*, *Nectandra*, and *Oreodaphne*.

It is a somewhat remarkable fact that this appears to be the first satisfactory specimen of *Sassafras* to be recorded from the Tertiary of the New World. Only two American Tertiary species were previously described and figured, so far as I am aware—*Sassafras* (*Araliopsis*) *burpeana* Dawson [63] and *S. selwyni* Dawson [64]—both presumably from Eocene deposits of southern Canada; but they are lobed leaves, and neither species is satisfactorily identifiable with the genus. Dawson was apparently in doubt in regard to their generic identity, as may be inferred from his references to the genus *Araliopsis* in connection with them; and his figures of the species appear to justify any doubts expressed or implied in regard to their generic relationship.

A number of well-defined species of *Sassafras* have been described and figured from the Tertiary of the Old World, especially those with lobed leaves, such as *S. ferretianum* Massalongo [65] and *S. primigenioides* Engelhardt,[66] but the entire-leaved forms that have been described, such as *S. aesculapi* Heer,[67] are not as readily identifiable with the genus as is our specimen.

Among the many published figures of fossil lauraceous leaves with which ours may be compared the one that approaches it most closely is *Laurus oreodaphnifolia* Massalongo,[68] from the Tertiary of Italy. This species appears to be identical with ours, except that it is slightly narrower, and the two specimens might well be relegated to one and the same species.

The ancestral history of the genus *Sassafras* is interesting. It had its first recorded beginning, as one of the most ancient types of dicotyledonous angiosperms, in Lower Cretaceous time, and is represented in deposits of the Potomac group of Maryland and

---

[59] Gaudin, C. T., Mémoire sur quelques gisements de feuilles fossiles de la Toscane: Soc. helvétique sci. nat. Nouv. mém., vol. 16, no. 3, p. 36, pl. 9, fig. 10; pl. 10, fig. 1; pl. 12, fig. 15, 1858; Val d'Arno: Idem, vol. 17, no. 4, p. 48, pl. 8, fig. 8, 1859.

[60] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 84, fig. 1 [excl. figs. 2–4], 1856.

[61] 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. 25, pl. 7, figs. 5–7, 1878.

[62] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 60, figs. 2, 3, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 103, pl. 48, figs. 3, 4, 1887.

[63] Dawson, J. W., On the Mesozoic floras of the Rocky Mountain region of Canada: Roy. Soc. Canada Trans., vol. 3, sec. 4, p. 17, 1885 [1886]; On the fossil plants of the Laramie formation of Canada: Idem, vol. 4, sec. 4, p. 28, pl. 2, fig. 12, 1886 [1887].

[64] Dawson, J. W., On the fossil plants collected by Dr. Selwyn in the lignite Tertiary formation of Roche Percee, Souris River: Canada Geol. Survey Rept. Progress for 1879–80, p. 53 A, 1881; On the fossil plants of the Laramie formation of Canada: Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 28, pl. 2, fig. 13, 1886 [1887].

[65] Massalongo, A. B., Synopsis florae fossilis senogalliensis, p. 63, Verona, 1858. Massalongo, Abramo, and Scarabelli, Giuseppe, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 268, pl. 12, figs. 1–3; pl. 13, fig. 1, Imola, 1859.

[66] Engelhardt, Hermann, Die Alttertiäre Flora von Messel bei Darmstadt: Hessischen geol. Landesanstalt Abh., vol. 7, no. 4, p. 56, pl. 16, figs. 6, 7, 1922.

[67] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 82, pl. 90, figs. 13–16, 1856.

[68] Massalongo, A. B., Sulla flora fossile de Sinigaglia, p. 23, Verona, 1857. Massalongo, Abramo, and Scarabelli, Giuseppe, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 254, pl. 35, fig. 11, Imola, 1859.

Virginia by *S. parvifolium* Fontaine,[69] *S. cretaceum heterolobum* Fontaine,[70] *S. bilobatum* Fontaine,[71] and *S. potomacensis* Berry.[72] It apparently reached its climax of development in middle Cretaceous time in America and is one of the most abundant and characteristic elements in the flora of the Dakota sandstone of the western United States, in the rocks of which it is represented by a profusion of specific and varietal forms, mostly under *Sassafras cretaceum* Newberry [73] and its subsequent elaboration by Lesquereux,[74] under the genera *Sassafras* and *Araliopsis*. About 30 different species and varieties have been described by these and subsequent authors, based on specimens from the Cretaceous of North America and Greenland. On the other hand, only two Cretaceous species—*Sassafras acutilobum* Lesquereux [75] and *Sassafras protophyllum* Saporta [76]—have been recorded from the Old World.

During the Tertiary period, however, the genus developed and reached its climax in the Old World while it declined in the New. A dozen or more Tertiary species were described from Eurasia and Australia but only two (previously mentioned) from America. During the Quaternary period the genus has been exterminated in the Eastern Hemisphere, except for a single species that still exists in eastern Asia; and it has suffered the same fate in the Western Hemisphere, where it is represented in our existing flora by one species only—our common sassafras of eastern North America. Incidentally it is of interest to note that, with the single exception of *Sassafras aesculapi* Heer [77] from the Tertiary of Switzerland, our specimen from Alaska is the only entire-leaved fossil representative of the genus thus far recorded. All the other species are more or less lobed. This is noteworthy for the reason that the entire-margined leaf is generally assumed to represent the primitive or older type, from which the lobed leaves subsequently developed. As far as the paleontologic record is preserved, however, the reverse appears to have been the course of development. One explanation of this apparent anomaly may be that many of the lobed Cretaceous leaves described under the genus *Sassafras* were erroneously referred to it, and that certain leaves with entire margins, described under other lauraceous genera, may represent primitive forms of *Sassafras* leaves.

Our existing American species has both lobed and entire leaves on the same individual tree, and it is significant that the sequence of appearance of the two forms, in the seasonal development of buds and twigs, is what would be theoretically expected, that is, the entire leaves are the first to appear, and the lobed ones are developed later.[78] It is not necessary here to discuss further the interpretation of this fact in connection with the paleontologic record of the genus, but those who may be interested in the subject will find it adequately treated in the paper previously cited and in two others by Jackson [79] and Berry.[80]

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Genus MALAPOENNA Adanson

Malapoenna magnifica (Saporta) Hollick, n. comb.

Plate 66, figures 1–5

Litsaea magnifica Saporta, Annales sci. nat. [Paris], sér. 5, Botanique, vol. 4, p. 280 (136), pl. 7, fig. 6, 1866.

If comparison of figures is of any value there can hardly be any question in regard to the specific identity of our specimens from Alaska with the specimen from the Tertiary of France described and figured by Saporta, especially our figures 1 and 2. These may also be compared with *Litsaea expansa* Saporta and Marion,[81] from the Eocene of Belgium, and our smaller specimens with *Litsaea deichmülleri* Engelhardt,[82] from the Tertiary of Bohemia. All three of these species might be segregated and included under a single specific name.

Our specimens vary somewhat in size and shape, but as all come from the same region, most of them from the same locality, and some are associated together in the same piece of matrix, I feel impelled to regard them all as representing leaf forms of a single species.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392) (pl. 66, figs. 1, 4). Idem

[69] Fontaine, W. M., The Potomac or younger Mesozoic flora: U. S. Geol. Survey Mon. 15, p. 289, pl. 139, fig. 7, 1889.

[70] Idem, pl. 152, fig. 5; pl. 159, fig. 8; pl. 164, fig. 5.

[71] Idem, p. 290, pl. 156, fig. 12; pl. 164, fig. 4.

[72] Berry, E. W., Systematic paleontology of the Lower Cretaceous deposits of Maryland: Maryland Geol. Survey, Lower Cretaceous, p. 487, pl. 94, fig. 1, 1911.

[73] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, pt. 1, p. 14, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 98, pl. 6, figs. 1–4; pl. 7, figs. 1–3; pl. 8, figs. 1, 2, 1898.

[74] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, pp. 77–83, 1874; The flora of the Dakota group: U. S. Geol. Survey Mon. 17, pp. 99–103, 1892.

[75] Velenovsky, Josef, Die Flora der böhmischen Kreideformation: Beitr. Paläontologie Oesterr.-Ungarns u. des Orients, vol. 4, no. 1, pt. 3, p. 49 (2), pl. 17 (2), fig. 1, Vienna, 1884.

[76] Saporta, Gaston de, Flore fossile du Portugal, p. 182, pl. 31, figs. 17, 17a, Lisbon, 1894.

[77] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 82, pl. 90, figs. 13–16. 1856.

[78] Humphreys, E. W., An analogy between the development of the plates of crinoids and the leaves of *Sassafras*: Torrey Bot. Club Bull., vol. 35, pp. 571–579, text figs. 2a, 2b, 1908.

[79] Jackson, R. T., Localized stages in development in plants and animals: Boston Soc. Nat. Hist. Mem., vol. 5, no. 4, pp. 107–109, 1899.

[80] Berry, E. W., Notes on *Sassafras*: Bot. Gazette, vol. 34, pp. 426–450, 1902.

[81] Saporta, Gaston de, and Marion, A. F., Révision de la flore heersienne de Gelinden: Acad. royale Belgique Mém. cour. et mém. sav. étrang., vol. 41, no. 3, p. 68, pl. 11, figs. 1, 2, 1878.

[82] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 330 (34), pl. 15 (8), fig. 5, 1885.

(original no. V, lot 4389) (pl. 66, fig. 3). Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 66, fig. 5). Near head of Hamilton Bay, Kupreanof Island (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 66, fig. 2).

Malapoenna carbonensis (Ward) Knowlton?

Plate 65, figure 6

Malapoenna carbonensis (Ward) Knowlton, U. S. Geol. Survey Bull. 152, p. 142, 1898.

Litsaea carbonensis Ward, U. S. Geol. Survey 6th Ann. Rept., p. 553, pl. 46, fig. 11, 1886; U. S. Geol. Survey Bull. 37, p. 48, pl. 24, fig. 1, 1887.

This specimen, in its entirety, was apparently larger than any other of the lauraceous leaves found in Alaska. It might, perhaps, be identified as *Malapoenna magnifica* (Saporta) Hollick, the species last described, but its fragmentary condition precludes the possibility of satisfactory comparison with any described species.

Locality: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16A); collected by E. M. Kindle in 1905 (lot 3652).

Genus BENZOIN Fabricius

Benzoin antiquum Heer

Plate 65, figures 2–5

Benzoin antiquum Heer, Flora tertiaria Helvetiae, vol. 2, p. 81, pl. 90, figs. 1–8, Winterthur, 1856.

Our four specimens are referred to this somewhat variable but distinctive species without hesitation, although this is the first time that it has been definitely identified on the North American continent. It is well represented in the Tertiary flora of Europe; a single specimen from the Tertiary (Eocene?) of Greenland was described and figured by Heer;[83] and it was recorded from Colorado, with a query, by Lesquereux[84] but was not subsequently mentioned by him.

In most of the many published figures of specimens referred to this species by various European authors, including certain of those of the type specimens by Heer,[85] the peculiar irregularity of the secondary nervation may be seen depicted, as in all of ours. Our figure 5 apparently represents an abnormal or distorted leaf.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

[83] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 104, pl. 79, fig. 10, 1883.

[84] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 379, 1873.

[85] Heer, Oswald, op. cit. (Helvetiae), pl. 90, figs. 1, 2, 3, 6.

Genus LAURUS Linnaeus

Laurus californica Lesquereux

Plate 64, figure 4a; plate 109, figure 8b

Laurus californica Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 252, pl. 57, fig. 3; pl. 58, figs. 6–8, 1883.

The only figures of this species heretofore published are those by Lesquereux, from the Miocene of California, although it was recorded by Knowlton[86] from the Yellowstone National Park. Lesquereux's figures vary somewhat in the characters of the secondary venation, and our specimens may be most satisfactorily compared with his figure 3, plate 57, and figure 8, plate 58.

Another species that appears to be worthy of critical examination and comparison in this connection is *Laurophyllum oregonensis* Chaney,[87] from the Oligocene (?) of Oregon, although Chaney does not suggest any apparent similarity to this or any other lauraceous species.

Localities: Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 496); collected by C. W. Wright in 1904 (lot 7474) (pl. 14, fig. 4a). Near head of Hamilton Bay, Kupreanof Island (original no. 55); collected by A. F. Buddington in 1922 (lot 7565) (pl. 109, fig. 8b).

Laurus fürstenbergii Alex. Braun

Plate 67, figure 9

Laurus fürstenbergi Alex. Braun, in Bruckmann, Ver. vaterl. Naturk, Württemberg Jahresh., vol. 6, p. 231, 1850.

Unger, Genera et species plantarum fossilium, p. 423, Vienna, 1850.

This species, abundantly represented in the Miocene of Europe, was first recorded and described in 1850 by Braun and Unger, but it was not figured until 1856, by Heer.[88] Subsequently it was figured by several other European authorities, and a variety of forms were included under the species. Our specimen agrees most closely with Heer's figure 1, from which it differs merely in its larger size and, apparently, more acute apex.

The only previous record of the species in America was by Lesquereux,[89] based upon specimens from the Miocene of California; but unfortunately the record consists merely of the name, without any description or illustration, and comparison of these specimens with our Alaska specimen has not been feasible.

Two other closely allied if not specifically identical leaves, are represented by *Laurus obovata* Weber,[90]

[86] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 725, 1899.

[87] Chaney, R. W., The flora of the Eagle Creek formation: Contr. Walker Mus., vol. 2, no. 5, p. 174, pl. 21, fig. 2 (excl. fig. 1), 1920.

[88] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 84, figs. 1–4, 1856.

[89] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 26, 1888.

[90] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Paleontographica, vol. 2, p. 180 (66), pl. 20 (3), fig. 4, 1851.

originally described from the Miocene of Germany and also described and figured by Heer [91] from the Miocene of Switzerland, and *Persea tiberghieni* Pilar,[92] from the Tertiary of Croatia. *Laurus obovata* was described by Lesquereux,[93] from the Eocene of Wyoming; but unfortunately, as in the case of *Laurus fürstenbergii*, the specimens upon which the identification was based were not figured. It is evident, however, that our specimen is identical with the general type of leaf to which these three species belong, and that in any critical revision of the genera the specimen would certainly be placed under one or another of these three specific names.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392).

Laurus hamiltonensis Hollick, n. sp.

Plate 64, figure 3

Leaf oblong-obovate, 10 centimeters or more in length by 4 centimeters in maximum width, abruptly constricted to a long, slender apex, rounded to a curved-cuneate base, petiolate, entire; venation pinnate, camptodrome; midrib somewhat curved or flexuous; secondary veins irregularly disposed and spaced, the lower ones closer together than the upper, all forming acute angles with the midrib, curved upward and becoming camptodrome toward their extremities.

The only fossil leaf that I have been able to identify tentatively with this specimen is represented by a fragmentary specimen from the Eocene of the Yellowstone National Park, figured by Knowlton [94] under the name *Phyllites* sp.; but it would be too hazardous to regard this reference as anything more than a suggestion. I am also somewhat in doubt in regard to the generic relationship of our specimen. Its general aspect, however, is strongly suggestive of the Lauraceae. The specific name adopted was chosen in order to identify the species with the locality where it was collected.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Laurus ocotaefolia Ettingshausen

Plate 67, figure 10

Laurus ocotaefolia Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, p. 17, pl. 3, fig. 4, 1851.

This specimen represents one of the many leaf forms that might be referred either to this species or to *Laurus primigenia* Unger.[95]

As far as I am aware there is no previous record of any American fossil leaf having been identified as *L. ocotaefolia*, but numerous specimens of American lauraceous leaves have been referred to *L. primigenia*. None of these, however, are liable to be confused with ours, although many of the 150 or more published figures of Old World specimens of *L. primigenia* might almost equally well be referred to *L. ocotaefolia* or to some one or another of the several similar leaf forms that have been described under other specific names in this and other lauraceous genera.

Those who may be interested in attempting to differentiate between *Laurus primigenia*, *L. ocotaefolia*, and *L. saliciformis* (the species described below) might compare the figures of our specimens with the type figures cited and also with certain figures of these and other species, elsewhere published, such as *L. primigenia* Unger according to Heer,[96] Lesquereux,[97] and Engelhardt; [98] *L. ocotaefolia* Ettingshausen and *L. swoszowiciana* Unger [99] according to Heer; [1] and *Mespilodaphne puryearensis* Berry.[2] Personally I am not prepared to express any opinion as to whether a critical revision of these leaf forms would result in segregation or in further differentiation of species.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Laurus princeps Heer

Plate 67, figure 1

Laurus princeps Heer, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 89, figs. 16, 16b, 17a, b, c; pl. 90, figs. 17a, b, c, 20; pl. 97, fig. 1, Winterthur, 1856.

This leaf apparently represents a rather small form of the species, similar to Heer's figure 16, plate 89. It is a common Old World Tertiary species but has been only sparingly identified in the Tertiary flora of the New World. A specimen from the Miocene of California was described and figured by Lesquereux [3] and one from the Eocene of the Yellowstone National

[91] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 89, fig. 14, 1856.

[92] Pilar, Georg, Flora fossilis susedana: Acad. sci. Slav. merid. Acta, vol. 1, p. 65, pl. 10, figs. 1, 12, 1883.

[93] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. Survey Terr. Ann. Rept. for 1872, p. 399, 1873.

[94] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 846, pl. 103, fig. 2, 1899.

[95] Unger, Franz, Genera et species plantarum fossilium, p. 423, Vienna, 1850; Die Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 168 (38), pl. 40 (19), figs. 1-4, 1850.

[96] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 153, fig. 3, 1859.

[97] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, pl. 36, figs. 5, 6, 8, 1878.

[98] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-car. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, pl. 13 (6), figs. 19, 20, 1885.

[99] Unger, Franz, Genera et species plantarum fossilium, p. 423, Vienna, 1850.

[1] Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, pl. 89, fig. 5, 1856; vol. 3, pl. 153, fig. 4, 1859.

[2] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, pl. 87, fig. 1, 1916.

[3] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 250, pl. 58, fig. 2, 1883.

Park by Knowlton,[4] but otherwise it has not been recorded from the North American continent. It should be borne in mind, however, that there are several species, of the same general type of leaf, in connection with which specific differentiation may be more or less difficult, especially in the case of fragmentary or poorly preserved specimens, as may be seen by comparing the figures of many of the leaf forms that have been included by Heer and other authors under *Laurus reussii* Ettingshausen[5] and *L. primigenia* Unger.[6] These species, however, may be readily differentiated from each other and from *L. princeps* by reference to the original figures of the type specimens.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, shore boulders east of Bradley Creek; collected by R. W. Stone in 1904 (lot 5822).

Laurus saliciformis Knowlton and Cockerell

Plate 67, figures 2–8

Laurus saliciformis Knowlton and Cockerell, U. S. Geol. Survey Bull. 696, p. 349, 1919.
Laurus salicifolia Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 251, pl. 58, figs. 4, 5, 1883. Not *L. salicifolia* Banks and Solander, 1838.

The seven specimens that are here included in this species might, almost equally well, be referred to *Laurus primigenia* Unger,[7] the smaller forms of which it is impossible to differentiate satisfactorily from *L. saliciformis*, as may be seen by comparison with figures of specimens referred to *L. primigenia* by Lesquereux,[8] from the Eocene of Wyoming; by Hollick,[9] from the Eocene of Louisiana; and by almost every paleobotanist who has had occasion to study the Tertiary floras of the Old World.

Whether or not all the Alaska specimens should be referred to a single species may perhaps be questioned. They do not differ among themselves, however, to the same extent as the many diverse forms that have, from time to time, been referred to *L. primigenia*. There is also more or less of a close resemblance to certain leaves from the Eocene of Greenland, referred to *Laurus reussii* Ettingshausen by Heer;[10] but this reference does not appear to be conclusive. In any event certain of our specimens resemble the figures cited far more closely than the latter resemble those of *L. reussii* as depicted by Ettingshausen.

As far as I am aware the Alaska specimens are the only representatives of *L. saliciformis* that have been recorded from elsewhere than the type locality, but whether or not this should be recognized as a valid species may be regarded as a matter of individual opinion. The specific identity of the Alaska specimens with the type specimens from the Miocene of California, however, appears to be reasonably well assured.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 67, fig. 2). Kachemak Bay, Kenai Peninsula, shore boulders east of Bradley Creek; collected by R. W. Stone in 1904 (lot 5822) (pl. 67, figs. 3, 4). Kachemak Bay, Kenai Peninsula, at entrance to Troublesome Gulch (original no. 3); collected by C. E. Weaver in 1906 (lot 4129) (pl. 67, figs. 5, 6, 7). Matanuska coal field, Matanuska-Cook Inlet region, 4,800-foot point on traverse of Matanuska River from Moose Creek (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 67, fig. 8).

Genus DAPHNOGENE Unger

Daphnogene kanii Heer

Plate 67, figure 11

Daphnogene kanii Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 277, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 112, pl. 14, figs. 1–5; pl. 16, fig. 1, 1868.
Cocculites kanii (Heer) Heer, Uebersicht der Miocenen Flora der arctischen Zone: Flora fossilis arctica, vol. 3, no. 4, p. 21, 1874; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 124, pl. 100, fig. 1b, 1883.

This specimen almost certainly represents the basal part of a leaf of this species, originally described and figured by Heer from the Eocene of Greenland.

The only previous record of the occurrence of this species in America was made when I tentatively identified it[11] in connection with a specimen from the Eocene of Louisiana; but this was subsequently described as a new species, *Cinnamomum postnewberryi*, by Berry,[12] who remarked: "This species is represented by fragmentary specimens * * * They resemble * * * *Daphnogene kanii* Heer in a general way but are perfectly distinct, differing in general form and in the details of their venation." The ab-

[4] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 725, pl. 95, fig. 3, 1899.

[5] Ettingshausen, Constantin, Die fossile Flora des Tertiär-beckens von Bilin: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 28, pt. 2, p. 193 (5), pl. 31, figs. 5, 5b, 11, 1868.

[6] Unger, Franz, Genera et species plantarum fossilium, p. 423, Vienna, 1850; Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 168 (38), pl. 40 (19), figs. 1–4, 1850.

[7] Unger, Franz, Genera et species plantarum fossilium, p. 423, Vienna, 1850; Die fossile flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 168 (38), pl. 40 (19), figs. 1–4, 1850.

[8] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 8, p. 214, pl. 36, figs. 5, 6, 8, 1878.

[9] Hollick, Arthur, A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 284, pl. 41, fig. 2 (excl. fig. 1?), 1899.

[10] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 105, pl. 77, figs. 4, 5, 1883.

[11] Hollick, Arthur, A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 284, pl. 41, fig. 3, 1899.

[12] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 298, pl. 79, fig. 9, 1916.

sence of any trace of secondary nervation in the Alaska specimen renders satisfactory comparison with *Cinnamomum postnewberryi* impossible; but in any event it is probably related to the leaves of the Arctic regions rather than to those of the southern part of the North American continent.

The family and generic relationships of *Daphnogene kanii* are not definitely known. Heer originally included it in the Lauraceae and subsequently, under the genus *Cocculites*, in the Menispermaceae. It was also included in the Menispermaceae under the names *Cocculus kanii* (Heer) by Saporta and Marion [13] and *Macclintockia kanii* (Heer) by Schimper; [14] and was again relegated to the Lauraceae, under the name *Cinnamomum kanii* (Heer), by Staub.[15] It appears to be doubtful if the species, as described by Heer, has been definitely recognized from elsewhere than the Arctic regions.

Locality: Bering River, 1 mile above Chilkat Village, Yakutat-Copper River region (original no. 19); collected by G. C. Martin in 1905 (lot 3705).

Order ROSALES

Family HYDRANGEACEAE

Genus HYDRANGEA Linnaeus

Hydrangea alaskana Hollick

Plate 63, figures 4, 5

Hydrangea alaskana Hollick, Torrey Bot. Club Bull., vol. 52, p. 21, pl. 2, figs. 1, 2, 1925.

This well-defined species is evidently similar to several from Tertiary horizons in both the Old World and the New, that have been refered to the genera *Getonia*,[16] *Viburnum*,[16] *Porana*,[17] and *Hydrangea* [18] by various authors from time to time and shifted from one genus to another by those who subsequently studied them. The species cited may be regarded as examples of three that simulate the Alaska forms rather closely, except in regard to size—ours being considerably larger than either of them.

Reference to the genus *Hydrangea* appears to be warranted, and comparison with sterile flowers of certain existing eastern Asiatic species, such as *H. davidi* Franchet, *H. hortensis* Smith, and *H. opuloides* (Lamarck) Koch, shows a very close resemblance in size, shape of the sepals or calyx lobes, and nervation. The normal number of sepals in the sterile flowers of most of the existing species is four, but most specimens present the appearance of having only three, for the reason that one of the four is usually aborted and is either inconspicuous or early deciduous; and in this connection it is of interest to note that of the two figured specimens of *Hydrangea bendirei*, both from the same locality, one is shown with three and the other with four sepals.

Locality: Jaw Mountain, 8½ miles northeast of Gates of Crater, Alaska Peninsula (original no. P–25); collected by W. R. Smith in 1922.

Family HAMAMELIDACEAE

Genus HAMAMELIS Linnaeus

Hamamelis clarus Hollick, n. sp.

Plate 115, figure 4

Leaf inequilateral, roughly ovate-lanceolate, much broader and more rounded on one side than on the other, petiolate; 8 centimeters in length by about 5.25 centimeters in maximum width; apex cuneate, acute; base rounded; margin undulate-dentate; venation pinnate, craspedodrome; secondary veins irregularly spaced, mostly alternate, diverging at acute angles from the midrib, except the upper ones, which diverge at angles more obtuse, lower ones branched from the under sides near their extremities, lowest two opposite, with numerous fine branches from the under sides, veins and branches all terminating in the marginal dentitions; tertiary venation mostly oblique to the secondaries, fine, closely spaced, curved or flexed, connected by fine cross venation, forming a reticulated network throughout the lamina of the leaf.

The genus *Hamamelis* has not been heretofore recognized in connection with any fossil plant remains in America and only very sparingly in the Old World, but the generic identity of our leaf appears to be clearly indicated in all its characters. A leaf whose close generic relationship with ours may be recognized, however, is *Hamamelites fothergilloides* Saporta,[19] originally described from the Tertiary of France and subsequently identified by Ward [20] from the Eocene (Fort Union formation) of Montana. It is also al-

[13] Saporta, Gaston de, and Marion, A. F., Essai sur l'état de la végétation à l'époque des marnes heersiennes de Gelinden: Acad. roy. sci. Belgique Mém. cour. et mém. sav. étrangers, vol. 37, no. 6, p. 63, pl. 10, fig. 1, 1873.

[14] Schimper, W. P., Traité de paléontologie végétale, atlas, pl. 98, fig. 13, 1874.

[15] Staub, Moritz, Die Geschichte des Genus *Cinnamomum:* Math. u. naturwiss. Ber. Ungarn, vol. 19, p. 27, 1901 [1904].

[16] *Getonia oeningensis* Unger, fide Weber, C. D., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 215 (101), pl. 7, fig. 2, 1851 [reprint 1852], =*Viburnum weberi* Schenk.

[17] *Porana oeningensis* (Alex. Braun) Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 18, pl. 103, figs. 21, 25–28, 1859, =*Antholithes oeningensis* Alex. Braun.

[18] *Hydrangea bendirei* (Ward) Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 60, pl. 9, figs. 6, 7, 1902, = *Porana bendirei* (Ward) Lesquereux, = *Marsilea bendirei* Ward.

[19] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire: Annales sci. nat., sér. 5, Botanique, vol. 3, p. 47, 1865; vol. 2, pt. 1, p. 43, 1866; Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, no. 3, p. 393 (105), pl. 32 (11), fig. 3, 1868, =*Hamamelis fothergilloides* (Saporta) Schenk, Die fossilen Pflanzenreste, p. 241, Breslau, 1888.

[20] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 554, pl. 49, fig. 6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 37, pl. 29, fig. 1, 1887.

most impossible to escape the conviction that the leaf described and figured under the name *Fagus papyraceae* Knowlton,[21] from the Eocene (Raton formation) of Colorado, is in reality a species of *Hamamelis* and one so closely similar to ours as to be almost indistinguishable from it.

Comparison may also be made with a leaf figured by Forbes,[22] from the Eocene of the Isle of Mull, which he described as "an inequilateral leaf, the affinities of which are doubtful."

Locality: Upper Yukon region, Seventymile Creek, half a mile below Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711).

Genus LIQUIDAMBAR Linnaeus

Liquidambar europaeum Alex. Braun

Liquidambar europaeum Alex. Braun, in Buckland, Geology and mineralogy, vol. 1, p. 513, 1836; Neues Jahrb., 1845, p. 170.
Unger, Chloris protogaea, pt. 1, p. 120, pl. 35, figs. 1–5, 1847.
Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 25, pl. 2, fig. 7, 1869.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

The single fragmentary specimen of this species figured by Heer, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, is the only one thus far recorded from Alaska.

It was identified from the Eocene of Wyoming by Lesquereux,[23] from the Eocene of Oregon by Newberry,[24] and from the Miocene of Oregon by Knowlton[25] but apparently has not been recorded from elsewhere in America, although it is abundantly represented in the Tertiary of the Old World. The species is well defined, and even fragmentary specimens are as a rule satisfactorily identifiable.

Family PLATANACEAE

Genus PLATANUS Linnaeus

Platanus aceroides latifolia Knowlton

Plate 68, figures 1, 2

Platanus aceroides latifolia Knowlton, U. S. Geol. Survey Prof. Paper 91, p. 13, 1916; U. S. Geol. Survey Prof. Paper 101, p. 321, pl. 92; pl. 93, fig. 3; pl. 94, 1917.

This variety was founded by Knowlton to include a form, represented by numerous specimens from the lower Eocene (Raton formation) of Colorado and New Mexico, with somewhat broader base and smaller, blunter teeth than in the specific type. It was also identified by Berry in the lower Eocene (Midway? formation) of Texas.

Our specimens agree in all essential characters with Knowlton's description and figures; and it appears to be probable that we may also include in the variety certain specimens of the species from the Eocene of Spitsbergen, figured by Heer,[26] and one from the Eocene of Greenland, figured by the same author[27] and referred to *Platanus guillelmae* Goeppert.

Our two specimens of this variety and the single specimen representing the species next described were found together at the same locality, and it is evident that they all belong to the same general type as *Platanus aceroides* Goeppert and *P. haydeni* Newberry,[28] which appear to be not very far apart specifically; indeed, Knowlton,[29] in a discussion of their mutual similarity, suggested that it might be advisable, ultimately, to regard the latter species as merely a variety of the former.

Locality: Yukon River, south bank, 1½ miles above Rampart and 300 feet above 11AE 1, central Yukon region (original no. 11AE 2); collected by H. M. Eakin in 1911 (lot 6095).

Platanus rectinervis Hollick, n. sp.

Plate 69

Leaf obscurely trilobed, roughly triangular, broad and rounded below the extremities of the lobes, broadly concave or truncate at the base, tapering above to a wedge-shaped apex, about 16 centimeters in length by 16 centimeters in maximum width across the expanded basilar region; margin bluntly undulate-dentate in the upper part, crenate-dentate in the lower part; venation pinnate-subpalmate, the basal secondaries simulating lateral primaries that are apparently suprabasilar, each with about 10 subparallel, almost straight branches that extend from the under sides to the margin and terminate in the dentitions, the lower branches only sparingly branched in a similar manner toward their extremities; secondary veins, including the pseudolateral primaries, about 12 on each side, subtending angles of 30° to 45° with the midrib, subparallel, almost straight or slightly curved up-

[21] 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. 297, pl. 68, fig. 1, 1917 [1918].
[22] Forbes, Edward, On the vegetable remains from Ardtun Head: Geol. Soc. London Quart. Jour., vol. 7, pt. 1, p. 103, pl. 3, fig. 1, 1851.
[23] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 159, pl. 32, fig. 1, 1883.
[24] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 100, pl. 47, figs. 1–3, 1898.
[25] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 62, 1902.
[26] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 76, pl. 17, figs. 1, 2; pl. 31, fig. 3, 1877.
[27] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 96, pl. 103, fig. 4, 1883.
[28] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 70, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 103, pl. 36; pl. 38; pl. 61, fig. 3, 1898.
[29] Knowlton, F. H., U. S. Geol. Survey Prof. Paper 101, p. 322, 1917 [1918].

ward, each one extending to and terminating in one of the marginal dentitions; tertiary venation almost at right angles to the secondaries throughout, slightly bent, or curved, or almost straight.

This appears to represent a somewhat unusual platanoid type of leaf by reason of the remarkably strict, subparallel character of the nervation throughout and the almost entire absence of branching. In some respects it resembles *Platanus aceroides* Goeppert [30] and *P. oeynhausiana* Goeppert [31] but the short, blunt dentitions, the uniform character of the secondary nervation, and the conspicuous width of the basal part of the leaf as compared with its length serve to differentiate it quite satisfactorily. Comparisons with about 30 figures of specimens referred to *P. aceroides* by various authors failed to indicate anything except a general resemblance to our specimen. *Platanus aceroides latifolia* Knowlton (the species last described), approaches it more closely than any other figured forms of the species, but the more sparse, irregular, upright and branching characters of the secondary nerves are clearly distinguishing features.

Locality: Yukon River, south bank, 1½ miles above Rampart and 300 feet above 11AE 1, Central Yukon region (original no. 11AE 2); collected by H. M. Eakin in 1911 (lot 6095).

Platanus nobilis Newberry

Platanus nobilis Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 67, 1868; U. S. Geol. Survey Mon. 35, p. 106, pl. 34; pl. 37, fig. 1; pl. 50, fig. 1, 1898.
Dall, U. S. Geol. Survey Bull. 84, p. 246, 1892.

The only record for this species in Alaska was that made by Dall, in describing the Tertiary rocks exposed at Topanica Creek, in the Norton Sound region, as follows:

> Following Topanica Creek easterly into the hills the greenish and blackish sands dip more and more steeply to the east, interleaved with shaly layers containing leaves and vegetable remains, among which leaves of *Platanus nobilis* Newberry, a foot across, were collected in a fine state of preservation.

It is a typical Eocene (Fort Union) and Lance species in North Dakota, Montana, and Wyoming and was also identified by Dawson [32] from the Eocene of Saskatchewan and Alberta.

It is unfortunate that no mention was made of the authority for the identification of the species.

Leaves of Platanus

"Leaves of *Platanus*" Dall, U. S. Geol. Survey Bull. 84, p. 246, 1892.

[30] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 492, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 21, pl. 9, figs. 1–3, 1855.
[31] Idem (Schossnitz), p. 20, pl. 10, figs. 1–4.
[32] Dawson, J. W., On the fossil plants of the Laramie formation of Canada: Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 24, pl. 1, fig. 7, 1886 [1887].

In connection with a geologic section on the Ulukuk River, in the lower Yukon-Norton Sound region, Dall mentioned "argillaceous shale, with leaves of *Platanus*", and we may infer, probably, that the leaves are those of *P. nobilis* Newberry, the species last discussed, as they were all found in the same general region.

Platanus sp. Knowlton

Platanus sp. Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 195, 1898.

The above generic identification by Knowlton is included in a list of fossil plant remains collected by J. E. Spurr and party in 1896, at Miller's Drew coal mine, on the north bank of the Yukon River, 25 miles above Mynook Creek, central Yukon region. I have not been able to identify it specifically with any of the remains of *Platanus* leaves subsequently collected in the same general region.

Family ROSACEAE

Genus SPIRAEA Linnaeus

Spiraea andersoni Heer

Spiraea andersoni Heer, Flora fossilis, alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 39, pl. 8, figs. 3, 3b, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

This species has been identified, as far as any records are concerned, only in connection with the type specimen, described and figured by Heer, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula in the Matanuska-Cook Inlet region. Heer's figure is well defined, however, and the species should be easy of identification in the event of the discovery of other specimens.

Spiraea weaveri Hollick, n. sp.

Plate 70, figure 7

Leaf oval-elliptical, short-petioled, 4 centimeters in length by 2.25 centimeters in width across the middle, rounded cuneate at base and summit; margin entire below, irregularly serrate-dentate above; venation pinnate, campto-craspedodrome; secondary veins irregularly spaced, diverging at angles of 45° to 75° from the midrib, flexed or abruptly curved upward and connected through a series of irregularly spaced branches that merge into the tertiary venation in the marginal region, forming loops from which, in the upper part of the leaf, fine veinlets extend to the marginal dentitions.

I have not been able to match this specimen with any described fossil species, but it is somewhat suggestive of the general type of leaf represented by the Old World Miocene species *Spiraea prunifolia* Ettingshausen.[33] The specific name is given in honor of Mr. C. E. Weaver, by whom it was collected.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Spiraea sp. Heer

Spiraea sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868.

The above generic identification was included in a list of fossil plants collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. It probably represents the leaf subsequently described and figured by Heer under the name *Spiraea andersoni*. (See p. 124.)

Genus ROSA Linnaeus

Rosa confirmata Hollick, n. sp.

Plate 70, figure 9

Leaflet oblong-obovate, short-petioled, 3.5 centimeters in length by 1.25 centimeters in maximum width, curving to the broadly wedge-shaped apex, tapering to the obtusely cuneate base; margin sharply serrate-dentate above, entire toward the base; venation campto-craspedodrome; secondary veins numerous, irregularly spaced and disposed, more or less flexed, diverging at angles of about 45° from the midrib; lower secondaries subcamptodrome, mostly connected by cross venation near the margin, with veinlets extending from the cross venation to the marginal dentitions; upper secondaries apparently strictly craspedodrome.

This specimen evidently represents a well-defined terminal leaflet of a species of *Rosa*—a genus that is but sparingly known in the fossil form. Five American species have been described, however, all of them from the Miocene lake deposits of Florissant, Colo. One, *R.? inquirenda* Knowlton,[34] is a calyx; one, *R. ruskinana* Cockerell,[35] is a flower bud; and the other three, *R. hilliae* Lesquereux,[36] *R. willmattae* Cockerell,[37] and *R. scudderi* Knowlton,[38] are compound leaves. The first one has 3 leaflets, the second one 5, and the third one 7. They all resemble one another very closely and differ among themselves little more than leaves from an individual bush of a single species might—the number of leaflets having no individual or specific significance.

Our specimen differs little from any of them, and its resemblance to the terminal leaflet of *R. scudderi* is so striking that they might, perhaps, be regarded as specifically identical. The larger size and the slightly more rounded base in our specimen may, however, serve to differentiate them.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, 30 feet below Bradley coal (original no. 910); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5820).

Rosa cetera Hollick, n. sp.

Plate 70, figure 8

Leaflet ovate, slightly falcate, short-petioled, 4 centimeters in length by 1.8 centimeters in maximum width, rounded-cuneate at the unequal-sided base, cuneate at the apex; margin entire below, serrate-dentate above; venation pinnate, campto-craspedodrome; midrib curved; secondaries irregularly spaced and disposed, diverging at angles of about 45° from the midrib, the lower ones subcamptodrome, the upper ones either simple or with branches from the under sides near their extremities, each vein and branch terminating in a marginal dentition.

This specimen may be a lateral leaflet of the same species as the one last described (*Rosa confirmata*), and had the two specimens been found associated in the same collection they would probably have been regarded as specifically identical. It closely resembles *Rosa bohemica* Engelhardt[39] and *R. lignitum* Heer as figured by Engelhardt,[40] from the Tertiary of Bohemia, and except for its obscurely falcate shape and slightly inequilateral base any characters by means of which it might be differentiated from one or the other of the above-mentioned figures would be very difficult to discern. The figure of the type specimen of *R. lignitum* Heer,[41] however, is markedly different from those referred to the species by Engelhardt.

Locality: Matanuska coal field, 4,800-foot point on traverse of Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1910 (lot 5901).

Family POMACEAE

Genus CRATAEGUS Linnaeus

Crataegus alaskensis Hollick, n. sp.

Plate 71, figure 5

Leaf oblong-obovate, 5 centimeters in length by 2.25 centimeters in maximum width, petiolate, the petiole

[33] Ettingshausen, Constantin von, Beiträge zur Kenntniss der Tertiärflora Steiermarks: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Sitzungsber., vol. 60, p. 93 (77), pl. 6, fig. 11, 1869.

[34] Knowlton, F. H., A review of the fossil plants in the United States National Museum from the Florissant lake beds at Florissant, Colo.: U. S. Nat. Mus. Proc., vol. 51, p. 273, pl. 17, fig. 1, 1916.

[35] Cockerell, T. D. A., Descriptions of Tertiary plants: Am. Jour. Sci., 4th ser., vol. 26, p. 540, fig. 5, 1908.

[36] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 199, pl. 40, figs. 16, 17, 1883.

[37] Cockerell, T. D. A., The fossil flora of Florissant, Colo.: Am. Mus. Nat. Hist. Bull., vol. 24, p. 94, pl. 7, fig. 14, 1908.

[38] Knowlton, F. H., A review of the fossil plants in the United States National Museum from the Florissant lake beds at Florissant, Colo.: U. S. Nat. Mus. Proc., vol. 51, p. 272, pl. 21, fig. 4, 1916.

[39] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 73, pl. 24 (19), fig. 10, 1885.

[40] Idem, figs. 11, 12.

[41] Heer, Oswald, Miocene baltische Flora: Beiträge zur Naturkunde Preussens, no. 2, p. 99, pl. 30, fig. 33, Königsberg, 1869.

1.25 centimeters in length; apex apiculate; base rounded-cuneate; margin irregularly dentate above, entire at the base, the dentitions doubly laciniate-serrate from about the middle upward, simply serrate and finer below; venation pinnate, craspedodrome; secondary veins irregularly spaced, 6 on each side, subparallel, or the lower ones somewhat divergent, leaving the midrib at angles of about 45°, each terminating in one of the main dentitions, with a branch or branches from the under side near the extremity, each of which terminates in one of the intermediate minor dentitions.

The general aspect of this leaf suggests that it belongs in the Pomaceae, and its characters indicate relationship with the genera *Malus*, *Crataegus*, etc. The only fossil species to which I have been able to note any near resemblance is *Crataegus* sp. Menzel,[42] from the Miocene of Germany, but the apparent generic identity of this specimen with ours is of more interest and importance than its specific resemblance.

Locality: Cape Douglas, Alaska Peninsula (original no. 11); collected by R. W. Stone in 1904 (lot 3547).

Crataegus cappsii Hollick, n. sp.

Plate 71, figure 3

Leaf oblong-ovate, 10 centimeters in length by 5.25 centimeters in maximum width, rounded below to a broadly cuneate base and tapering above to an acuminate or a narrowly cuneate apex; margin entire below, coarsely crenate above, the crenations finely dentate; venation simply pinnate, craspedodrome; secondary veins irregularly alternate, 10 or 11 on each side, leaving the midrib at angles of about 45°, the lower ones diverging at angles somewhat more obtuse than those above, all extending almost straight until near the margin, where they curve slightly upward and terminate in the marginal crenations, with tertiary branches on the under sides that curve upward and terminate in the dentitions; tertiary cross venation at right angles to the secondaries, more or less flexed or angled.

This well-defined leaf is apparently different from any heretofore described species of *Crataegus*, and I take pleasure in naming it after the collector, Mr. S. R. Capps.

Locality: Nenana coal field, Tanana region, Coal Creek, just west of Healy Coal Co.'s mine (original no. 23AC 7), collected by S. R. Capps in 1923 (lot 7622).

Crataegus yukonensis Hollick, n. sp.

Plate 71, figure 4

Leaf ovate-orbicular, 4.5 centimeters in length by 4 centimeters in width across the middle; base rounded and broadly cuneate, apex broadly cuneate; margin irregularly and doubly dentate; venation pinnate, craspedodrome; secondary veins irregularly spaced, opposite or subopposite below, alternate above, the former diverging at obtuse angles from the midrib, the latter at angles more acute, all more or less flexed and curved upward near their extremities, with small branches from the under sides, the extremities of the veins and branches terminating in the marginal dentitions.

This leaf has somewhat the appearance of certain forms of the living species *Crataegus mollis* and *C. tomentosa*, with the primary dentition less pronounced than is typical of the specific type. I have failed to find any described fossil species with which it might be identified.

Locality: Yukon River, north bank, at Drew's mine, central Yukon region (original no. 14); collected by W. W. Atwood in 1907 (lot 4708).

Family DRUPACEAE

Genus PRUNUS Linnaeus

Prunus scottii Heer

Plate 70, figure 4

Prunus scottii Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 2, p. 279, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 126, pl. 8, fig. 7, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 483, pl. 55, figs. 5a, b, c, 1869; Nachträge zur fossilen Flora Grönlands: Idem, vol. 6, pt. 1, no. 2, p. 16, pl. 6, figs. 2, 3, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 137, pl. 84, fig. 13, 1883.

The only difference that is apparent between the Alaska specimen and those from Greenland described and figured by Heer is that ours is somewhat broader. The species was known only from the Eocene of Greenland before its identification as an element in the Tertiary flora of Alaska.

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

Prunus hartungi Heer var. aequalis Hollick, n. var.

Plate 70, figures 1–3

This variety differs from the specific type, *Prunus hartungi* Heer,[43] in its more closely spaced secondary veins, which diverge, in the larger specimens, at more obtuse angles with the midrib. If our figure 2, which represents the smallest of our three specimens, were the only one in our collection, any characters by which it could be differentiated from the species would be difficult to discern.

Prunus hartungi was originally described and figured by Heer from the Tertiary (Miocene?) of the

[42] Menzel, Paul, Über die flora der Senftenberger Braunkohlenablagerungen: K. preuss. geol. Landesanstalt Abh., n. ser., no. 46, p. 80, pl. 4, fig. 16b; pl. 5, fig. 10, 1906.

[43] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 308, Winterthur, 1859; Miocene baltische Flora: Beiträge zur Naturkunde Preussens, no. 2, p. 49, pl. 12, figs. 3, 3b, 4, 4b, 4c, Königsberg, 1869.

Baltic region of Prussia, and later from the Eocene of Greenland,[44] hence it is not surprising to find it, in a slightly modified form, in the Tertiary flora of Alaska.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, 30 feet below Bradley coal (original no. 910); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5820).

Prunus olympica Ettingshausen

Plate 70, figures 5, 6

Prunus olympica Ettingshausen, K. Akad. Wiss. [Wien] Denkschr., vol. 29, p. 55, pl. 53, fig. 21, 1869.

Except for a slight difference in size I can discern no characters by means of which our specimens can be differentiated from the species originally described and figured by Ettingshausen and later by Engelhardt,[45] from the Tertiary (Miocene?) of Bohemia, although it has not been heretofore recorded from America. *Prunus hartungi* Heer, however, also originally recorded as a European Miocene species, was later identified as an element in the Eocene flora of Greenland; and a variety (var. *aequalis*, see p. 126, pl. 70, figs. 2, 3) so closely similar to the specific type as to be almost indistinguishable, is included in the same collection from Alaska that includes the species now under discussion—all of which may be regarded as favorable testimony in connection with the specific identity of the latter.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region. Bluff Point, 7 miles west of Homer, 30 feet below Bradley coal (original no. 910); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5820).

Prunus variabilis Newberry?

Plate 71, figures 1, 2

Prunus variabilis Newberry, U. S. Nat. Mus. Proc., vol. 5, pl. 509, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 112, pl. 52, figs. 3 in part, 4 in part, 5, 1898.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

Three specimens of this species [U. S. Nat. Mus. nos. 7108 (fig. 5), 7109 (fig. 4), 7110 (fig. 3)], collected at Cook Inlet in 1867, by Capt. W. A. Howard, of the United States Revenue Cutter Service, were described and figured by Newberry. The largest of these, represented by his figure 3, is the one with which our specimens may be compared; but the comparison is not conclusive or satisfactory, as the basal portion in each of ours is lacking. The shape and general character of the nervation, and the finely denticulate margin, however, appear to be identical in all, and I have ventured to refer ours tentatively to the species. It may be noted, however, that the difference between this species and *Prunus dakotensis* Lesquereux,[46] from the Eocene (Fort Union formation) of North Dakota, is not very obvious, except that in *P. variabilis* the base is described and figured as wedge-shaped, whereas in *P. dakotensis* the base is rounded. If either of our specimens possessed a perfect base this might result in definitely determining to which one of the two species they should be referred. In the absence of this determining feature, however, the factor of geographic distribution may be regarded as favoring relationship with *P. variabilis.*

Locality: Summit of mountain 1 mile southwest of forks of Pumicestone Creek, Alaska Peninsula (original no. P-23); collected by W. R. Smith in 1922.

Family MIMOSACEAE

Genus PITHECOLOBIUM Martius[47]

Pithecolobium ceterum Hollick, n. sp.

Plate 72, figures 9b, 11b

Leaflets inequilateral-ellipsoidal, 4.25 centimeters in length by 2.75 centimeters in maximum width, tapering to base and apex; margin entire; venation simply pinnate, camptodrome; secondary veins subparallel, about 10 on each side, irregularly spaced and disposed, the lower ones opposite or subopposite and diverging at acute angles from the midrib, the upper ones subopposite or alternate and diverging at angles more obtuse, all extending straight from the midrib to the marginal area, where they are connected in a series of loops; tertiary venation obscure.

This specimen is apparently comparable with several fossil species that have been described under this genus, such as *Pithecolobium tenuifolium* Engelhardt,[48] from the Tertiary of Colombia; and *P. eocenicum* Berry,[49] from the Eocene of Tennessee.

Locality: Yukon River, right [north] bank, at Drew mine, central Yukon region (original no. 3AH 9); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246).

Genus ACACIA Adanson

Acacia aquilonia Hollick, n. sp.

Plate 120, figure 13

Legume broadly linear, slightly curved, about 10 centimeters in length by 2 centimeters in width, with

[44] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 137, pl. 92, figs. 5, 6, 1883.

[45] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 72, pl. 25 (18), figs. 1, 19, 1885.

[46] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 237, pl. 46A, fig. 8, 1883.

[47] Martius, C. F. P., Hortus regius monacensis, 1829. Martius established the genus as *Pithecellobium* but without generic- or other description. In 1837 (Herbarium florae brasiliensis, pp. 114–116), he corrected the name to *Pithecollobium,* with full generic description. This form, with one *l* omitted, is usually followed by modern authors.

[48] Engelhardt, Hermann, Über neue Tertiärpflanzen Süd-Amerikas: Senckenb. naturf. Gesell. Abh., vol. 19, p. 37, pl. 3, fig. 21, 1895.

[49] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 225, pl. 45, fig. 2, 1916.

an elongated, tapering, wedge-shaped end terminating in a pointed beak and a rather short, wedge-shaped base; marginal costa well defined, from which fine, flexuous veinlets extend from side to side; seeds small.

The two fragments upon which this species is based apparently represent the distal and proximal extremities of a legume similar to several that have been described and figured from Tertiary horizons in Europe and in North America.

Acacia microphylla Unger,[50] representative of the Tertiary of the Old World, is similar to our species, but Unger's figure includes only the distal part of the legume, and this shows a broad, blunt end, whereas in ours the distal end is long and pointed. A fragment that shows what is apparently the proximal part of a specimen was figured by Engelhardt,[51] and this simulates the equivalent part of our specimen so closely as to appear almost identical with it.

Four species of *Acacia*, based upon the legumes, have been described from North America—all from Miocene deposits. *A. oregoniana* Lesquereux,[52] from Oregon, resembles our specimen in every particular except in its broad distal extremity; otherwise it would be practically impossible to differentiate between them. *A. macrosperma* Knowlton,[53] *A. lamarensis* Knowlton,[54] and *A. wardii* Knowlton,[55] all from the Yellowstone National Park, differ from our specimen and from the other species cited in their apparently larger seeds and in their conspicuous marginal wings.

Incidentally it may also be of interest to note the more or less suggestive resemblance between the several species above discussed and a legume from the Miocene of France, described and figured under the name *Calpurnia europea* Saporta; [56] and comparisons may also be made with legumes of living species in the genera *Cercis* and *Cladrastis*.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

[50] Unger, Franz, Genera et species plantarum fossilium, p. 494, Vienna, 1850; Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 189 (59), pl. 68 (46), fig. 11, 1850.

[51] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 377 (81), pl. 27(20), fig. 37, 1885.

[52] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 14, pl. 5, fig. 4, 1888.

[53] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 729, pl. 98, fig. 8, 1899.

[54] Idem, p. 730, pl. 98, fig. 6.

[55] Idem, pl. 98, fig. 7.

[56] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 2, pt. 2, p. 226, pl. 13, fig. 8 B, 1866; Annales sci. nat., sér. 5, Botanique, vol. 4, p. 370, pl. 13, fig. 8, 1865.

Family CAESALPINIACEAE

Genus CASSIA Linnaeus

Cassia glenni Berry?

Plate 72, figures 3, 4

Cassia glenni Berry, U. S. Geol. Survey Prof. Paper 91, p. 233, pl. 45, figs. 15, 16, 17a, 18; pl. 52, fig. 6, 1916.

The diversity of leaf forms from the Eocene of Mississippi and Tennessee included in this species by Berry affords ample opportunity for selection and comparison, and although certain of the forms, if considered by themselves, would hardly be regarded as even generically related to our specimens, nevertheless, if the latter are compared with his figure 18 the similarity is so close that specific identity appears to be indicated.

Comparison may also be made between the series of forms represented by *Cassia glenni* and those included under certain other species, such as *C. berenices* Unger [57] as identified by Heer [58] from the Miocene of Switzerland. Each series includes forms that might be more or less satisfactorily compared with one another, and Heer's figure 51 would match Berry's figure 18 and our two very closely.

Another species of which our specimens are strikingly suggestive is *Glycyrrhiza blandusiae* Unger,[59] from the Tertiary of Styria, especially if comparison is made with his figure 9.

In the circumstances it does not seem advisable to attempt a new specific description for our specimens, as it appears to be reasonably certain that they are specifically identical with one or another of the several forms of Tertiary age included under published specific names, some of which should be segregated and others differentiated as species. The tentative reference of our specimens to *Cassia glenni* is therefore to be regarded as implying probable relationship with the particular specimen represented by Berry's figure 18, and not, necessarily, with the specimens represented by the other figures cited.

Localities: Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH9); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246) (pl. 72, fig. 3). Matanuska coal field, 4,800-foot point on traverse of Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 72, fig. 4).

[57] Unger, Franz, Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 188 (58), pl. 64 (43), figs. 4–10, 1850.

[58] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 137, figs. 42–56, 1859.

[59] Unger, Franz, Genera et species plantarum fossilium, p. 486, Vienna, 1850; Sylloge plantarum fossilium, pt. 2: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, p. 20, pl. 4, figs. 6–10, 1860.

Cassia phaseolites Unger?

Plate 72, figures 5, 6

Cassia phaseolites Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 188 (58), pl. 65 (44), figs. 1–5; pl. 66 (45), figs. 1–9, 1850.

In connection with these specimens remarks similar to those made in discussing the species last described would also apply. A great diversity of leaf forms were included by Unger under this specific name, and an even more diversified series of forms, from the Miocene of Switzerland, were subsequently referred to the species by Heer.[60] Whether or not this reference was justified may be regarded as an open question, and although our two specimens are hardly comparable with any of Unger's figures they are highly suggestive of identity with certain of Heer's—for example, his figures 1, 3, 9, and 11, plate 138. Comparison may also be made with *Cassia lignitum* Unger,[61] from the Tertiary of Croatia, especially with his figure 13.

Detached leaflets of many of the Leguminosae are exceedingly unsatisfactory subjects for identification. Heterophylly is frequent, and specific and even generic differentiation is often difficult; hence the three genera and four species of Leguminosae represented by the 20 individual figures on plate 72 might, if more complete specimens should be obtained, be increased or diminished in number or be relegated to other genera and identified with other species.

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

Family PAPILIONACEAE

Genus SOPHORA Linnaeus

Sophora multiformis Hollick, n. sp.

Plate 72, figures 1, 2, 7, 8, 9a, 10, 11a, 12, 13

Leaves pinnate; leaflets oblong-lanceolate, attached to the rachis at intervals of about 1.75 centimeters, from 1.75 to 5 centimeters in length by 7.5 to 1.8 centimeters in width, entire, rounded or bluntly acuminate at the apex, rounded-cuneate at the more or less inequilateral base; midrib straight; nervation simply pinnate, camptodrome; secondary nerves irregularly disposed, diverging at angles of about 45° from the midrib, almost straight proximally, curving upward and becoming camptodrome toward their distal extremities.

The reference of these diverse forms to a single species may perhaps be subject to criticism, but they were all found at one locality and in identically similar matrix throughout.

A similar disposition was made by Berry of a closely allied if not identical species from the Eocene of Tennessee (*Sophora wilcoxiana* Berry [62]), in which the variation in form and dimensions of the leaflets is even more pronounced than in ours. At first I was inclined to regard these leaflets as specifically identical with ours, for the reason that comparisons between certain of the figures made differentiation almost impossible. Thus, our figures 1 and 2 are comparable with Berry's figures 5 and 11; our figures 7, 8, and 10 with his figure 3; and our figures 12 and 13 with his figures 1, 6, and 7; but *Sophora wilcoxiana* is represented by certain leaflets (Berry's figs. 12, 13) that are considerably larger and more distinctly oblong or oblong-elliptical than any of ours; and ours, throughout, appear to be more distinctly inequilateral at their bases.

The reference of these two species to the genus *Sophora* may also be questioned, inasmuch as most of the figures, individually, could be more or less satisfactorily compared with certain figures of species described under other generic names, such as *Cassia* and *Leguminosites* as depicted by Heer,[63] from the Tertiary of Switzerland, and *Physolobium kennedyaefolium* Unger,[64] from the Tertiary of Styria, which is strikingly suggestive of our figures 1 and 2. About all, in fact, of which we may be justified in feeling reasonably certain is that these specimens from Alaska represent leaflets of compound leaves that are referable to the Leguminosae.

Locality: Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH9); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246).

Genus CANAVALIA Adanson

Canavalia eocenica Berry

Plate 71, figure 8

Canavalia eocenica Berry, U. S. Geol. Survey Prof. Paper 91, p. 248, pl. 53, figs. 3–6, 1916.

Although our specimen does not show any venation, other than the well-defined midrib, it compares so closely in shape with Berry's figures of *Canavalia eocenica* from the Eocene of Mississippi and Tennessee, especially with the leaflets represented by his figure 6, that any attempt at descriptive differentia-

[60] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 119, pl. 137, figs. 66–74; pl. 138, figs. 1–12, 1859.

[61] Unger, Franz, Genera et species plantarum fossilium, p. 492, Vienna, 1850; Sylloge plantarum fossilium, pt. 2: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, p. 30, pl. 10, figs. 11–16, 1860.

[62] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 241, pl. 47, figs. 1–13, 1916.

[63] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pl. 138, 1859.

[64] Unger, Franz, Sylloge plantarum fossilium, pt. 2: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, pl. 5, fig. 1, 1860.

tion would be very difficult, and I have little hesitation in regarding them as specifically identical.

Only one other American fossil species (*C. acuminata* Berry)[65] has been referred to the genus, and this species has the same geologic and geographic distribution as *C. eocenica*. So far as I am aware the genus has not been recognized in the fossil form from any locality in the Old World except Jonje, Africa,[66] although in our existing flora it is a tropical and semitropical genus that is common to both the Old and the New World.

A number of fossil leaves of similar aspect have been described under the genera *Eugenia* and *Sapotacites*, and these genera should also receive careful consideration in connection with the study and comparison of the general foliar type represented by fossil leaves such as those of the species under discussion. Whatever the generic identification may be, however, the immediate matter of interest is the apparent mutual identity of the specimens from the Eocene of the southeastern United States and Alaska.

Locality: South side of Bering Lake, 1 mile east of Sinclair's cabin, Yakutat-Copper River region (original no. 14); collected by A. G. Maddren in 1905 (lot 3702).

Genus DOLICHOS Linnaeus

Dolichos convexus Hollick, n. sp.

Plate 71, figures 6, 7

Leaflets rounded or convex-triangular, 6.5 to 8.5 centimeters in length by 5 to 6 centimeters in maximum width, asymmetric, cordate-truncate at the bases, rounded and bulging on one side, cuneate and oblique on the other, curving above to a blunt apex; margin entire; venation pinnate, camptodrome; secondary veins irregularly disposed and spaced, mostly subopposite or opposite, those on the rounded side of the leaf diverging at obtuse angles from the midrib, those on the cuneate side diverging at angles more acute, the lowest one on each side giving off five or more branches from beneath, the one next above, on the rounded side, with two branches from beneath, distad.

These specimens apparently represent lateral leaflets of a leguminous plant, similar to the existing *Dolichos tetrogonolobus* Linnaeus of the Philippine Islands, and the European Tertiary species *Dolichites maximus* Unger,[67] which he compared with the existing *Dolichos ciliatus* Wallich, of the East Indies.

The only other American fossil species heretofore described in either genus is *Dolichites deusseni* Berry,[68] from the Eocene of Texas; but between this species and ours there is only a very remote resemblance.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Order GERANIALES

Family MALPIGHIACEAE

Genus TETRAPTERIS Cavanilles

Tetrapteris harpyiarum Unger

Plate 93, figure 3

Tetrapteris harpyiarum Unger, Genera et species plantarum fossilium, p. 455, Vienna, 1850.

This genus has not been heretofore recognized in American paleobotany, but there does not appear to be any doubt that our leaf is identical with Unger's species from the Tertiary of Hungary.[69] In our existing flora the genus is confined to the tropical regions of the New World.

Locality: Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 141); collected by R. S. Tarr in 1905 (lot 3879).

Order SAPINDALES

Family ANACARDIACEAE

Genus SEMECARPUS Linnaeus

Semecarpus alaskana Hollick, n. sp.

Plate 93, figure 7

Leaf roughly ellipsoidal, about 9.5 centimeters in length by 7 centimeters in maximum width, entire, apparently unsymmetrical, rounded at the base, abruptly and inequilaterally contracted and contorted at the apex; venation pinnate, camptodrome; midrib stout; secondary veins numerous, diverging at obtuse angles from the midrib, very irregularly disposed and spaced, crowded at the apex, all extending out close to the margin, where they connect through branches and cross nervation in a series of loops; tertiary cross venation throughout the lamina of the leaf forked, flexed, and branched, irregularly arranged, mostly at obtuse and right angles to the secondaries.

I have failed to find any described fossil leaf with which this specimen may be satisfactorily compared, either generically or specifically; but it resembles, more or less closely, certain existing species in the genus *Semecarpus*. This is a tropical Asiatic and Australasian genus that extends northward into the Philippine Islands. It has not heretofore been recognized—or at least recorded—in the fossil form, al-

[65] Berry, E. W., op. cit., p. 249, pl. 110, figs. 4, 6.

[66] Menzel, P., Uber Pflanzenreste aus Basalttuffen des Kamerungebietes: Beiträge geol. Erforschung deutsch. Schutzgebiete, Heft 18, p. 27, 1920.

[67] Unger, Franz, Sylloge plantarum fossilium: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 22, p. 25, pl. 6, figs. 1–5; pl. 7, figs. 1–6; pl. 8, figs. 1–4, 1863.

[68] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 14, pl. 3, fig. 3, 1916.

[69] Unger, Franz, Die fossile Flora von Sotzka: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 176 (46), pl. 50 (29), figs. 8–10, 1850.

though Saporta [70] figured a leaf from the Tertiary of France, under the name *Anacardites alnifolius*, which he compared with the existing species *Semecarpus anacardium* Lamarck (Saporta's fig. 1a). This figure is so strikingly similar to our figure 7 that it would be difficult to regard them otherwise than as congeneric.

It is interesting to identify this genus in the fossil form, for the first time, as an element in the Tertiary flora of Alaska, especially in view of its exclusive tropical distribution in our existing eastern Asiatic flora.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Semecarpus prindlei Hollick, n. sp.

Plate 104, figures 8, 9

Leaves varying considerably in size, asymmetrically oblong-ovate, short-petiolate; apex curved-cuneate, base oblique on one side, rounded on the other; texture coriaceous; surface rugose; margin entire; venation pinnate; secondary veins irregularly disposed and spaced, mostly diverging at obtuse angles from the somewhat flexuous midrib, the upper ones at angles more acute, occasionally branched or forked distad, all extending close to the margin, where they bend upward and disappear or merge into the tertiary veinlets; tertiary venation at right angles to the secondaries throughout, closely spaced, often forked and connected, with fine vienlets in between, forming a uniform, finely reticulated network throughout the entire leaf.

These leaves appear to be generically identical with *Anacardites alnifolius* Saporta,[71] from the Tertiary of France, which he compared with the existing East Indian species *Semecarpus anacardium* Linnaeus, of which he gives a figure (fig. 1a) for comparison. The generic identity of our specimens with the leaf represented by this figure appears to be unmistakable, the resemblance between them being more striking than that between this leaf and Saporta's figures of *Anacardites alnifolius*.

We may also compare our figure 9 with *Leguminosites normanni* Heer,[72] from the Tertiary of Greenland, in connection with which it is difficult to note any detail of character or appearance that might serve to differentiate one figure from the other. Generic comparison may also be made between our figures and those of *Artocarpoides balli* Berry,[73] from the Eocene of Louisiana. The correct taxonomic status of our specimens, in the circumstances, cannot be regarded as satisfactorily determined.

The specific name adopted for our specimens is given in recognition of the contributions made to the collections of fossil plants of Alaska by the collector, Mr. L. M. Prindle.

Locality: Bryant Creek, upper Yukon region (original no. 3AP350); collected by L. M. Prindle in 1903 (lot 3229).

Genus RHUS Linnaeus

Rhus frigida Knowlton

Rhus frigida Knowlton, U. S. Nat. Mus. Proc., vol. 17, no. 998, p. 227, pl. 9, fig. 6, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

The specimen upon which this species was based (U. S. Nat. Mus. no. 3764) was collected at Herendeen Bay, Alaska Peninsula, by C. H. Townsend in 1890. It has not been identified in any of the subsequent collections from the region or elsewhere. Knowlton compared it with *Rhus meriani* Heer,[74] from which, he said, it is almost impossible to distinguish it.

Family ILICACEAE

Genus ILEX Linnaeus

Ilex insignis Heer

Plate 73; plate 74, figure 1

Ilex insignis Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 37, pl. 10, figs. 1, 1b, 1869. Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 229, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey, 17th Ann. Rept., pt. 1, p. 889, 1896.

The identity of our specimens with this species may perhaps be questioned, in view of the fragmentary character of Heer's figure, which is the only illustration of the species available for comparison. The part of the leaf that is represented, however, is so strikingly similar to the equivalent part of our specimen that it is impossible to differentiate between them.

Heer's description and figure are the only ones published; hence the following amended description, based upon our almost perfect specimen, seems to be advisable:

Leaf lanceolate, 17 centimeters in length by 9 centimeters in maximum width, tapering above to an acuminate apex and rounded below to a somewhat oblique and slightly cordate base, long-petioled; margin den-

[70] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, pt. 1: Annals sci. nat., sér. 4, Botanique, vol. 17, p. 201 (48), pl. 2, figs. 1a, 1b, 1c, 1862.

[71] Saporta, Gaston de, Études sur la végétation du sud-est la France à l'époque tertiaire, pt. 1, no. 2: Annales sci. nat. [Paris], sér. 4, Botanique, vol. 17, p. 201 (48), pl. 2, figs. 1a, 1b, 1863.

[72] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 139, pl. 84, fig. 18, 1883.

[73] Berry, E. W., Additions to the flora of the Wilcox group: U. S. Geol. Survey Prof. Paper 131, p. 8, pl. 4, figs. 8–10; pl. 5, 1922.

[74] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 82, pl. 126, figs. 5–11, Winterthur, 1859.

ticulate in the upper part, apparently entire near the base; venation pinnate, campto-craspedodrome; secondary veins irregularly disposed and spaced, subtending obtuse angles with the midrib, the lower ones crowded at their points of origin and bent downward, the upper ones relatively distant from one another, curved strongly upward and becoming camptodrome near the margin in a series of small loops with fine veinlets extending from the outer sides to the marginal denticulations.

Although the specific identity of the specimens appears to be assured, their generic status is dubious, as noted by Heer,[75] who remarked that the leaf is also suggestive of certain other genera, such as *Celastrus*, *Euonymus*, and *Quercus*.

Leaves somewhat similar to ours, from the Eocene of Colorado, were described and figured under the name *Celastrus serratus* Knowlton,[76] and the generic affiliation of our leaf appears to be with these rather than with *Ilex*, and the family relationship certainly appears to be with the Celastraceae; but in the absence of definite identifications it seems best not to change Heer's generic appellation in connection with the Alaska specimens.

Localities: Kukak Bay, north shore, 1 mile west of Cape Nukhshak, Alaska Peninsula (original no. 941); collected by T. W. Stanton and R. W. Stone in 1914 (lot 3517) (pl. 73). Nenana coal field, Tanana region, near Jinx coal bed, about 300 yards above mouth of Coal Creek; collected by Mrs. J. A. Davis in 1923 (lot 7634) (pl. 74, fig. 1). Port Graham, Kenai Peninsula, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm.

Ilex? reticulata Heer

Plate 103, figure 3b

Ilex? reticulata Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 124, pl. 48, fig. 7, 1868.

Our specimen agrees in every detail with the description and illustration of Heer's species, which was based upon a single specimen from the Eocene of Greenland and referred, with query, to the genus *Ilex*. It is unfortunate that in both of these specimens the upper part is missing, and as the species is known only by these two specimens, a complete description and representation is not possible. It was especially characterized by its coriaceous texture, which is indicated by the well-defined incurved margins of the leaves and by the finely reticulated rugosities of the surfaces, a character well shown in the figure of each specimen.

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

[75] Heer, Oswald, op. cit. (Flora fossilis alaskana), p. 38.

[76] 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. 329, pl. 99, fig. 4; pl. 100, fig. 1 [excl. pl. 98, fig. 3], 1917 [1918].

Family CELASTRACEAE

Genus CELASTRUS Linnaeus

Celastrus comparabilis Hollick, n. sp.

Plate 75, figures 1a, 2b

Leaf broadly ovate, about 9 centimeters in length by 6.5 centimeters in width across the middle; margin acutely triangular-serrate dentate above, entire near the base; venation simply pinnate, craspedodrome; secondary veins irregularly disposed, the lower ones diverging at angles of about 90° from the midrib, the upper ones at angles less obtuse, all curving upward, the lower and middle ones merging into the tertiary venation toward their extremities, with veinlets extending to and terminating in the marginal dentitions, those near the summit extending directly from midrib to margin.

This species differs but little from *Celastrus ferrugineus* Ward,[77] from the Eocene (Fort Union formation) of Montana. It is somewhat broader, with rounded instead of cordate base and with finer, more acute teeth and more slender midrib. There might appear to be ample justification for regarding it merely as a variety of the species mentioned; but the general aspect, which can be perceived more readily than it can be defined, seems to be sufficiently distinctive to warrant specific differentiation.

It may also be compared with one of the figures of *Celastrus serratus* Knowlton,[78] from the Eocene (Raton formation) of Colorado, in regard to which Knowlton said: "The present species is undoubtedly very closely related to *Celastrus ferrugineus* Ward * * * about the only difference that can be readily observed is the greater size and sharper-pointed form of *C. serratus*."

Localities: Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 141); collected by R. S. Tarr in 1905 (lot 3879) (pl. 75, fig. 1a). Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH 9a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246) (pl. 75, fig. 2b).

Celastrus borealis Heer

Plate 74, figures 2, 3

Celastrus borealis Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 37, pl. 10, fig. 4, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 229, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 889, 1896.

The species to which our specimens are tentatively referred was based by Heer upon a single fragmen-

[77] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 52, figs. 11–14, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 78, pl. 34, figs. 1–4, 1887.

[78] 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. 329, pl. 98, fig. 3, 1917 [1918].

tary leaf collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. Heer's description of this leaf and its accompanying figure are the only published description and illustration of the species, so far as I am aware. Unfortunately the basal portion is lacking, and in our two specimens the apical portions are lacking. The general shape of the leaves, however, and the characters of the margins and venation appear to be identical in all three specimens, and I have but little doubt that they are all referable to one and the same species; if so, Heer's specific description should be amended by adding "base rounded; secondary veins subcamptodrome in a series of elongated angular loops; ultimate ramifications of the tertiary veins consisting of fine veinlets that extend from the exterior angles of the marginal loops and terminate in the denticulations."

Whether or not the genus *Celastrus* represents the correct generic reference may perhaps be questioned; but the venation is characteristic of a number of fossil leaves that have been so referred, such as *C. ferrugineus* Ward [79] and *C. alnifolius* Ward,[80] which differ but little from *C. borealis*, except in their somewhat smaller size and coarser dentition.

Locality: Nenana coal field, Tanana region, Coal Creek, just west of Healy Creek Coal Corporation's mine (original no. 23AC7); collected by S. R. Capps in 1923 (lot 7622).

Celastrus sp.? Heer

Celastrus sp.? Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868.

It is possible that the specimen originally listed as above by Heer may represent the one subsequently described by him as *Celastrus borealis*, the species last described, inasmuch as each record refers to a specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula; but this, of course, is mere conjecture.

Genus ELAEODENDRON Jacques fils

Elaeodendron helveticum Heer

Elaeodendron helveticum Heer, Flora tertiaria Helvetiae, vol. 3, p. 71, pl. 122, fig. 5, Winterthur, 1859.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 449, pl. 9, fig. 4, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 263, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 228, 1894; Geol. Soc. America Bull., vol. 5, p. 586 [1894]; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 889, 1896.

A specimen of this species [U. S. Nat. Mus. no. 1381] was collected by W. H. Dall in 1880 on Unga Island, off the south coast of Alaska Peninsula, and was subsequently described and figured by Lesquereux. It is not represented in any of the more recent collections from Alaska, nor has it been recorded from elsewhere in America.

[79] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 52, figs. 11–14, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 78, pl. 34, figs. 1–4, 1887.

[80] Idem (6th Ann. Rept.), pl. 53, figs. 1, 2; (Bull. 37), p. 80, pl. 35, figs. 1. 2.

Family ACERACEAE

Genus ACER Linnaeus

Acer arcticum Heer

Plate 77, figure 1; plate 78, figures 7, 8

Acer arcticum Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 86, pl. 22, figs. 1–7; pl. 23, figs. 1–4a, 5–9; pl. 24, figs. 1, 2a; pl. 25, figs. 1–3, 1876.

A great diversity of leaf forms from the Eocene of Spitsbergen were included in this species by Heer, and those with which our specimens compare most closely are represented by his figure 8, plate 23, and figure 1, plate 24, which he included under his form 4.

The species has been identified in collections of Tertiary plants from Spitsbergen, Siberia, Japan, and Greenland, hence its discovery in equivalent deposits in Alaska might have been anticipated.

A leaf from Miocene auriferous gravel of California was referred to the species by Lesquereux,[81] but the description was not accompanied by a figure. He remarked, however,[82] that "the identification of this finely preserved leaf is positive." The same author [83] also described and figured two specimens from the Eocene (Fort Union formation) of North Dakota and referred them to the species; but the specimens are fragmentary, and their identity appears to be open to question.

A most remarkable resemblance, however, may be noted between our figures and those of *Populus acerifolia* Newberry,[84] from the Eocene (Fort Union formation) of North Dakota, in connection with which he remarked that "among fossil species this perhaps resembles most *P. leucophylla*" [85]; and Heer [86] remarked upon the resemblance of his *Acer arcticum*, form 4, to *P. leucophylla*. This form, as previously stated, is the particular one that our specimens most closely resemble, and it is almost impossible to escape the conviction that Newberry's *Populus acerifolia* is specifically identical with form 4 of Heer's *Acer arcticum* and therefore with our speci-

[81] 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. 60, 1878.

[82] Idem, p. 61.

[83] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 233, pl. 49, figs. 8, 9, 1883.

[84] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 37, pl. 28, figs. 5–8, 1898.

[85] Unger, Franz, Iconographia plantarum fossilium: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 4, p. 118 (46), pl. 44, figs. 7, 8, 1851; Die fossile Flora von Gleichenberg: Idem, vol. 7, p. 177 (21), pl. 4, figs. 6–9, 1854.

[86] Heer, Oswald, op. cit., p. 87.

mens from Alaska. Should this apparent identity be satisfactorily determined, the distribution of the species, according to Penhallow,[87] would have to be extended so as to include a number of localities in Canada.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 77, fig. 1). Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178) (pl. 78, fig. 7). East of divide, on trail to Herendeen Bay, Alaska Peninsula (original no. 11); collected by H. M. Eakin in 1908 (lot 5181) (pl. 78, fig. 8).

Acer disputabilis Hollick, n. sp.

Plate 74, figure 4

Leaf about 10 centimeters in length by 9 centimeters in width, trilobate, rounded and broadly cordate at the base; middle lobe considerably longer than the lateral ones; margin finely and uniformly serrate-dentate; venation tripalmate, craspedodrome; lateral primaries subtending acute angles with the midrib, at first ascending and curving slightly inward, ultimately diverging and curving slightly outward; secondary veins widely spaced, irregularly disposed, leaving the primaries at acute angles of divergence, at first curving upward, ultimately becoming straight or slightly curved in the opposite direction; basilar secondaries with tertiary branches from the under side, each one curved inward and terminating in a marginal dentition.

In certain respects this specimen is suggestive of *Acer bendirei* Lesquereux,[88] from the Miocene of Oregon—a species of considerable diversity in form and dimensions—but the fine, uniform character of the dentition in our specimen at once serves to differentiate it from the species mentioned, which is characterized by coarse, irregular dentition.

Comparison may also be made with *Acer triangulilobum* Goeppert,[89] from the Miocene of Silesia; and another species with which there may be a possibility of specific relationship is represented by certain leaf forms that have been described and figured under the name *Acer otopterix* Goeppert,[90] originally founded by Goeppert upon a single seed, or samara, but subsequently amplified by other authors and made to include leaves as well as fruit. Fragmentary leaf remains from Greenland and Iceland were tentatively referred to this species by Heer,[91] and certain of these (his figs. 2, 6, 8) resemble ours more or less closely; but no specimen is sufficiently perfect for satisfactory comparison. Heer, however, cited *Acer vitifolium* Alex. Braun, as described and figured by Weber,[92] as being closely related to or identical with the Arctic specimens; and the species is also mentioned in connection with *Acer aequidentatum* Lesquereux [93] in that author's discussion of the type specimens from the Miocene of California. To this species our specimen appears to be suggestively similar; but it is evident that among such a wide diversity of leaf forms as are included in the several species cited, together with certain individual specimens among them that present an appearance of close similarity, specific differentiation may be regarded as a matter of individual opinion rather than satisfactory identification. Under the circumstances I have therefore decided to describe our specimen under a new specific name, even though it does not differ from certain figures of certain described species as much as many of the individual specimens included in either one of the species differ between themselves.

Locality: Summit of mountain 1 mile southwest from forks of Pumicestone Creek, Alaska Peninsula (original no. P-23); collected by W. R. Smith in 1922.

Acer grahamensis Knowlton and Cockerell

Acer grahamensis Knowlton and Cockerell, U. S. Geol. Survey Bull. 696, p. 50, 1919.

Acer macropterum Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 37, pl. 9, figs. 7–9, 1869. Knowlton, Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 227, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

Not *A. macropterum* Visiani, 1860.

This species, based on two specimens of fruit and a fragment of a leaf, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region, is not mentioned by Heer elsewhere than in connection with the original specimens from Port Graham, and it is not recorded from any other locality by any subsequent writer. The probability appears to be that a perfect specimen of the leaf would be found to be identifiable with some other recognized species. Incidentally, also, Heer's application of the specific name was unfortunate, as this had been previously used for the living species *A. macropterum* Visiani, in 1860.

[87] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 75, 1908.

[88] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 14, pl. 5, fig. 5; pl. 6, fig. 1; pl. 7, fig. 1; pl. 8. fig. 1, 1888.

[89] Goeppert, H. R., Ueber die Braunkohlenflora des nordöstlichen Deutschlands: Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 494, 1852; Die tertiäre Flora von Schossnitz in Schlesien, p. 35, pl. 23, fig. 6, Görlitz, 1855.

[90] Goeppert, H. R., Beiträge zur Tertiärflora Schlesien's: Palaeontographica, vol. 2, p. 279 (23), pl. 38 (6), fig. 4, 1852.

[91] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 122, pl. 50, fig. 10; p. 152, pl. 28, figs. 1–8, 1868.

[92] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 197 (83), pl. 5, figs. 4a, 4b, 1851; reprint, 1852.

[93] Lesquereux, Leo, Report on the fossil plants of the auriferous gravel deposits of the Sierra Nevada: Harvard Univ. Mus. Comp. Zoology Mem., vol. 6, no. 2, p. 26, pl. 7, figs. 4, 5, 1878.

Acer inaequale Heer?

Plate 77, figures 2, 3

Acer inaequale Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 89, pl. 24, figs. 4–6, 1876.

Under the above name Heer described and figured three fragmentary specimens from the Eocene of Spitsbergen, which might or might not be regarded as referable to a single species, or as representing the genus to which they were referred. Heer was evidently in doubt in regard to the generic reference and remarked:

Die ungleiche Entwickelung der beiden Blattseiten spricht für ein zusammengesetztes Blatt und da bei *Acer* zusammengesetzte Blätter mit ähnlicher Nervation vorkommen, habe ich sie *Acer* eingereiht, welche Bestimmung indessen keineswegs als ganz gesichert betrachtet werden kann.

However, there appears to be little doubt that our specimens are identical with the specimen represented by his figure 5.

Heer did not again mention or refer to the species, and the only other author to mention it, so far as I am aware, was Steger,[94] in an inaugural dissertation for a doctorate degree at the University of Breslau; but there was no accompanying illustration, and the reference is of bibliographic interest only.

A surficial resemblance may be noticed between our specimens and certain leaves that have been included from time to time in the heterophyllous genus *Grewiopsis*, especially with those of *G. populifolia* Ward.[95] The genus *Grewiopsis*, however, is so overburdened with leaf forms of various descriptions that it does not seem to me advisable to add still further to the series.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, Chickaloon River, shales overlying 15-foot coal near Watson's tunnel 2 (original no. 1); collected by G. C. Martin in 1905 (lot 3672) (pl. 77, fig. 2). Matanuska coal field, Eska Creek; collected by Theodore Chapin in 1910 (lot 5897), (pl. 77, fig. 3).

Acer trilobatum productum (Alex. Braun) Heer

Plate 76, figure 2

Acer trilobatum productum (Alex. Braun) Heer, Flora tertiaria Helvetiae, vol. 3, p. 50, pl. 114, figs. 1, 4–8, Winterthur, 1859.
Knowlton, Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Nat. Mus. Proc., vol. 17, p. 227, pl. 9, fig. 3, 1894; U. S. Geol. Survey, 17th Ann. Rept., pt. 1, p. 888, 1896.
Acer productum Alex. Braun, Neues Jahrb., 1845, p. 172.

It is with some hesitation that I have referred this specimen even to one of the varietal forms of this polymorphous species. Its fragmentary condition renders accurate comparison impossible, but it may be compared with Heer's figure 7 more or less satisfactorily.

A very small specimen, collected at Herendeen Bay, Alaska Peninsula, by C. H. Townsend in 1890 (U. S. Nat. Mus. no. 5397) was referred to the variety and figured by Knowlton, but the identification does not appear to be altogether conclusive, although many more or less different leaf forms have been included in the variety from time to time by various authors.

Lesquereux referred to this variety specimens from Wyoming[96] and Oregon,[97] but the identity of the former is open to question, and three of the Oregon specimens (figs. 1, 2, 4) represent *Acer bendirei* Lesquereux[98] and the other one (fig. 3) represents *Platanus dissecta* Lesquereux.[99] We may therefore say that *Acer trilobatum productum* has not yet been conclusively identified as an element in the Tertiary flora of any part of America, although it is abundantly represented in that of the Old World.

Locality: Yukon River, south bank, 2 to 4 miles above Rampart, central Yukon region (original no. 15); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4710).

Acer trilobatum var. Knowlton

Acer trilobatum var. Knowlton, Alaska, vol. 4, p. 155, pl. 29, fig. 2, Harriman Alaska Expedition, 1904 [U. S. Nat. Mus. no. 30086].

This fragmentary specimen, collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899, is apparently varietally identical with a similar fragment from the Yukon River region which I have tentatively referred to *Acer trilobatum productum* Heer, the variety last described. Neither specimen, however, is sufficiently complete for either satisfactory comparison or identification.

Acer visibilis Hollick, n. sp.

Plate 76, figures 3, 4

Leaf about 14 centimeters in length, broadly trilobate; lobes broadly triangular, terminating in narrow, acuminate apices; margin irregularly triangular-dentate, coarse on the middle lobe, finer on the lateral lobes; venation palmate, the lateral primaries almost as long as the midrib, each with numerous curved, anastomosing secondary veins that branch from the

[94] Steger, Victor, Die schwefelführenden Schichten von Kokoschütz in Oberschlesien, p. 23, Ratibor, 1883.

[95] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th 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.

[96] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 261, pl. 48, figs. 2, 3a, 1873.

[97] Lesquereux, Leo, The Cretaceous and Tertiary floras: Idem, vol. 8, p. 253, pl. 59, figs. 1–4, 1883.

[98] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 14, pl. 5, fig. 5; pl. 6, fig. 1; pl. 7, fig. 1; pl. 8, fig. 1, 1888.

[99] 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. 13, pl. 7, fig. 12; pl. 10, figs. 4, 5, 1878.

under sides; main secondary veins irregularly disposed and flexed, the lower ones branched, with occasional weak secondaries between; general system of venation craspedodrome throughout, either through the primaries and secondaries directly or through tertiary veinlets that extend from the anastomosed secondaries.

The two specimens upon which this species is based are too fragmentary to serve for full description of a complete leaf, which, apparently, was of the general type of the living *Acer pennsylvanicum* Linnaeus, so far as the general shape is concerned; but it does not appear to be comparable with any described fossil species. Our principal specimen, represented by figure 4, is evidently laterally compressed and contorted, but fortunately the characters of the venation and of the marginal dentition are perfectly preserved, and these, in combination with the indicated shape of the leaf, should be sufficient to identify the species in the event of more complete specimens being discovered in the future.

Locality: Yukon River, south bank, about 1½ miles above Rampart, central Yukon region (original no. 2AC 146); collected by A. J. Collier in 1902 (lot 2974).

Fruit of Acer sp.? Hollick

Plate 76, figure 1

This small but well-defined fruit of *Acer* was not found associated with any leaves that could be referred to the genus. Probably, however, it represents the fruit of some described Tertiary species, similar to *A. trilobatum* (Sternberg) Alex. Braun, numerous specimens of which, associated with the leaves, were figured by Heer.[1] Leaves tentatively referred to *A. trilobatum productum* (see p. 135) have been found in Alaska, but none were found associated with the fruit.

Locality: Cache Creek, half a mile above Cache Creek Mining Co.'s camp, Yentna River, Matanuska-Cook Inlet region (original no. 1); collected by S. R. Capps in 1911 (lot 6063).

Family AESCULACEAE

Genus AESCULUS Linnaeus

Aesculus arctica Knowlton

Aesculus arctica Knowlton, Alaska, vol. 4, p. 155, pl. 30, Harriman Alaska Expedition, 1904.

The type specimen of this species (U. S. Nat. Mus. no. 30085), so far as may be judged from the figure, does not appear to be distinguishable from *Hicoria magnifica* Knowlton.[2] The two species were collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899.

[1] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pls. 111 and 112, Winterthur, 1859.

[2] Knowlton, F. H., op. cit., p. 152, pl. 27; pl. 29, fig. 1.

Genus CUPANIA Linnaeus

Cupania comparabilis Hollick, n. sp.

Plate 74, figure 5

Leaf oblong-lanceolate, 7 centimeters in length by 2 centimeters in maximum width, tapering gradually to the acuminate apex and rather abruptly to the slightly convex-cuneate base; margin dentate or undulate-dentate above, entire below; venation simply pinnate; upper secondary veins craspedodrome, subtending acute angles with the midrib, each one terminating in a marginal dentition, lower ones subtending more obtuse angles and possibly camptodrome.

This leaf is suggestive of some from the Tertiary of Oregon, originally described and figured by Newberry[3] under the name *Quercus consimilis*, especially of his figure 2; and if this figure were the only one to represent the species it might be difficult to differentiate between them. In ours, however, the dentitions appear to be fewer and less well defined, and the secondaries, especially the lower ones, subtend more obtuse angles with the midrib. It may be compared with the existing West Indian species *Cupania glabra* Swartz.

Locality: Kukak Bay, north side, 1 mile west of Cape Nukhshak, Alaska Peninsula (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3517).

Family SAPINDACEAE

Genus PAULLINIA Linnaeus

Paullinia alaskana Hollick, n. sp.

Plate 75, figure 2a

Leaf or leaflet elliptical, about 11 centimeters in length by 5.5 centimeters in width across the middle; base acutely wedge-shaped; margin acutely and irregularly serrate-dentate; midrib stout; venation simply pinnate, craspedodrome; secondary veins about 10 on each side, irregularly disposed, diverging at angles of 40° to 45° from the midrib, extending almost straight, some with a slight upward curve, each to one of the larger marginal dentitions.

This leaf is evidently generically identical with *Paullinia dispersa* Saporta,[4] from the Tertiary of France. In fact, the only apparent difference between the figures of the two species is in size, and the Alaska specimen might perhaps be regarded merely as a large form of the Old World species. If they represent leaflets of a compound leaf more or less variation in the size of specimens might be expected, and in this connection it may be noted that our specimen ap-

[3] Newberry, J. S., Prief descriptions of fossil plants, chiefly Tertiary, from western North America: U. S. Nat. Mus. Proc., vol. 5, p. 505, 1882 [1883]; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 71, pl. 43, figs. 2–5, 7–10, 1898.

[4] Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 2, pt. 2: Annales sci. nat. [Paris], sér. 5, Botanique, vol. 4, p. 327 (183), pl. 8, fig. 7, 1865.

pears to be slightly inequilateral, with the secondary nerves on one side somewhat straighter and more oblique to the midrib than on the other.

This is the first time that the genus has been recognized in America in the fossil form, although 11 species have been recorded from the Tertiary of Europe.

As a living genus it includes about 120 species of tropical or semitropical distribution, mostly in the Old World. Two species are native in Mexico, and these represent the farthest northward range of the genus in the existing American flora.

Locality: Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3AH 9a); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246).

Genus SAPINDUS Linnaeus

Sapindus affinis Newberry?

Plate 76, figure 5

Sapindus affinis Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 51, 1868; U. S. Geol. Survey Mon. 35, p. 116, pl. 30, fig. 1; pl. 40, fig. 2, 1898.

I have questioned the reference of this specimen to the above species, for the reason that it differs considerably from Newberry's types, and I should hardly have regarded it as specifically identical except that specimens closely similar to ours, from the Eocene of the Yellowstone National Park, were described, figured, and referred to the species by Knowlton,[5] and with these our specimen may be compared and identified with reasonable certainty. Knowlton also described and figured similar but smaller specimens from the Tertiary of Colorado,[6] and it has been recorded in one or another of its forms from Wyoming, Montana, North Dakota, and southern Canada, always in connection with Eocene deposits.

Locality: Eska Creek. Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Sapindus angustifolius Lesquereux? (not Blume)

Plate 76, figure 6

Sapindus angustifolius Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1873, p. 415, 1874; U. S. Geol. Survey Terr. Rept., vol. 7, p. 265, pl. 49, figs. 2–7, 1878; vol. 8, p. 181, pl. 37, figs. 1–8; pl. 39, fig. 12, 1883.

This single, fragmentary leaf is apparently referable to one or another of the several forms that were included by Lesquereux under *Sapindus angustifolius*—a name, however, which was antedated by *S. angustifolius* Blume, applied in 1847 to an existing species. Two of these forms were differentiated by Cockerell[7] under the names *S. coloradensis* (=Lesquereux, op. cit., vol. 7, pl. 49, fig. 2; vol. 8, pl. 37, figs. 3–5) and *S. leonis* (=Lesquereux, op. cit., vol. 8, pl. 37, fig. 7); and closely similar forms, from the Eocene of the southern United States, were described and figured by Berry[8] under *S. mississippiensis*, *S. linearifolius*, and *S. formosus*. In the paper cited Berry discussed the resemblances and differences between the several allied forms and species and arrived at the general conclusion that those from the Miocene of Colorado and those from the Eocene of the Southern States are of distinctly different specific types. The differences are very slight, however, and our specimen is too imperfect for accurate comparison, hence I have decided to refer it, tentatively, to the comprehensive specific type as originally described by Lesquereux. The other specific type that appears to resemble it most closely is *S. mississippiensis* Berry.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Sapindus basilicus (Unger) Unger

Plate 77, figure 4

Sapindus basilicus (Unger) Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 25, p. 50, pl. 16, fig. 2, 1865.

Juglans basilica Unger, Genera et species plantarum fossilium, p. 470, Vienna, 1850.

Our leaf agrees in all respects with Unger's species from the Eocene of Croatia, except that it is slightly broader in proportion to its length. It has not heretofore been recorded from America, but its identity can hardly be questioned.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Genus KOELREUTERIA Laxmann

Koelreuteria eakini Hollick, n. sp.

Plate 81, figure 1

Leaf pinnatifid, the sinuses acutely triangular; divisions of the leaf oblong-ovate, cuneate-acuminate at the free apices; margins finely and uniformly denticulate; venation pinnate craspedodrome; mid veins subtending obtuse angles with the main rachis of the leaf; secondary veins numerous, pinnately arranged, rather uniformly spaced, diverging at various angles from the mid veins, terminating in the marginal denticulations and coalescing in the interdivisional areas.

From the condition of this specimen it is impossible to determine with certainty if it represents the remains

[5] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 736, pl. 102, figs. 1–3, 1899.

[6] 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. 331, pl. 99, fig. 3, 1917 [1918].

[7] Cockerell, T. D. A., The fossil flora of Florissant, Colo.: Am. Mus. Nat. Hist. Bull., vol. 24, p. 101, pl. 9, fig. 31; p. 102, 1908.

[8] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 274, pl. 63, fig. 1; pl. 64, fig. 10; pl. 66, figs. 1, 2; pl. 109, fig. 1; p. 275, pl. 63, figs. 2–5; pl. 69, fig. 4; p. 276, pl. 66, figs. 3–7, 1916.

of a complete leaf or merely the pinnatifid distal part of a leaf that was pinnate below. In certain respects it is suggestive of the genus *Sorbus*, but the divisions are conspicuously more divergent than in that genus.

In the existing flora the genus *Koelreuteria* is represented by two species, natives of eastern Asia. In the fossil form it is represented by about a dozen species, all of Tertiary age, of which one was described from Siberia, one from Spitsbergen, and the others from the European continent. Heretofore foliage of this genus has not been recognized in the New World, although leaves of suggestively similar type, from the Tertiary of Colorado, were described and figured by Lesquereux[9] under the name *Myrica diversifolia*, subsequently referred to the genus *Sorbus* by Cockerell. Dawson[10] described and figured a leaf of similar aspect to ours, from the Tertiary (Oligocene?) of British Columbia, under the name *Acerites negundifolium.*

The specific name adopted for the Alaska specimen is given in honor of Mr. H. M. Eakin, to whom we are indebted for the collection of this and other paleobotanic specimens of the region.

Locality: Yukon River, south bank, 1½ miles above Rampart, central Yukon region (original no. 11AE 1); collected by H. M. Eakin in 1911 (lot 6094).

Order RHAMNALES

Family RHAMNACEAE

Genus RHAMNUS Linnaeus

Rhamnus rossmaessleri Unger

Plate 78, figure 6a

Rhamnus rossmaessleri Unger, Genera et species plantarum fossilium, p. 464, Vienna, 1850.

Phyllites rhamnoides Rossmaessler, Beiträge zur Versteinerungskunde, no. 1, p. 35, pl. 8, figs. 36, 37 (30, 31), Dresden and Leipzig, 1840.

A wide diversity in the size of the leaves is represented in the numerous specimens that have been included in this species; but the type specimens, figured by Rossmaessler, from the Tertiary of Bohemia, are small and almost identical with ours, and among the next that were figured were two by Massalongo,[11] which compare very closely with ours both in size and shape, and one, somewhat larger, by Sismonda[12]—all three from the Tertiary of Italy. Other authors, however, referred to the species leaves that were more or less asymmetric and some that were much larger than the specific types. Several such specimens were described and figured by Heer[13] from Tertiary horizons in Switzerland, the Baltic provinces, and Greenland, and by other authors from localities in other parts of Europe.

The species has not been heretofore satisfactorily identified in America, although it was recorded by Lesquereux[14] from the Eocene of Wyoming and was erroneously identified by me[15] from the Cretaceous of New York. It is unfortunate that our specimen is imperfect, but enough of the leaf is preserved to identify it with the type specimens of the species far more satisfactorily than can be done with many of the specimens that have been referred to it.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392).

Rhamnus brevifolius Alex. Braun

Plate 79, figure 3

Rhamnus brevifolius Alex. Braun, in Bruckman, Ver. vaterl. Naturk. Württemberg Jahresh., vol. 6, p. 232, 1850.

This species has not been heretofore recorded from the North American continent; but it was described and figured by Heer[16] from the Tertiary (Eocene?) of Greenland, and it is now identified as an element in the Tertiary flora of Alaska.

Incidentally it may be suggested that this species is similar to certain of the smaller leaf forms of *Rhamnus rossmaessleri* Unger, the species last described.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near the entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Rhamnus decheni Weber

Plate 78, figure 3

Rhamnus decheni Weber, Palaeontographica, vol. 2, p. 204 (90), pl. 23 (6), figs. 2a–f, 1851 (1852).

It is with some hesitation that I decided to consider this specimen as identical with the species originally

[9] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 148, pl. 25, figs. 6, 10–15, 1883, =*Sorbus diversifolia* (Lesquereux) Cockerell, T. D. A., Descriptions of Tertiary plants: Am. Jour. Sci., 4th ser., vol. 29, p. 76, fig. 1, 1910.

[10] Dawson, J. W., On fossil plants from the Similkameen Valley and other places in the southern interior of British Columbia: Roy. Soc. Canada Trans., vol. 8, sec. 4, p. 86, fig. 19, 1900.

[11] Massalongo, Abramo, and Scarabelli, Giuseppe, Studii sulla flora fossile e geologia stratigraphica del Senigalliese, p. 381, pl. 26–27, fig. 26; pl. 36, fig. 6, Imola, 1859.

[12] Sismonda, Eugéne, Matériaux pour servir à la paléontologie du Piémont: Acad. sci. Turin Mém., sér. 2, vol. 22, p. 451 (63), pl. 15, fig. 7, 1865.

[13] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 80, pl. 124, figs. 18–20, Winterthur, 1859; Miocene baltische Flora: Beiträge zur Naturkunde Preussens, no. 2, p. 46, pl. 10, figs. 19–20, Königsberg, 1869; Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 132, pl. 69, fig. 6, 1883.

[14] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 283, pl. 54, fig. 4, 1878, =*Juglans rhamnoides* Lesquereux, fide Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 336, 1919.

[15] Hollick, Arthur, Paleontology of the Cretaceous formation on Staten Island: New York Acad. Sci. Trans., vol. 12, p. 35, pl. 3, fig. 5, 1892, =*Myrsinites? gaudini* Lesquereux, fide Hollick, Arthur, Cretaceous flora of southern New York and New England: U. S. Geol. Survey Mon. 50, p. 103, pl. 39, fig. 12, 1906.

[16] Heer, Oswald, Flora fossilis arctica, vol. 1, p. 123, pl. 49, fig. 1, 1868; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 132, pl. 67, fig. 10, 1883.

described by Weber from the Tertiary of the Old World. It compares satisfactorily, so far as the discernible characters are concerned, but the upper part of the leaf is missing.

The species was recorded by Lesquereux [17] as found in Wyoming, in rocks presumably of Eocene age, but was not figured; and it was not subsequently recorded from elsewhere in America by any other author, so far as I am aware.

Certain specimens figured and referred to the species by Old World authors other than Weber appear to be more nearly like our specimen than those that represent the original specific types, as may be seen by comparison with figures by Gaudin,[18] Sismonda,[19] and others. An American species that approaches it very closely in appearance, however, is *Rhamnus belmontensis* Knowlton and Cockerell,[20] in regard to which Newberry remarked: "Of described species it most resembles Weber's *R. decheni* * * * but differs from it in having an ovate, lanceolate form, and the nervation is a little more crowded."

Apparently our specimen is identical with one from the Eocene of Mississippi, identified by Berry [21] as *Rhamnus marginatus* Lesquereux (p. 140), but his identification does not appear to be warranted by the figure.

Locality: Yakutat-Copper River region, tributary of Glacier Creek, opposite Brown's 3-tent camp (original no. 41); collected by A. G. Maddren in 1905 (lot 3848).

Rhamnus gaudini Heer

Plate 78, figures 4, 5

Rhamnus gaudini Heer, Flora tertiaria Helvetiae, vol. 3, p. 79, pl. 124, figs. 4–15; pl. 125, figs. 1, 7, 13, 1859.

Our specimens appear to be the best-defined representatives of this species thus far recorded from America. They are narrower and more acute at the base than most of the specimens depicted by Heer, but this appears to be the only difference between them. In this respect they more closely resemble *Rhamnus rectinervis* Heer,[22] but the marginal denticulations are those of *R. gaudini*. If they should be described as a new species, it would merely represent a leaf form that would include certain characters of each of the above-mentioned species and might equally well be regarded as a varietal form of either one. *R. gaudini* is a well-known European Tertiary species, and a fragmentary specimen from the Tertiary of Greenland was tentatively identified by Heer.[23] In the New World the species is not well known, although it was tentatively identified by Newberry [24] from rocks of uncertain age, at Birch Bay, Wash.; and what was apparently the specimen upon which he based his identification was figured, without name, in the atlas of the Wilkes Exploring Expedition;[25] but the identification, if based upon the specimen represented by this figure, would seem to be questionable. The species was also recorded from the Tertiary (Eocene?) of British Columbia by Penhallow,[26] but without any description or illustration. He remarked, however, that "*Rhamnus gaudini* is a species which appears to present very great variation in size and shape."

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 78, fig. 4). Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 78, fig. 5).

Rhamnus pseudogoldianus Hollick, n. sp.

Plate 79, figures 1, 2; plate 119, figure 5

Leaves ovate to ovate-oblong, 13 centimeters in length by 4 to 6.25 centimeters in maximum width, slightly oblique, rounded, or subcordate at the base; margin entire; venation simply pinnate; secondary veins numerous, irregularly spaced and disposed, subparallel, ascending, curved upward, thinning out and disappearing close to the margin, the upper ones acrodrome.

These leaves would be referred, with but little hesitation, to *Rhamnus goldianus* Lesquereux [27] if it were not that there is no indication of any branching of the lower secondaries, a feature emphasized by Lesquereux as one of the principal distinguishing specific characters of *R. goldianus*. In all other characters the two species are closely alike.

Localities: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow

[17] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. Survey Terr. Ann. Rept. for 1872, p. 397, 1873; Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 20, 1888.

[18] Gaudin, C. T., Mémoire sur quelques gisements de feuilles fossiles de la Toscane: Soc. helvétique sci. nat. Nouv. mém., vol. 16, no. 3, p. 39, pl. 7, fig. 6, 1858.

[19] Sismonda, Eugene, Matériaux pour servir à la paléontologie du terrain tertiaire du Piémont, pt. 1 (Végétaux): Acad. sci. Turin Mém., sér. 2, vol. 22, p. 451 (63), pl. 12, fig. 4a; pl. 15, fig. 6; pl. 30, fig. 2, 1865.

[20] 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. 544, 1919, = *R. elegans* Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 117, pl. 50, fig. 2, 1898.

[21] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 282, pl. 72, fig. 1, 1916.

[22] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 80, pl. 125, figs. 2–6, 1859.

[23] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 124, pl. 50, fig. 6, 1868.

[24] Newberry, J. S., Descriptions of the fossil plants collected by Mr. George Gibbs, geologist to the United States Northwest Boundary Commission: Boston Jour. Nat. Hist., vol. 7, p. 520, 1863.

[25] Dana, J. D., Geology: U. S. Expl. Exped. during the years 1838–42, under the command of Charles Wilkes, U. S. N., text, vol. 10, appendix I, p. 730, atlas, pl. 21, figs. 10 (11, 12), 1849.

[26] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 84, 1908.

[27] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 28, pl. 53, figs. 4–8, 1878.

trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 79, figs. 1, 2). Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 119, fig. 5).

Rhamnus marginatus Lesquereux

Plate 78, figures 1, 2

Rhamnus marginatus Lesquereux, in Owen, D. D., Second report of a geological reconnaissance * * * of Arkansas, p. 319, pl. 6, fig. 2, 1860.

It is not often that such satisfactory examples of a relatively little-known species are found as are represented by our specimens. They serve to supplement the described and figured characters of the specific types, from the Eocene of Kentucky and Tennessee, and of the other specimens subsequently identified by Lesquereux [28] and Berry,[29] from deposits of equivalent age in Mississippi. Except in connection with the specimens above mentioned from the southern United States and those here described and figured from Alaska, the species has not been identified, and it is a matter of considerable interest to have such a well-defined index fossil in the collections from these widely separated regions. The figures of our specimens show, better than any of the figures heretofore published, the characteristic thick midrib, the coarse camptodrome secondaries, and the marginal nerve caused by the extension and coalescing of the secondaries along the border of the leaf. The tertiary venation is also well preserved in our specimens, and its characters are, for the first time, clearly depicted in our figures.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Genus ZIZYPHUS Adanson

Zizyphus hyperboreus Heer?

Plate 79, figures 5, 6

Zizyphus hyperboreus Heer, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 123, pl. 49, figs. 2, 2b?, 1868; Contributions to the flora of North Greenland: Idem, vol. 2, no. 4, p. 482, pl. 50, fig. 20, 1869; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 130, pl. 67, fig. 6, 1883.

Our two fragmentary specimens that are tentatively referred to this species may be seen to differ considerably from each other, but not more so than the figures of the Greenland Tertiary specimens depicted by Heer. Thus, our figure 6 compares with Heer's figures 20 and 6, and our figure 5 with his figures 2 and 2b. Comparison may also be made with a specimen from the Eocene of Wyoming, doubtfully referred to the species by Lesquereux,[30] which is suggestive of the form represented by our figure 6, and a specimen of *Z. meekii* Lesquereux [31] from the same region, which is suggestive of the form represented by our figure 5.

It would seem as if our two specimens should be regarded as specifically distinct from each other, and in any critical revision of the genus such distinction would probably be recognized. In the meantime, however, the main point of interest is that each of our two diverse leaf forms may be identified with a similar form from the Tertiary of Greenland, irrespective of whether or not the two forms may be ultimately regarded as distinct species.

Localities: Summit of mountain 1 mile southwest of forks of Pumicestone Creek, Alaska Peninsula (original no. P–23); collected by W. R. Smith in 1912 (pl. 79, fig. 5). Jaw Mountain, 8½ miles northeast of Gates of Crater, Alaska Peninsula (original no. P–25); collected by W. R. Smith in 1922 (pl. 79, fig. 6).

Zizyphus meigsii (Lesquereux) Berry? (not Schimper)

Plate 31, figure 3a; plate 79, figure 4

Zizyphus meigsii (Lesquereux) Berry, U. S. Geol. Survey Prof. Paper 91, p. 278, pl. 70, figs. 3–5, 1916.
Ceanothus meigsii Lesquereux, Am. Philos. Soc. Trans., vol. 13, p. 419, pl. 19, figs. 5–7, 1869.

The specimen provisionally referred to the above species lacks the upper part, which would probably determine whether or not the specific identification is valid. One of the prominent features of the species is the long, attenuated apex, and the apex is wanting in our specimen.

If the several specimens that have been included in the species by Berry and by Knowlton [32] are referable to it, then it includes a considerable variety of forms. Ours has a truncate base and is decidedly inequilateral. In general appearance it seems to approach most nearly the specimen represented by Knowlton's figure 1, plate 99, from the Eocene (Raton formation) of New Mexico. Those figured by Berry and by Lesquereux came from the Eocene (Wilcox group) of Tennessee and Mississippi.

Locality: Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Zizyphus townsendi Knowlton

Zizyphus townsendi Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 229, pl. 9, figs. 8, 9, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 889, 1896.

[28] Lesquereux, Leo, On species of fossil plants from the Tertiary of the State of Mississippi: Am. Philos. Soc. Trans., vol. 13, p. 420, pl. 22, figs. 3–5, 1869.

[29] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 282, pl. 71, fig. 1; [excl. pl. 72, fig. 1], 1916.

[30] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 276, pl. 51, fig. 15, 1878.

[31] Idem, p. 275, pl. 51, fig. 13.

[32] 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. 336, pl. 99, figs. 1, 2; pl. 100, fig. 3, 1917 [1918].

This species was based by Knowlton on specimens (U. S. Nat. Mus. no. 3765) collected by C. H. Townsend at Herendeen Bay, Alaska Peninsula, in 1890. It was compared by the author with such species as *Zizyphus serrulatus* Ward [33] and *Z. cinnamomoides* (Lesquereux) Lesquereux.[34] It does not appear to have been recognized except in connection with the type specimens.

Genus PALIURUS Jussieu

Paliurus colombi Heer

Plate 115, figures 5–7

Paliurus colombi Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 279, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 122, pl. 17, fig. 2d; pl. 19, figs. 2–4, 1868.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 230, pl. 9, fig. 2, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 889, 1896.

The first specimen of this species that was recorded from Alaska was collected at Herendeen Bay, Alaska Peninsula, in 1890, by C. H. Townsend, and was described and figured by Knowlton. Our specimens vary considerably in size, but the wide diversity of leaf forms that were included in the species by Heer, after his original description, might justify the inclusion of certain other specimens not so identified, generically or specifically.

If all the specimens referred to the species by Heer [35] are to be regarded as specifically identical it had a distribution in the Arctic region in Tertiary time that included Greenland, Spitsbergen, Siberia, and Sakhalin; and its discovery in Alaska adds another locality to its area of circumpolar distribution.

Outside of the Arctic regions the species has not been identified on the Eurasian continent; but in the United States specimens from Eocene horizons in Wyoming, Montana, and the Yellowstone National Park were described, figured, and referred to the species by Lesquereux,[36] Ward,[37] and Knowlton,[38] and these specimens vary but little among themselves and compare quite satisfactorily with Heer's figures of the type specimens of the species.

Localities: Jaw Mountain, 8½ miles northeast of Gates of Crater, Alaska Peninsula (original no. P–25); collected by W. R. Smith in 1922 (pl. 115, figs. 5, 6). Portage (Balboa) Bay, Alaska Peninsula, shale beds about half a mile north of end of bay (original no. 3); collected by H. M. Eakin in 1908 (lot 5177) (pl. 115, fig. 7).

Paliurus ceterus Hollick, n. sp.

Plate 79, figures 7, 8

Leaves ovate or ovate-oblong, about 5.5 centimeters in length by 3 centimeters in maximum width, rounded to the base, entire; venation consisting of a midrib, two well-defined inner acrodrome lateral primaries that extend upward from the base subparallel with the midrib, and two weaker, poorly defined outer ones that merge into the several secondary veins that branch from the outer sides of the inner lateral primaries.

It is possible that these leaves might be regarded as merely representing a form of *Paliurus colombi* Heer, the species last described, especially if compared with certain figures of broad and large specimens, such as are described and figured by Heer.[39] The prevailing form of the species, however, is characterized by a more or less acute or cuneate base, not a rounded one, as in ours. This rounded base is more nearly represented by leaves of *Paliurus ovoideus* (Goeppert) Heer,[40] but these appear to be distinctly cordate rather than simply rounded. On the whole our leaves appear to be larger, more oblong, and less laterally expanded than any of the specific forms heretofore referred to the genus, and to be worthy of being regarded as specifically distinct.

Incidentally it may be noted that Kryshtofovich [41] identified a leaf strikingly similar to ours, from supposed Cretaceous rocks of Sakhalin, as *Cocculus extinctus* Velenovsky,[42] but any resemblance to Velenovsky's figures is difficult to discern. It appears to be

[33] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 554, pl. 51, figs. 14, 15, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 73, pl. 33, figs. 3, 4, 1887.

[34] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 277, pl. 52, figs. 7, 8, 1878, = *Ceanothus cinnamomoides* Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 289, 1872.

[35] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 122, pl. 17, fig. 2d; pl. 19, figs. 2–4, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 482, pl. 50, figs. 18, 19, 1869; Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 67, pl. 14, fig. 11, 1870; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 91, pl. 31, fig. 8, 1876; Beiträge zur fossilen flora Sibiriens und des Amurlandes, pt. 4, Tertiäre Pflanzen vom Tschirimyi-felsen an der Lena: Idem, vol. 5, no. 2, p. 35, pl. 9, figs. 2a, b, 1878; Miocene flora der Insel Sachalin: Idem, vol. 5, no. 3, p. 52, pl. 13, figs. 1–3, 1878; Die fossilen flora Grönlands, pt. 2: Idem, vol. 7, p. 131, pl. 69, fig. 9; pl. 84, fig. 12; pl. 97, fig. 8, 1883.

[36] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 273, pl. 50, figs. 13–17, 1878.

[37] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 52, figs. 4–6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 75, pl. 33, figs. 8–10, 1887.

[38] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 740, pl. 101, fig. 7, 1899.

[39] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 122, pl. 17, fig. 2d; pl. 19, fig. 4, 1868.

[40] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 76, pl. 121, figs. 58, 59; pl. 122, fig. 30, Winterthur, 1859, = *Ceanothus ovoideus* Goeppert? Die tertiäre Flora von Schossnitz in Schlesien, p. 36, pl. 22, fig. 13, 1855.

[41] Kryshtofovich, African, On the Cretaceous flora of Russian Sakhalin: Imp. Univ. Tokyo Coll. Sci. Jour., vol. 40, art. 8, p. 51, text fig. 8, 1918.

[42] Velenovsky, Josef, Die Flora der böhmischen Kreideformation, pt. 4: Beitr. Paläontologie Österr.-Ungarns u. des Orients, vol. 5, no. 1, p. 64 (3), pl. 29 (6), figs. 1, 3, 1885.

more probable that the geologic age of the rock in which the specimen from Sakhalin was found was not correctly determined.

Localities: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897). Matanuska coal field, 2¼ miles northwest of United States locating monument no. 1, elevation 2,750 feet; collected by G. C. Martin August 12, 1910 (lot 5899) (pl. 79, figs. 7-8).

Family VITACEAE

Genus VITIS Linnaeus

Vitis olriki Heer

Plate 81, figure 2

Vitis olriki Heer, Flora fossilis arctica, vol. 1, p. 120, pl. 48, fig. 1, 1868.

Although our specimen is fragmentary it shows enough of the essential characters of the Eocene Greenland species described and figured by Heer to identify it with reasonable certainty.

The species is not very well known. A single specimen, from the Eocene (?) (Evanston formation) of Wyoming, was described and figured by Lesquereux;[43] an imperfect specimen, from the Tertiary (Miocene?) of Canada, was provisionally identified and listed by Penhallow;[44] and specimens from the Eocene (Raton formation and Dawson arkose) of Colorado, the Raton formation of New Mexico, and the Evanston formation (Eocene?) of Wyoming, were identified and recorded by Knowlton.[45] These are the only previous references to the species, so far as I am aware, other than in connection with the type specimen.

Locality: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565).

Vitis atwoodi Hollick, n. sp.

Plate 80, figure 4

Leaf apparently orbiculate-cordate, about 8 centimeters in length by 8 centimeters in maximum width; margin acutely sublobate, sharply and irregularly serrate-dentate; venation pinnate-subpalmate, craspedodrome; midrib flexed or angled; secondary veins alternate, the lower two spreading, simulating basilar lateral primaries with branches from the under sides, the upper ones ascending and slightly curved upward, diverging at acute angles from the midrib, branched from the under sides distad, each vein terminating in the apex of a lobe and each branch in one of the intermediate dentition; tertiary venation rather pronounced, at right angles to the supporting secondaries and their branches, somewhat bent or almost straight.

This leaf is somewhat similar in appearance to *Vitis olriki* Heer, the species last described, but the sublobate, sharply dentate margin at once serves to distinguish it from Heer's species. The specific name is given in honor of the collector, Mr. W. W. Atwood.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Vitis heeriana Knowlton and Cockerell?

Plate 80, figure 3

Vitis heeriana Knowlton and Cockerell, U. S. Geol. Survey Bull. 696, p. 648, 1919.

Vitis crenata Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 8, fig. 6, 1869.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 228, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 889, 1896.

Not *Vitis crenata* Thunberg, 1825.

Vitis crenata Heer? Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 195, 1898.

This well-defined species was based by Heer on a specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, but, except for a provisional identification by Knowlton of a specimen collected by J. E. Spurr in 1896, at Miller's coal mine, on the Yukon River 25 miles above Minook Creek, the species does not appear to have been heretofore identified otherwise than in connection with the type specimen.

Our specimen is evidently distorted and is too fragmentary for any but provisional identification; but the small piece of crenate-dentate margin preserved at the base and the flexed, irregular character of the venation appear to indicate identity with this species.

Locality: Nenana coal field, Tanana region, Lignite Creek, north side, bluff between two creeks in eastern part of sec. 30, T. 12 S., R. 6 W., burned beds overlying coal (original no. 7); collected by R. M. Overbeck in 1916 (lot 7266) (pl. 50, fig. 3).

Vitis alaskana Cockerell

Vitis alaskana Cockerell, Am. Mus. Nat. Hist. Bull., vol. 24, p. 103, 1908.

Vitis rotundifolia Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 513, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 120, pl. 51, fig. 2 in part; pl. 53, fig. 3, 1898.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 228, 1894; Geol. Soc. America Bull., vol. 5, p. 586, 1894; U. S. Geol. Survey Ann. Rept., pt. 1, p. 889, 1896.

Not *Vitis rotundifolia* Michaux, 1803.

The specimens upon which Newberry based this species were collected by Capt. W. A. Howard, of the United States Revenue Cutter Service, in 1867, at "Admiralty Inlet" [Island?], southeastern Alaska. It

[43] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 241, pl. 41, fig. 8, 1878.

[44] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 96, 1908.

[45] 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. 338, 1917 [1918]; The flora of the Denver and associated formations of Colorado: U. S. Geol. Survey Prof. Paper 155, p. 115, pl. 49, fig. 6; pl. 50, fig. 4, 1930.

has not been identified in any of the collections subsequently made in Alaska and has not been definitely identified from elsewhere. It was listed by Penhallow [46] from British Columbia, but the identification was queried and the author merely stated that "one imperfect specimen of what appeared to be *Vitis rotundifolia* was obtained by Lambe from Quilchena in 1906."

Genus CISSUS Linnaeus

Cissus cissoides (Saporta) Hollick, n. comb.

Plate 80, figure 2

Vitigene cissoides Saporta, Annales sci. nat., sér. 5, Botanique, vol. 3, p. 48, 1865; Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 2, pt. 1, p. 44, 1866.
Cissus primaeva Saporta, Soc. géol. France Mém., vol. 8, no. 3, p. 388 (100), text fig. 16, pl. 31 (10), figs. 10, 11; pl. 32 (11), figs. 1, 2, 1868.

It is with considerable hesitation that I have referred this fragmentary specimen to the species from the Eocene of France, described and figured by Saporta. His figures, however, show a wide variation in size, shape, and other characters, and our specimen certainly appears to resemble very closely his text figure 16, and figure 10, plate 31, above cited. It is quite possible, however, that a more perfect specimen, which would reveal the marginal and basilar characters, might show the Alaska species to be distinct from *C. cissoides*.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Cissus pterospermoides Hollick, n. sp.

Plate 80, figure 1

Leaf apparently broadly obovate-oblong, about 13 centimeters in length by 10 centimeters in maximum width, decurrent at the base; midrib slender above, rather abruptly enlarged at the base, venation tripalmate, from a distance of 1.2 centimeters above the base of the leaf; lateral primaries ascending, diverging at acute angles from the midrib, curved inward distad, extending to almost the same vertical distance as the apex of the leaf, branched from the under side; main secondary veins arranged in four opposite or subopposite pairs, ascending, diverging at acute angles from the midrib; basilar secondaries two in number, weak, opposite, diverging at right angles from the expanded basal part of the midrib; tertiary venation strong, bent or flexed, mostly percurrent to the midrib and the supporting secondaries, or branchlike and ascending at acute angles from the lower or outer distal part of the secondaries, the interspaces crossed and intersected by fine veinlets.

[46] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 96, 1908.

It is unfortunate that no portion of the margin of this leaf was preserved. The general character of the venation, however, is strongly suggestive of that of leaves that have been referred to the genus *Cissus*, and the base and general shape of the leaf suggests the genera *Credneria* and *Pterophyllum*. On the whole I am rather inclined to compare it with *Cissus primaeva* Saporta,[47] especially with his figure 1 on plate 32 (11), representing a specimen from the Eocene of France. This represents a leaf that is much larger than ours, but others of his figures represent much smaller leaves.

It may also be noted that there is a suggestive resemblance between our specimen and one from Greenland originally described and depicted as *Ficus? grönlandica* Heer [48] but subsequently included by the author under *Pterospermites alternans* Heer.[49] However, in view of the imperfect condition of our specimen and the impossibility of making critical or satisfactory comparisons with other described species, it would seem best merely to note apparent resemblances, pending the possible discovery of more perfect material for study and comparison.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Order MALVALES

Family ELAEOCARPACEAE

Genus ELAEOCARPUS Linnaeus

Elaeocarpus alaskensis Hollick, n. sp.

Plate 80, figure 5

Leaf apparently narrowly oblong-ellipsoidal; margin entire or remotely and obscurely denticulate; venation simply pinnate; secondary veins irregularly disposed and spaced, diverging at obtuse angles from the midrib, bent more or less abruptly distad, connecting in a series of irregularly bent and angled loops.

This leaf is, to all appearances, generically identical with *Elaeocarpus photinaefolia fossilis* Nathorst,[50] from recent Tertiary (Pliocene) deposits of Japan, and with leaves which Florin [51] referred directly to the existing Japanese species *Elaeocarpus photinaefolia* Hooker and Arnott. The resemblance of our specimen to Florin's figure 14 is so close that they might well be regarded as specifically identical.

[47] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., vol. 8, no. 3, p. 388 (100), text fig. 16, pl. 3 (10), figs. 10, 11; pl. 32 (11), figs. 1, 2, 1868.

[48] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 111, pl. 49, fig. 8, 1868.

[49] Heer, Oswald, Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 480, 1869.

[50] Nathorst, A. G., Contributions à la flore fossile du Japon: K. svenska vet.-akad. Handl., vol. 20, no. 2, p. 64, pl. 9, fig. 5, 1883.

[51] Florin, Rudolf, Zur Kenntniss der jungtertiären Pflanzenwelt Japans: K. svenska vet.-akad. Handl., vol. 61, no. 1, pp. 25, 33, pl. 5, figs. 1–3; pl. 6, figs. 14, 14a, 1920.

The genus *Elaeocarpus* has not heretofore been recorded from the New World as a fossil, and in our existing flora it is an exclusively Old World genus, with a distribution that includes eastern and southeastern Asia, parts of Australasia, Japan, and Hawaii. Several species, however, have been described from the Tertiary of Europe as well as Japan, and its discovery as an element in the Tertiary flora of Alaska is in line with the discovery of other generic and specific elements that indicate a close relationship between the Tertiary floras of eastern Asia and northwestern North America.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821).

Family TILIACEAE

Genus TILIA Linnaeus

Tilia malmgreni Heer

Plate 103, figure 1c

Tilia malmgreni Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 23, no. 6, p. 151, 1866; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 160, pl. 33, figs. 1, 2, 1868; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 84, pl. 19, fig. 18; pl. 30, figs. 4, 5, 1877; Die Miocene Flora des Grinnell-Landes: Idem, vol. 5, no. 1, p. 37; pl. 9, figs. 7, 8, 1878; Beiträge zur Miocenen Flora von Nord-Canada: Idem, vol. 6, pt. 1, no. 3, p. 17, pl. 3, figs. 2, 3, 1880.

Our specimen, although somewhat imperfect, compares so closely with the smaller forms of this species that I have little hesitation in regarding them as specifically identical. The rather remarkable long petiole, in particular, that is a prominent character in several of Heer's figures, may be seen also in the figure of our specimen.

Another Arctic species that is, apparently, closely related to *Tilia malmgreni* is *T. sachalinensis* Heer,[52] from Sakhalin; and the figures of the imperfectly defined species *T. alaskana* Heer,[53] from Alaska, may be compared with certain of the larger figures of *T. malmgreni*.

The previously known distribution of *Tilia malmgreni* included Spitsbergen, Grinnell Land, and the Mackenzie River region of Canada, and the closely allied species *T. sachalinensis* was found on the island of Sakhalin, in eastern Asia; hence Alaska would seem to be a locality or region in which *T. malmgreni* might well be expected to occur.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

[52] Heer, Oswald, Die Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 47, pl. 12, figs. 6, 7, 1878.
[53] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 10, figs. 2, 3, 1869.

Tilia alaskana Heer

Tilia alaskana Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 10, figs. 2, 3, 1869.

Two fragmentary leaf specimens, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, represent the material upon which Heer based the description and illustration of this species. It was not subsequently recognized from elsewhere than the type locality by Heer or any other author, so far as I am aware; but it would not be possible, in any event, to identify satisfactorily such fragmentary material as either identical with or different from other similar material. Heer noted its resemblance to *Tilia malmgreni* Heer [54] from Spitsbergen, and briefly remarked: "Sed dentibus majoribus discrepat."

Tilia grewioides Hollick, n. sp.

Plate 81, figures 4, 5

Leaves ovate or orbiculate, cordate, petiolate, about 6 centimeters in length by 5 to 6 centimeters in maximum width; margin crenate-serrate dentate; venation palmate from the base, pinnate above, craspedodrome; lateral primaries two on each side, the upper or inner pair the strongest, diverging at acute angles from the midrib, curved upward and ultimately inward, the lower or outer pair diverging at obtuse, almost right angles from the midrib, curved upward, all branched from their under sides, the branches branched in a similar manner; secondary veins three on each side, the lower ones opposite or subopposite, all at acute angles with the midrib and curving upward subparallel with the inner lateral primaries.

This species is strongly suggestive of certain fossil leaves that were referred to *Grewia crenata* (Unger) Heer [55] by Heer, but in our species the venation is strictly craspedodrome throughout and the secondary veins are well defined and are coordinate with, not subsidiary to, the lateral primaries.

The venation is about equally suggestive of *Grewia* and *Tilia*, and the foliar outline suggests either genus about equally well, but I have failed to find any description or figure of a fossil species in either genus with which they may be satisfactorily compared.

The species that appears to approach ours most closely is *Tilia distans* Nathorst,[56] from the Tertiary of Japan, although a fragment of a basal part of a leaf from the Tertiary of the Mackenzie River region in Canada, identified as *Tilia malmgreni* Heer [57] by Heer, is almost exactly like the similar parts of our

[54] Heer, Oswald, Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 160, pl. 33, figs. 1, 2, 1868.
[55] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 42, pl. 110, figs. 3, 6, Winterthur, 1859.
[56] Nathorst, A. G., Contributions à la flore fossile du Japon: K. svenska vet.-akad. Handl., vol. 20, no. 2, p. 65, pl. 6, figs. 5–13, 1883.
[57] Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, no. 3, p. 17, pl. 3, fig. 2, 1880.

specimens. This fragment, however, does not compare satisfactorily with the type specimen from Spitsbergen as described and figured by Heer,[58] and although it is difficult to consider them as belonging to one and the same species the specific identity of the Mackenzie River specimen with ours from Alaska might be recognized.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Tilia notabilis Hollick, n. sp.

Plate 82

Leaf 2.2 decimeters or more in length by about 1.8 decimeters in maximum width, apparently ovoid, with a rounded base and a cuneate apex; margin finely dentate, the dentition consisting of widely separated, relatively large teeth, with smaller ones between; venation pinnate-subpalmate, craspedodrome; secondary veins 7 or 8 on each side, opposite or subopposite, except the 5 or 6 irregularly disposed distal ones, all diverging at acute angles from the midrib, at least one of the lowest pair simulating a lateral primary, branched from the under side from proximal to distal extremity, the next above branched three times from the under side, the next two branched twice each in a similar manner, the next one once, the upper ones simple, each vein terminating in one of the major dentitions, each branch and branchlet terminating in one of the minor ones; tertiary veins fine, almost straight, curved, or bent, approximately at right angles to the midrib and supporting secondaries and their branches throughout.

A careful examination of this specimen indicates so close a resemblance to the similar part of a large *Tilia* leaf that I have but little hesitation in referring it to that genus. The marginal dentitions and the characters of the venation are identical, and the trend of the outline in the lower part of the leaf indicates a rounded or cordate basal extension to this part.

Well-defined leaves of the genus, from the Tertiary rocks of Spitsbergen, Grinnell Land, and the Mackenzie River region of Canada, were described and figured by Heer[59] under the name *Tilia malmgreni*, in which the generic characters may be seen to compare satisfactorily with those preserved in our specimen, but even the largest of Heer's specimens,[60] from Spitsbergen, appears small compared with ours. I have, however, seen leaves growing on vigorous young shoots and saplings of *Tilia* trees in cultivation that were almost as large as the fossil leaf from Alaska. Heer[61] also described and figured some fragmentary leaf remains from the Tertiary of Alaska under the name *Tilia alaskana*, which he compared with his *T. malmgreni*, but remarked that the coarser dentition of *T. alaskana* served to differentiate them. Other leaf remains, closely similar to *T. alaskana*, from the Tertiary of Sakhalin, were described and figured by the same author[62] under the name *T. sachalinensis*. The fossil species that appears to approach ours most closely is *Tilia speciosissima* Knowlton,[63] from the Eocene of Colorado, which is larger than either of the three species described by Heer, but only about two-thirds the size of ours.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Tilia sp.? Hollick

Plate 81, figure 6

This fragmentary leaf is too imperfect for specific description, but the indications appear to be that, except for its smaller size, it was similar to *Tilia notabilis*, the species last described, and this inference is strengthened by the fact that they are both included in the same collection. It may be merely a small form of that species.

Locality: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Genus GREWIA Linnaeus

Grewia crenata (Unger) Heer

Plate 84, figure 1

Grewia crenata (Unger) Heer, 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.

Ficus crenata (Unger) Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, p. 14, pl. 6, figs. 3–5. 1860.

Whatever may be thought of the specific identity of Unger's *Ficus crenata* with the leaves subsequently referred to the species by Heer, there can be little doubt that our specimen and others recorded from elsewhere in the New World are specifically identical with those from the Tertiary of Switzerland so referred by Heer. The particular specimen with which

[58] Heer, Oswald, Miocene Flora von Spitsbergen: Flora fossilis arctica, vol. 1, p. 160, pl. 33, figs. 1, 2, 1868.

[59] Heer, Oswald, Om de af A. E. Nordenskiöld och C. W. Blomstrand på Spetsbergen upptäckta fossila växter: K. svenska vet.-akad. Öfvers. Förh., vol. 23, no. 6, p. 151, 1866; Miocene Flora von Spitzbergen: Flora fossilis arctica, vol. 1, p. 160, pl. 33, figs. 1, 2, 1868; Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 65, 1870, Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 84, pl. 19, fig. 18; pl. 30, figs. 4, 5, 1876; Die Miocene Flora des Grinnell-Landes: Idem, vol. 5, no. 1, p. 37, pl. 9, figs. 7, 8, 1878; Beiträge zur Miocenen Flora von Nord-Canada: Idem, vol. 6, pt. 1, no. 3, p. 17, pl. 3, figs. 2, 3, 1880.

[60] Idem, vol. 1, pl. 33, fig. 2.

[61] Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 10, figs. 2, 3, 1869.

[62] Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 47, pl. 12, figs. 6, 7, 1878.

[63] 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. 336, pl. 66, 1917 [1918].

ours may be most closely compared is represented by Heer's figure 3, plate 110, with a deeply cordate, almost auriculate base.

The species was recorded from the Eocene of Montana, and a specimen was described and figured by Ward.[64] Other specimens, from the Miocene (?) of Oregon, were described and figured by Newberry;[65] were recorded from the same region, but not figured, by Knowlton;[66] and were recorded from southwestern Canada by Penhallow.[67]

The resemblance of certain forms of the species to *Populus zaddachi* Heer[68] cannot be ignored in any critical comparison of the two species, and in many instances it is exceedingly difficult, if not impossible, to differentiate satisfactorily between them, or to decide to which species a certain figure should be referred. Nearly every author who has had occasion to study and compare the two species has discussed this difficulty; and it may be pertinent to remark, in this connection, that I have been somewhat influenced in referring our specimen to *Grewia crenata* rather than to *Populus zaddachi* by the fact that the genus *Grewia* is abundantly represented in the fossil flora of the locality by the closely related species next described, whereas no specimen of *Populus zaddachi* has been recognized in it.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

Grewia orbiculata Hollick, n. sp.

Plate 83, figures 1–4; plate 84, figures 3–5

Leaves orbicular or suborbicular, varying in diameter from 4.75 to 12 centimeters, cordate to cordate-auriculate at the base; margin coarsely crenate, mostly from about the middle upward, entire or undulate below; venation 5- or 7-palmate from the base; lateral primaries consisting of one strong inner or upper pair and one or occasionally two weaker outer or lower pairs, the inner pair starting at acute angles of divergence from the midrib, soon bending inward and extending upward subparallel with the midrib, the outer pair or pairs divergent or bent downward, simulating or approximating basilar branches or secondaries of the inner pair, all irregularly branched from their outer or lower sides, the branches becoming camptodrome, with tertiary veinlets extending from the loops to the marginal crenations and undulations; secondary veins weak, irregularly disposed, two on each side of the upper part of the midrib, from which they diverge at various angles and ultimately merge into the tertiary venation, through which they connect with the inner lateral primaries and midrib.

This species is so closely like *Grewia crenata* (Unger) Heer, the species last described, that I was at first inclined to regard them as specifically identical. Most of our specimens, however, are much larger than any figured specimens of *G. crenata*, and even our smallest are about the size of the largest elsewhere depicted. They are also more rounded or orbicular and are not inequilateral or oblique at the base.

Our specimens appear to compare more nearly with the type figures of *Ficus* [*Dombeyopsis*] *crenata* Unger[69] than with any of the published figures of *Grewia crenata* (Unger) Heer by Heer or any of the several other authors who have depicted specimens of the species, and it is of interest to note that Unger[69a] protested against the merging of the two species by Heer in the following words:

> Herr O. Heer zieht meine *Dombeyopsis crenata* zu seiner *Grewia crenata*. Es steht mir kein Urtheil über die Schweizer Petrefacte zu; was aber die in rede stehende Pflanze von Trofaiach betrifft, so spricht der lange Blattstiel und die deutliche Kerbung des Blattrandes, offenbar gegen eine Vereinigung mit *Grewia*, die sich durch kurzgestielte Blätter und scharfe Zahnung des Randes vor allen ähnlichen Formen auszeichnen.

American specimens of *Grewia crenata* were described and figured by Ward[70] and by Newberry,[71] and a comparison of these figures with those by Heer clearly indicates specific identity; but they could hardly be regarded as anything more than generically related to ours. Specimens from Spitsbergen, however, referred by Heer[72] to *Grewia crenata*, are so closely similar to our smaller specimens that they might be regarded as specifically identical; and the same might be said of his *Grewia crenulata*,[73] which is almost indistinguishable, as far as the figures are concerned, from the associated figures of *G. crenata*. Our specimens also closely resemble *Grewia auriculata* Lesquereux,[74] from the Miocene of Oregon, which Lesquereux compared with *G. crenulata* and remarked

[64] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 54, fig. 13, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 85, pl. 39, fig. 1, 1887.

[65] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 46, fig. 2; pl. 48, figs. 2, 3, 1898.

[66] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 80, 1902.

[67] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 58, 1908.

[68] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 307, 1859; Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 98, pl. 6, figs. 1–4; pl. 15, fig. 1b. 1868.

[69] Unger, Franz, Genera et species plantarum fossilium, p. 448, Vienna, 1850 (=*Dombeyopsis crenata*); Sylloge plantarum fossilium: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 19, p. 14, pl. 6, figs. 3–5, 1860.

[69a] Idem (Sylloge), p. 15.

[70] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 54, fig. 13, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 85, pl. 39, fig. 1, 1887.

[71] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 46, fig. 2; pl. 48, figs. 2, 3, 1898.

[72] Heer, Oswald, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 84, pl. 19, figs. 12a–14, 1876.

[73] Idem, p. 85, pl. 16, fig. 9b; pl. 19, figs. 16, 17.

[74] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 252, pl. 55, fig. 1, 1883.

that "it may be the same species." Recognition or nonacceptance of specific and varietal differences, in connection with leaves as closely alike as ours and those of the two species last mentioned, may be regarded as merely an expression of personal opinion.

Localities: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 83, figs. 1–4; pl. 84, figs. 3, 4). Yukon River, north bank, at Drew's mine, central Yukon region (original no. 14); collected by W. W. Atwood in 1907 (lot 4708) (pl. 84, fig. 5).

Grewia zizyphoides Hollick, n. sp.

Plate 84, figure 2

Leaf lanceolate-ovate, about 4.75 centimeters in length by 3.75 centimeters in maximum width, rounded or somewhat cordate at the base; margin finely serrate-dentate, except at the base, where it is entire; venation 5-palmate from the base, consisting of a midvein and two pairs of lateral primaries, the inner pair stout, diverging at acute angles from the base of the midrib, soon bent and continuing upward almost parallel with the midrib, irregularly branched on the outer sides, the branches merging by a series of loops into the obscurely defined outer pair of lateral primaries, which thin out and disappear close to the margin just above the middle of the leaf; secondary veins obscure, weak, irregularly spaced, connecting the upper part of the midrib with the inner pair of lateral primaries; ultimate venation craspedodrome through veinlets extending from the marginal loops to the dentitions.

This leaf, to which I have given a new specific name, appears to be specifically identical with one from the Eocene (Fort Union formation) of Montana referred to *Grewia crenata* (Unger) Heer by Ward.[75] The symmetry of these leaves and their sharply dentate instead of crenate margins certainly serve to differentiate them specifically from *Grewia crenata* as defined and figured by Heer,[76] and in this connection it is interesting to note the opinion expressed by Ward,[77] in his discussion on the specimen mentioned:

> The parts of the leaf that are present are very perfectly preserved, and upon close inspection it appears that the margins, instead of being crenate, are minutely sharply serrate, the teeth being usually provided with short nervelets from the arches of the secondary system. Whether this is sufficient to remove it from this species or even from the genus I will not now attempt to decide. Should the latter be necessary the Rhamneae would seem to be the order into which it must find its way, where it will find analogs in *Paliurus, Ceanothus, Zizyphus*, etc.

[75] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 54, fig. 13, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 85, pl. 39, fig. 1, 1887.

[76] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 42, pl. 109. figs. 12, 12b, 12c; pl. 110, figs. 1–11, Winterthur, 1859.

[77] Ward, L. F., op. cit. (Bull. 37), pp. 85–86.

I am also inclined to think that certain leaves from the upper Eocene (Clarno formation) of Oregon, referred to *Grewia crenata* by Newberry,[78] should be included in the same category with Ward's specimen from Montana and with ours from Alaska. Generically their relationship appears to be with *Grewia* as paleobotanically recognized, although it is difficult to differentiate them from certain species described and figured under the genus *Zizyphus*, as for example *Z. meekii* Lesquereux,[79] in regard to which the author remarked that it "is comparable also by the shape of the leaves to *Grewia crenata* of Heer."

We may also compare our figure with those referred to *Grewia crenata* by Engelhardt,[80] from the Tertiary of Bohemia, and, if Engelhardt's identifications are accepted, we must include our specimen with his under that name.

The differentiation or segregation of *Grewia crenata*, *G. orbiculata*, and *G. zizyphoides* may, for the present, be regarded as open to discussion.

Locality: Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Genus GREWIOPSIS Saporta

Grewiopsis grandiculus Hollick, n. sp.

Plate 87, figure 1

Leaf ovate-oblong, about 13.5 centimeters in length by 8.75 centimeters in maximum width, at about the middle, petiolate, broadly cuneate at the base; margin entire at the base, finely wavy dentate and wavy undulate above; venation pinnate; secondary veins six or more on each side, irregularly spaced and disposed, ascending, diverging at acute angles from the midrib, the lower two opposite, with irregularly disposed and spaced branches from the under sides that form various angles with their supporting veins and terminate in the adjacent marginal inequalities, the upper ones branched distad from their under sides, all apparently camptodrome; tertiary venation bent, flexed, forked, and subtending various angles with the secondaries.

The imperfect condition of this specimen renders complete description of its characters impossible. The apical portion is lacking, and the margin, in its upper part, is not clearly defined. It appears to be entire and undulate. This appearance, however, may be due to infolding; and a dentate condition similar to that of the part immediately below might have existed. If such was the actual condition, then the secondaries and

[78] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 46, fig. 2; pl. 48, figs. 2, 3, 1898.

[79] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 275, pl. 51, figs. 10–14, 1878.

[80] Engelhardt, Hermann, Die Tertiärflora des Jesuitengrabens bei Kundratitz in Nordböhmen: K. leop.-carol. deutsch. Akad. Naturf. Nova acta, vol. 48, no. 3, p. 347 (51), pl. 17 (10), figs. 33–35; pl. 18 (11), figs. 20, 24, 25; pl. 19 (12), figs. 1–4, 1885.

their branches would probably terminate in the dentitions. In that event we should have a leaf similar in appearance and general characters to *Grewiopsis credneriaeformis* (Saporta) Saporta,[81] from the Eocene of France. Generic relationship, at least, appears to be strongly indicated, if comparison is made between the two figures, and it is possible that other specimens from Alaska and France, more perfect than those figured, might indicate mutual specific identity.

Locality: Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Grewiopsis frustratorius Hollick, n. sp.

Plate 86, figure 1

Leaf ovate-oblong or ellipsoidal, about 13 centimeters in length by 10 centimeters in maximum width, long-petiolate, rounded toward and apparently abruptly truncate at the base; petiole 4 centimeters in length; venation pinnate; secondary veins irregularly alternate, ascending, more or less flexuous, branched from their under sides distad, craspedodrome, 5 or 6 on each side of the midrib and diverging from it at acute angles, the two lowest with 5 or 6 branches from the under sides that form acute angles with their supporting veins and terminate in the inequalities of the margin; margin entire and undulate below, becoming undulate or wavy-dentate above, the dentitions receiving the termini of the main veins and their branches; tertiary venation obscure, apparently almost straight or somewhat flexed and at right angles to the secondaries throughout.

The imperfect condition of this specimen renders accurate description or satisfactory comparison with other figured species impossible. In shape it is, apparently, more or less comparable with *Grewiopsis grandiculus*, the species last described, except for the rounded truncate base. It may also be compared with one of the figures of *Grewiopsis populifolia* Ward,[82] from the Eocene of Montana. The much smaller size of that species, however, would seem to eliminate it from further consideration.

Grewiopsis defectivus Hollick, n. sp.

Plate 86, figure 2a

Leaf ovate-ellipsoidal, about 15 centimeters in length by about 10 centimeters in maximum width, cuneate and somewhat decurrent at the base; venation pinnate; secondary veins opposite or subopposite, ascending, branched from their under sides distad, craspedodrome, apparently 5 on each side of the midrib and diverging from it at acute angles, the lowest pair suprabasilar, with a minor pair of basilar veins below and 4 or more branches that spring from and form acute angles with the under sides, the branches apparently becoming camptodrome close to the margin; margin entire below, remotely dentate above, the dentitions receiving the termini of the secondaries and their branches; tertiary venation subtending various angles with the midrib and secondaries, the veins flexed, bent, or forked.

This specimen, like the one last described, is so imperfectly preserved that accurate and satisfactory comparison with other figured species is not possible. In common with *Grewiopsis frustratorius*, it also is suggestive of *G. grandiculus* Hollick (see p. 147), and there is also no very great difference between our specimen and *G. populifolia* Ward[83] and *G. viburnifolia* Ward,[84] from the Eocene of Montana; but these may all be distinguished from our specimen by the smaller size of their leaves and, with the exception of *G. viburnifolia*, by their conspicuously broader bases. In connection with these species it is interesting to note Ward's remark[85] that "these three impressions [*G. populifolia*] * * * are perhaps sufficiently similar to be grouped together as one species, and it is possible that the form last described [*Grewiopsis viburnifolia*] * * * may belong with it. * * * They have a strong general resemblance to the larger Sezanne forms (*G. credneriaeformis* Saporta, *G. anisomera* Saporta, and *G. tiliacea* Saporta)."

Locality: South side near the head of Hamilton Bay, Kupreanof Island, southeastern Alaska, intermediate of three horizons (original no. IV); collected by W. W. Atwood in 1907 (lot 4391).

Grewiopsis congerminalis Hollick, n. sp.

Plate 85, figures 5, 6

Leaves elliptical-ovate, from 9 to 11 centimeters in length by 5 to 8 centimeters in maximum width, rather abruptly narrowed above to an acute or acuminate apex, curved below to a cuneate, somewhat decurrent base; margin sinuate-dentate toward the apex, the teeth becoming less conspicuous and wider apart proximad and wanting in the basal region; venation pinnate-subpalmate, craspedodrome; secondary veins diverging at acute angles from the midrib, ascending mostly opposite or subopposite or the upper ones alter-

[81] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., vol. 8, no. 3, p. 404 (116), pl. 24 (13), fig. 7, 1868, =*Sezannia credneriaeformis* Saporta, Annales sci. nat., sér. 5, Botanique, vol. 3, p. 45, 1865; Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 2, pl. 1, p. 41, 1866.

[82] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 55, fig. 10, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 90, pl. 40, fig. 5, 1887.

[83] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th 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.

[84] Idem (6th Ann. Rept.), p. 555, pl. 55, fig. 7; (Bull. 37), p. 89, pl. 40, fig. 2.

[85] Idem (Bull. 7), p. 91.

nate, lower pair simulating lateral primaries, suprabasilar, curved or bent outward and more or less flexed, branched from the under sides, next two above branched three times from the under sides distad, the next two twice branched in a similar manner, those above once branched or simple, each main vein and branch terminating in one of the marginal dentitions; tertiary venation curved, bent, flexed, forked, and connected by cross venation, forming a network of irregular-shaped, coarse, and fine areolae in the interspaces between the secondaries and between their branches.

These leaves, which I have ventured to describe as representing a new species, are similar in appearance to one of the leaves described and figured by Ward[86] under the name *Grewiopsis populifolia.* This particular leaf is represented by his figure 9, plate 55, and figure 4, plate 40, and if these were the only representations of the species it would be difficult to differentiate our leaf from them; but the other leaves that are figured and included in the original description differ considerably and could hardly be regarded as specifically identical with ours.

Localities: Upper Yukon region, Seventymile Creek, half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 85, fig. 5).

Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519) (pl. 85, fig. 6).

Grewiopsis alaskana Hollick, n. sp.

Plate 85, figures 1–4

Leaves ovoid, about 6.5 centimeters in length by 5.5 to 6 centimeters in width across the middle, cordate or truncate at the base, blunt at the apex; margin entire near the base, crenate-dentate above; venation pinnate, campto-craspedodrome; midrib slightly curved, apparently bent to one side at the apex; lowest secondary veins basilar, opposite, with 5 or more branches from their under sides; upper secondaries subopposite and alternate, irregularly spaced, all forming almost uniform angles of 40° to 45° with the midrib, flexuous, occasionally branched from the under side toward their extremities, curving upward, the lower ones becoming camptodrome, with veinlets extending from the loops to the adjacent marginal dentitions, the upper ones craspedodrome.

This species resembles *Grewiopsis populifolia* Ward,[87] from the Eocene (Fort Union formation) of Montana, more especially his figure 10, plate 55, and figure 5, plate 40. The generic identity of our leaves with these is unmistakable, but the bases of Ward's specimens are more or less abruptly cuneate and, with the exception of those shown in his figures 10 and 5, are much larger than ours. The Alaska leaves may also be seen to resemble *Grewiopsis orbiculata* (Saporta) Saporta,[88] from the Eocene of France, but this species is much smaller than ours.

Localities: Chignik, about 200 yards south of native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519) (pl. 85, fig. 1). Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 85, figs. 2–4).

Genus APEIBOPSIS Heer

Apeibopsis? discolor (Lesquereux) Lesquereux

Plate 81, figure 3

Apeibopsis? discolor (Lesquereux) Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 259, pl. 46, figs. 4–7, 1878.

Rhamnus discolor Lesquereux, U. S. Geol. Survey Terr. Ann. Rept. for 1872, p. 398, 1873.

Rhamnus? discolor Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 280, pl. 52, fig. 17, 1878.

The single specimen of this species from Alaska agrees more or less satisfactorily with Lesquereux's figure 6, from the Eocene of Wyoming. It does not appear to have been recorded heretofore from elsewhere than the original stations in Wyoming.

Locality: Near summit of mountain 3 miles south of east end of King Salmon Lake, Alaska Peninsula (original no. 24); collected by W. R. Smith in 1922.

Family MALVACEAE

Genus ABUTILON Gaertner

Abutilon eakini Hollick, n. sp.

Plate 118, figure 3

Leaf cordate, apiculate, petiolate, 10.5 centimeters in length by 9.5 centimeters in maximum width; margin irregular, coarsely crenate-dentate; venation tripalmate from the base, craspedodrome; lateral primaries ascending, with 7 or more secondaries curving upward from the outer side, with similar tertiary veins toward their extremities, each terminating in a marginal dentition; secondaries from the midrib irregularly disposed and spaced, diverging at obtuse angles, the lower ones connecting with the inner sides of the lateral primaries, the upper ones ascending, curved inward and apparently terminating in the margin; petiole stout.

This specimen was at first compared with certain leaves that had been referred to the genus *Populus*,

[86] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th 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.

[87] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th 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.

[88] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, no. 3, p. 411 (123), pl. 32 (9), figs. 11, 12, 1868.

such as *P. nebrascensis* Newberry [89] and, in particular, *P. nebrascensis grandidentata* Lesquereux,[90] as far as may be determined by Lesquereux's description, which was not accompanied by any illustration. Whatever may be thought, for or against the possible generic relationship between our specimen and those above cited, I am inclined to believe that the characters of our specimen indicate relationship with *Abutilon* or some other genus of the Malvaceae, rather than with *Populus*.

The specific name is given in recognition of the work of the collector, Mr. H. M. Eakin.

Locality: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186).

Abutilon sp.?

Plate 31, figure 3b

This specimen is too fragmentary for either description or satisfactory comparison, but it is suggestive of the Malvaceae and may be generically related to *Abutilon eakini*, the species last described. The portion of the leaf that is preserved has strong and well-defined characters, which should serve to identify it in the event of a more perfect specimen being found.

Locality: Chignik River opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298).

Family BOMBACACEAE

Genus HAMPEA Schlechtendahl

Hampea conditionalis Hollick, n. sp.

Plate 118, figure 1

Leaf ovate-lanceolate, 11 centimeters in length by 7 centimeters in maximum width, tapering above to an acuminate, narrowly cuneate apex, rounded below to a broadly convex base, petiolate; petiole 3 centimeters or more in length; margin entire or, possibly, minutely crenulate-dentate; venation tripalmate from a distance of about 3 millimeters above the base, apparently camptodrome throughout; lateral primaries diverging at acute angles from the midrib, curving upward and joining the lower secondary veins close to the margin, at a distance of about 2 centimeters from the apex, branched from their under or outer sides, the branches ascending, curving upward, and becoming camptodrome close to the margin; secondary veins irregularly disposed and spaced, diverging at angles of about 45° from the midrib, curved or bent rather abruptly upward and merging into one another close to the margin, the lower ones alternate, the upper two pairs opposite; tertiary veins more or less curved or flexed, occasionally branched, and approximately at right angles to the supporting primaries and secondaries throughout.

The validity of this species may perhaps be questioned, as it is closely similar in its main characters to *Protoficus crenulata* Saporta,[91] from the Eocene of France, from which it is distinguishable only by the character of the margin, which in ours is entire or so minutely dentate as to appear entire, whereas in Saporta's species the margin is conspicuously dentate except in its lower part, where it is entire.

It has also a surficial resemblance to the leaf described and figured under the name *Cinnamomum mississippiense* Lesquereux,[92] from the Eocene of Mississippi, and here again the question of possible mutual specific identity would appear to depend mainly upon the character of the margin in Lesquereux's leaf, which is entire throughout. Our specimen, however, does not appear to be a *Cinnamomum*, and the genus *Protoficus* has no definite systematic status. The specimen may, however, be satisfactorily compared with leaves of certain existing species of the malvaceous genus *Hampea*, a genus of tropical distribution, and I have decided so to refer it.

Localities: Yakutat-Copper River region, Yakutat Bay, west shore at Dalton's coal outcrop (original no. 141); collected by R. S. Tarr in 1905 (lot 3879) (pl. 118, fig. 1). Talus slope at base of cliff, Kings River, east bank at coal camp 7 miles above mouth, Matanuska coal field, Matanuska-Cook Inlet region; collected by F. J. Katz for G. C. Martin August 9, 1910.

Family STERCULIACEAE

Genus PTEROSPERMITES Heer

Pterospermites spectabilis Heer

Plate 87, figure 2; plate 88, figure 2; plate 89, figures 2, 3

Pterospermites spectabilis Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 480, pl. 43, fig. 15b; pl. 53, figs. 1–4a, 1869.

Our specimen agrees perfectly, except in its larger size, with Heer's figure 15b, plate 43. Our leaf, if entire, would be about 13 centimeters in length by about 10 centimeters in maximum width, whereas Heer's figure measures about 7.5 by 4.5 centimeters. His subsequent figures (pl. 53, figs. 1–4a), however, represent leaves that must have been fully as large as ours, and fragmentary remains from the Mackenzie River region in Canada, indicate leaves of even larger

[89] Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, pt. 1, p. 62, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 47, pl. 27, figs. 4, 5, 1898.

[90] Lesquereux, Leo, Fossil plants collected at Golden, Colo.: Harvard Coll. Mus. Comp. Zoology Bull., vol. 16, no. 3, p. 47, 1888. Not *Populus grandidentata* Michaux, 1803.

[91] Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., vol. 8, no. 3, p. 355 (67), pl. 27(6), fig. 5, 1868.

[92] Lesquereux, Leo, in Dana, J. D., Manual of geology, p. 513, fig. 794, 1863; On species of fossil plants from the Tertiary of the State of Mississippi: Am. Philos. Soc. Trans., vol. 13, p. 418, pl. 19, fig. 2, 1869.

size.[93] The species is not recorded from elsewhere than Greenland, Canada, and Alaska, so far as I am aware.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, strata beneath coal, Kings River; collected by Sidney Paige and Adolph Knopf in 1906 (lot 3955) (pl. 87, fig. 2). Yukon River, south bank, 2 to 4 miles above Rampart, central Yukon region (original no. 15); collected by W. W. Atwood and H. M. Eakin in 1907 (lot 4710) (pl. 88, fig. 2). Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot no. 3519) (pl. 89, fig. 2). Upper Yukon region, Seventymile Creek, half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 89, fig. 3).

Pterospermites alternans Heer

Plate 88, figure 1

Pterospermites alternans Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 480, pl. 54, fig. 3, 1869.

It is very doubtful if this species should be regarded as distinct from *Pterospermites spectabilis* Heer, the species last described, for the reason that the only difference appears to be in connection with the lateral primaries, or " first strong secondary nerves " as designated by Heer, which are described as " opposite " in *P. spectabilis* and " not opposite " in *P. alternans.*

Incidentally, in his discussion of *P. alternans*, Heer remarked that " This and the large leaf figured in my ' Flora arctica ' (pl. 49, fig. 8)[94] belong to the same species. * * * Plate 13, figures 2–5, of my ' Flora arctica '[94] belong, I believe, to this species." And in his discussion of *Ficus? grönlandica*[95] he stated that " In my ' Flora arctica ' I have unfortunately placed two species under this name. Plate 13, figure 6, is correct; the other [figs. 1–5?] belongs, I believe, to *Pterospermites.*"

All Heer's specimen's came from the Tertiary rocks of Greenland, and the species, apparently, has not been recorded from elsewhere. There can be little question, however, in regard to the specific identity of the Alaska specimen with those from Greenland, and I am also inclined, in accordance with Heer's description of *Pterospermites alternans*, to include in the species one of his figures designated *P. spectabilis*,[96] representing a specimen from the Eocene of the Mackenzie River region in Canada, in which the two basal secondaries are depicted as distinctly not opposite. If it were not for Heer's apparent intention to maintain the two slightly different forms as specifically distinct, I should not have questioned their mutual specific identity.

Locality: Upper Yukon region, Seventymile Creek, half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711).

Pterospermites imparilis Hollick, n. sp.

Plate 89, figure 1; plate 90, figure 1

Leaf oblong, about 12 centimeters in length by 9 centimeters in maximum width, auriculate-cordate at the base, petiolate; petiole stout, becoming broader proximad; venation pinnate, camptodrome; midrib somewhat flexed, becoming conspicuously stout proximad; secondary veins 4 or 5 on each side of the midrib, irregularly spaced and disposed, more or less branched from their under sides, diverging at acute angles from midrib, ascending, the extremities and branches becoming camptodrome, lowest two subopposite, basilar, one conspicuously stouter than the other; tertiary venation curved, bent, and occasionally forked, and connected by cross venation at various angles.

This leaf is either distorted or naturally inequilateral, and the secondary veins are apparently stouter on one side of the midrib than on the other, but the uncertainty that these represent normal characters renders it inadvisable to consider or to describe them as specific. In general appearance it is strongly suggestive of *Pterospermites whitei* Ward,[97] from the Eocene of Montana, but that species has a dentate margin and craspedodrome venation, whereas our specimen has an entire or slightly wavy margin and camptodrome venation. These characters of margin and venation, however, in connection with at least one species of the genus (*Pterospermites spectabile* Heer, see p. 150), were not regarded by the author as specifically significant or diagnostic, whether present or absent, hence it might be suggested that in connection with *P. whitei* also they could equally well be regarded merely as varietal or form characters.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 89, fig. 1). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 90, fig. 1).

Pterospermites auriculaecordatus Hollick, n. sp.

Plate 92, figures 1–5; plate 93, figures 1, 2

Leaves varying in size, apparently ovate to ovate-oblong, with auriculate-cordate bases and wavy or coarsely crenate-dentate margins; venation pinnate-

[93] Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, no. 3, p. 17, pl. 2, figs. 1, 2, 1880.

[94] *Ficus? grönlandica* Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, 1868.

[95] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 473, 1869.

[96] Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, no. 3, pl. 2, fig. 1, 1880.

[97] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 56, figs. 5, 6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 94, pl. 41, figs. 5, 6, 1887.

subpalmate, craspedodrome, the lower two of the main secondaries simulating suprabasilar lateral primaries, below which are one or more basilar, minor secondaries on each side of the midrib; secondary veins all irregularly spaced and disposed, somewhat crowded at the base of the leaf, forming mostly acute angles with the midrib, ascending, curving upward, the lower ones at more obtuse angles, branched from their under or outer sides, the upper ones branched or forked at their extremities or the ultimate ones simple, each main vein and branch terminating in one of the marginal dentitions; tertiary venation curved and bent, approximately at right angles to the midrib and supporting secondaries throughout.

It is with some hestitation that I have decided to describe these specimens under a new specific name. They appear to be intermediate in form between *Pterospermites imparilis* (the species last described) and *P. dentatus* Heer.[98] In *P. imparilis* the margins are not dentate, as they are in the species under discussion, and in *P. dentatus* the base is peltate or subpeltate, whereas in our specimens it is auriculate-cordate. Incidentally it is of interest here to note that Newberry[99] described and figured certain specimens from the Cretaceous of the Yukon River region, Alaska, and referred them to *P. dentatus*, to which species they bear more or less of a resemblance. Subsequently, however, I studied and compared them with additional material from the Yukon River region and redescribed them as new species, under the names, respectively, *Credneria inordinata maxima*, *Pseudoprotophyllum dalli*, and *Pseudoprotophyllum magnum*.[1] This is one of the many instances that might be cited which emphasizes the difficulty that often arises in trying to differentiate between leaves representing the genera *Pterospermites*, *Pseudoprotophyllum*, and *Credneria*. In the same category may also be included the genera *Grewiopsis* and *Protophyllum*. They all appear to be more or less closely related, but their systematic position in the Dicotyledonae cannot be said to be satisfactorily determined. Stratigraphically the probability appears to be that Cretaceous species may properly be referred to either *Protophyllum*, *Pseudoprotophyllum*, or *Credneria*, and Tertiary species to *Pterospermites* or *Grewiopsis;* but the entire group requires careful and thorough revision.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 92, figs. 1–5). Chignik, about 200 yards south of native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519) (pl. 93, fig. 1). Matanuska coal field, 4,800-foot point on traverse of Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1910 (lot 5901) (pl. 93, fig. 2).

Pterospermites dentatus Heer

Pterospermites dentatus Heer. Newberry, U. S. Geol. Survey Mon. 35, p. 133, pl. 53, figs. 1, 2; pl. 54, fig. 4, 1898.

The identification of this species by Newberry was based on certain specimens collected on the Yukon River by W. H. Dall in 1866; but it is evident that Newberry was not entirely satisfied with the identification, as he remarked that "the leaves here represented are probably not distinct from those described by Professor Heer[2] under the above name, although the fragments which he had did not permit him to give a full characterization or satisfactory figures." Newberry's identification was subsequently discovered to be erroneous and the specimens to be of Cretaceous age, and they were redescribed, refigured, and renamed.[3] They have no place in any Tertiary flora, and the above reference to them is inserted merely because they were originally described as belonging to a recognized Tertiary species and were thus recorded and generally recognized and so referred to in paleobotanic literature.

Pterospermites dentatus Heer is a poorly defined species, and I have not been able to identify it in any of the collections from Alaska.

Pterospermites conjunctivus Hollick, n. sp.

Plate 90, figure 2; plate 91, figures 1, 2

Leaves ovate to ovate-ellipsoidal, from 12 to 18 centimeters in length by 8.5 to 12 centimeters in maximum width, rounded below to a curved-truncate, more or less auriculate base, tapering above to a cuneate (?) apex; margin undulate to wavy-dentate; venation pinnate, craspedodrome; secondary veins irregularly spaced and disposed, mostly alternate, about 8 on each side, extending almost straight or somewhat flexed to the marginal region, where they are more or less bent upward, diverging at an angle of about 45° from the midrib, the lower ones branched distally, the basilar two somewhat arcuate and curved upward, with numerous branches from the under sides, each vein and branch terminating in one of the marginal dentitions; tertiary veins bent, forked, and flexed, diverging at various angles from the supporting secondaries, connected by cross venation, forming a coarse network of irregular-shaped areolae.

[98] Heer, Oswald, Miocene Pflanzen vom Mackenzie: Flora fossilis arctica, vol. 1, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6–9, 1868.

[99] 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.

[1] Hollick, Arthur, The Upper Cretaceous floras of Alaska: U. S. Geol. Survey Prof. Paper 159, p. 86, pl. 58, figs. 1, 2; p. 94, pl. 71, fig. 1; p. 95, pl. 72, figs. 1, 2, 1930.

[2] Heer, Oswald, Miocene Pflanzen vom Mackenzie: Flora fossilis arctica, vol. 1, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6–9, 1868.

[3] Hollick, Arthur, The Upper Cretaceous floras of Alaska: U. S. Geol. Survey Prof. Paper 159, p. 86, pl. 58, figs. 1, 2; p. 94, pl. 71, fig. 1; p. 95, pl. 72, figs. 1, 2, 1930.

These leaves, like many others that may be referred to the genus *Pterospermites*, are difficult to differentiate specifically from certain others in the same genus. They resemble *P. imparilis* (p. 151) in shape, but the dentate margin and straighter secondary veins of *P. conjunctivus* are distinguishing characters. The marginal dentitions and somewhat auriculate base are suggestive of *P. auriculaecordatus* (p. 151), but that species differs conspicuously in its more rounded shape and in the more irregular characters of its secondary nervation.

Localities: Chignik, about 200 yards south of native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519) (pl. 90, fig. 2). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 91, fig. 1). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, intermediate of three horizons (original no. IV); collected by W. W. Atwood in 1907 (lot 4391) (pl. 91, fig. 2).

Pterospermites alaskana Knowlton

Pterospermites alaskana Knowlton, Alaska, vol. 4, p. 156, pl. 26, fig. 2; pl. 32, Harriman Alaska Expedition, 1904.

This well-defined species was described and figured by Knowlton in connection with specimens (U. S. Nat. Mus. nos. 30081 and 30089) collected by De Alton Saunders in 1899 at Kukak Bay, Alaska Peninsula. It has not been identified in any of the collections subsequently made in Alaska.

Pterospermites magnifolia Knowlton

Pterospermites magnifolia Knowlton, Alaska, vol. 4, p. 156, pl. 31, Harriman Alaska Expedition, 1904.

This species, described and figured by Knowlton, was based on specimens collected by De Alton Saunders in 1899 at Kukak Bay, Alaska Peninsula. The type specimen (U. S. Nat. Mus. no. 30088) is described as 23 centimeters in length by about 14 centimeters in width, but in the figure it is reduced to about 16 by 10 centimeters. It has not been identified in any of the other collections of fossil plants from Alaska.

Order PARIETALES

Family DILLENIACEAE

Genus DILLENIA Linnaeus

Dillenia alaskana Hollick, n. sp.

Plate 94, figures 1, 2

Leaves ovate-elliptical, 15 centimeters in length by 8.75 centimeters in maximum width, tapering to the apex, rounded to a broad cuneate base; margin finely dentate above, with intermediate minor denticulations, becoming obscurely denticulate below, and entire at the base; venation simply pinnate, craspedodrome; secondaries irregularly disposed, about 9 on each side, diverging at approximately uniform angles of about 45° from the midrib, curving rather sharply upward toward their extremities, each one terminating in a marginal dentition, with branchlets extending from the under sides and terminating in the adjacent denticulations.

If the generic determination of these specimens is correct, as it appears to be, they represent a new generic element in the known Tertiary flora of the New World and indicate relationship between that of Alaska and that of southeastern Asia at the time when this flora was in existence. The genus, in our existing flora, is of Australian and tropical Asiatic distribution, extending northward to the Philippine Islands, and is not represented in the flora of the New World.

The fossil genus *Dillenites* Berry,[4] however, under which are included the four species and varieties next described, might be regarded as congeneric with *Dillenia*, and in that event the distribution of the genus in the New World in Tertiary time would include the southern part of the North American continent as well as Alaska.

Localities: Chignik River, opposite Nun Point, Alaska Peninsula (original no. 57); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5298) (pl. 94, fig. 1). Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 496); collected by C. W. Wright in 1904 (lot 7474) (pl. 94, fig. 2).

Genus DILLENITES Berry

Dillenites microdentatus (Hollick) Berry

Plate 97, figure 4

Dillenites microdentatus (Hollick) Berry, U. S. Geol. Survey Prof. Paper 91, p. 291, pl. 75, fig. 3; pl. 77, fig. 1; pl. 114, fig. 5, 1916.

Quercus microdentata Hollick, Louisiana Geol. Survey Special Rept. 5, p. 280, pl. 34 [figure three-fourths natural size], 1899.

It is, perhaps, questionable if the several leaf forms here included in the genus *Dillenites* under different varietal and specific names should be so differentiated, especially if comparison is made with the three specimens figured by Berry and referred to a single species. All of our specimens came from the same region, and all but one from a single locality; in most of the specimens the characters by means of which they are differentiated are not well defined or are poorly preserved; and all of them are more or less fragmentary. Individual differences may be discerned, however, more clearly than they can be described, and in the circumstances I have thought it advisable to differentiate the principal forms under three distinctive names, even though they may all be subsequently segregated under the original specific name.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

[4] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 291, 1916.

Dillenites ellipticus Hollick, n. sp.

Plate 95, figures 1–3; plate 97, figure 1

Leaves elliptical, from 9 to 26 centimeters in length by 4.5 to 14 centimeters in width; cuneate at base and apex; margin minutely serrate-denticulate above, entire below; venation simply pinnate, craspedodrome; secondary veins numerous, mostly alternate, parallel, curving upward close to the margin, forming angles of about 45° with the midrib in its lower part, the angles becoming successively more acute above.

These leaves, to which I have ventured to give a new specific name, are more or less similar to *Dillenites microdentatus* (Hollick) Berry,[5] from which they differ mostly in their broader elliptical shape, more obtusely cuneate base and apex, and finer denticulations. It should be noted, however, that Berry[6] referred to *D. microdentatus* certain leaves from the Eocene (Wilcox formation) of Louisiana which appear to be more nearly like ours from Alaska than they are like the species to which they were referred; and we may, perhaps, regard it merely as a matter of personal opinion whether all these leaves should be recognized as forms or varieties of a single species.

The genus *Dillenites* was founded by Berry to include a certain type of leaves of which the general characters are surficially suggestive of *Fagus*, *Quercus*, and *Ulmus* and also of genera in families of more southern distribution, such as the Dilleniaceae and Ternstroemiaceae. A critical examination of the specimens seems to indicate that the correct systematic position of these leaves is with the Dilleniaceae rather than with the Fagaceae or Ulmaceae, and this idea is supported by the identification, in the same collection, of a number of specimens representing undoubted tropical and subtropical genera, including certain ones in the Cycadaceae.

Localities: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, lowest of three horizons (original no. 3); collected by W. W. Atwood in 1906 (lot 4392) (pl. 95, figs. 1, 2). Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 496); collected by C. W. Wright in 1904 (lot 7474) (pl. 95, fig. 3). South side near head of Hamilton Bay, Kupreanof Island, highest in the series (original no. V); collected by W. W. Atwood in 1907 (lot 4389) (pl. 97, fig. 1).

Dillenites ellipticus ulmifolius Hollick, n. var.

Plate 96, figures 2–4; plate 97, figures 2, 3

Leaves ovate-elliptical, somewhat inequilateral at the base, broadly wedge-shaped at the apex, about 11 to 14 centimeters in length by 6.75 to 9 centimeters in width, petiolate; petiole 2.5 centimeters in length; margin sharply and doubly serrate-dentate above, becoming more finely dentate or denticulate below and entire near the base; venation pinnate, craspedodrome; secondary veins numerous, mostly alternate, occasionally opposite or subopposite, parallel, diverging at angles of 40° to 50° from the midrib, the angles prevailingly more obtuse below than above.

This variety is very similar to *Dillenites ellipticus* Hollick, the species last described, and it is evident that they should be regarded either as specifically identical or as varietal forms of the same species. Our figure 4 apparently represents the same species as a leaf from the lower Eocene (Wilcox formation) of Louisiana, referred by Berry[7] to *Dillenites microdentatus* (Hollick) Berry,[8] but the reference hardly appears to be warranted by a comparison of the two figures. The generic identity of all these leaves, however, cannot be doubted, and they indicate the contemporaneity of the Tertiary flora of the Hamilton Bay region in Alaska with that of the Wilcox formation in Louisiana.

Locality: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16[a]); collected by E. M. Kindle in 1905 (lot 3653).

Dillenites ceterus Hollick, n. sp.

Plate 96, figure 1

Leaf oblong-ovate, slightly asymmetric, 7.5 centimeters in length by 4.5 centimeters in maximum width, rounded above to a broad, curved-cuneate apex and below to a truncate or obliquely subcordate base; margin minutely and uniformly denticulate; venation pinnate, craspedodrome; secondary veins numerous, 20 or more on each side, irregularly disposed, rather evenly spaced, the lower ones at more obtuse angles with the midrib than those above, and those on one side of the midrib at angles more obtuse than those on the opposite side, extending subparallel with one another almost straight to the margin, where each terminates in one of the denticulations.

This leaf appears to represent a form that is intermediate in size, shape, and dentition between the several forms included under the species and variety above described. As previously mentioned, however, it may be that all might, with ample support of precedent, be regarded as belonging to one and the same species.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4392).

[5] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 291, pl. 75, fig. 3; pl. 77, fig. 1; pl. 114, fig. 5, 1916, = *Quercus microdonta* Hollick, in Harris, G. D., and Veatch, A. C., A preliminary report on the geology of Louisiana, p. 280, pl. 34, 1899.

[6] Berry, E. W., op. cit., pl. 77, fig. 1; pl. 114, fig. 5.

[7] Idem, p. 291, pl. 77, fig. 1, 1916.

[8] Idem, p. 291, pl. 75, fig. 3.

Genus SAURAUJA Willdenow

Saurauja alaskana Hollick, n. sp.

Plate 93, figure 4

Leaf irregularly obovate-panduriform, 11.5 centimeters in length by 6 centimeters in maximum width, rounded at the apex, narrowed below to a somewhat inequilateral, cuneate base; margin minutely denticulate above, entire and undulate below; venation pinnate; secondary veins irregularly disposed and spaced, somewhat crowded near the base, flexuous, curving sharply upward close to the margin, where they gradually approach and ultimately coalesce, the upper ones with fine veinlets on the outer sides, each of which extends to and terminates in one of the adjacent marginal denticulations; tertiary venation at right angles to the midrib and oblique to the secondaries throughout, mostly bent or flexed, forming oblong, quadrilateral areolae.

The family and generic relationships of this leaf have not been determined with certainty. In our existing flora the genus is represented by about 60 species, of tropical distribution, in Asia and America; but in the fossil form the genus has not heretofore been recognized in the New World and only sparingly in the Old World in the Tertiary of Europe. A fossil species that appears to somewhat remotely resemble ours is *Sauraja* [*Saurauja*] *roborans* Langeron,[9] from the Eocene of France. The resemblance, however, is indicative of family rather than generic relationship.

A species that ours appears to resemble somewhat more nearly is *Saurauja deformis* (Unger) Ettingshausen,[10] from the Tertiary of Croatia, originally described by Unger as a species of *Juglans*. In fact, it was the surficial resemblance of our leaf to *Juglans* and *Hicoria*—especially the latter—that caused me to hesitate about referring it to *Saurauja;* and other authors were evidently more or less in doubt in regard to the generic affiliation of the European species. Weber [11] accepted the name *Juglans deformis* and applied it to a fragmentary leaf from the Miocene of Germany, in connection with which he remarked:[12] "Ähneln in so hohem Grade den Blättern von *Carya* [*Hicoria*] *alba*, dass man fast geneigt wird, sie für identisch zu halten."

[9] Langeron, Maurice, Contributions à l'étude de la flore fossile de Sézanne: Soc. hist. nat. Autun Bull., vol. 13, p. 338 (10), pl. 5, fig. 1, 1900.

[10] Ettingshausen, Constantin von, Beiträge zur Kenntniss der fossilen Flora von Radoboj: K. Akad. Wiss. [Wien] Sitzungsber., vol. 61, pt. 1, p. 887 (59), pl. 11, fig. 7, 1870, = *Juglans deformis* Unger, Franz, Blätterabdrücke aus dem Schwefelflötze von Swoszowice in Galicien: Haidinger's Naturwiss. Abh., vol. 3, pt. 1, no. 6, p. 126, pl. 14, fig. 19, 1850.

[11] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 210 (96), pl. 23 (6), fig. 7, 1851 [1852].

[12] Idem, pp. 210–211 (96–97).

The indication of a tropical flora, as represented by the genus *Saurauja*, is consistent with a number of the floral elements found associated with our specimen, including cycads and fan palms.

Certain fragmentary leaves from the Eocene of Wyoming that closely resemble our specimen were described and figured by Lesquereux [13] under the name *Ficus alkalina*, and it appears probable that these specimens and ours are at least generically identical, and more perfect specimens than those thus far figured might indicate even closer relationship.

Locality: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7565).

Order THYMELEALES

Family ELAEAGNACEAE

Genus LEPARGYRAEA Rafinesque

Lepargyraea weaveri Hollick, n. sp.

Plate 93, figure 5

Leaf narrowly ovate, 4 centimeters in length by 1.5 centimeters in maximum width, tapering to the acuminate apex, cuneate at the base; margin entire, somewhat wavy; venation pinnate, camptodrome; midrib slender; secondary veins thin, irregularly spaced, alternate or some subopposite, diverging at various angles from the midrib, more or less curved upward, camptodrome, with obscurely defined minor camptodrome venation between the main loops and the margin.

The discovery, in the Tertiary flora of Alaska, of a leaf that is apparently referable to the genus *Lepargyraea* or *Elaeagnus* is interesting, not only because neither of these genera has heretofore been recognized in the fossil flora of North America but also for the reason that they are represented by existing species that are native in Canada.

The specific name is given in honor of Mr. C. E. Weaver, to whom we are indebted for the collection of this and other specimens of interest from the region.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, near entrance to Fritz Creek (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Order MYRTALES

Family COMBRETACEAE

Genus TERMINALIA Linnaeus

Terminalia sp.?

Plate 93, figure 6

This specimen is too fragmentary to serve as a basis for a specific description, as only the basal portion of the leaf is preserved. This is wedge-shaped, with

[13] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 164, pl. 44, figs. 7–9, 1883.

an entire and apparently somewhat wavy or undulate margin. The thick midrib is its most conspicuous character.

It appears to be closely similar to if not identical with a fragmentary specimen from the Eocene of Texas, described and figured by Berry [14] under the name *Terminalia hilgardiana* (Lesquereux) Berry, and identified as conspecific with *Magnolia hilgardiana* Lesquereux [15] from the Eocene of Mississippi. I am not in possession of all the facts and information upon which this identification was based and am therefore unable to discuss whether or not the change in the generic name, as applied to Lesquereux's specimens, was justified; nor do I think that critical comparison of Lesquereux's figure with ours would result in any definite conclusion as to their mutual identity; but the generic identity of Berry's fragmentary specimen with ours appears to be reasonably certain.

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Family TRAPACEAE

Genus TRAPA Linnaeus

Trapa borealis Heer

Trapa borealis Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 38, pl. 8, figs. 9–14, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

This species was based by Heer on bicornute fruits collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula. No leaves were found associated with them, but their generic identity cannot be doubted.

Similar fruits, associated with leaves of *Trapa? microphylla* Lesquereux, from the Upper Cretaceous (?) of Alberta, were referred to the species by Dawson; [16] and other fruits of the same type but varying more or less in minor characters, from several different geologic horizons and localities elsewhere in America, were described under various specific names by Knowlton [17] and by Berry.[18] In the Old World at least 9 species, ranging from Eocene to Pliocene in age, were described and figured, as well as some 12 varieties of the living species *Trapa natans* Linnaeus, from Pleistocene and more recent deposits.

At the present time the genus is represented by only 3 species, all natives of the Old World. *Trapa natans*, characterized by having four spinose protuberances or horns on the fruit, has a distribution that includes central Asia, central and southern Europe, and Africa. *Trapa bicornis* Linnaeus and *Trapa bispinosa* Roxburgh, each with two horns, are restricted to eastern and southern Asia; and in this connection it is interesting to note that all the American fossil species are bicornute, indicating a closer relationship with the eastern Asiatic than with the Eurasian-African species.

Order UMBELLALES

Family ARALIACEAE

Genus HEDERA Linnaeus

Hedera macclurii Heer

Plate 98, figures 1–3

Hedera macclurii Heer, Naturf. Gesell. Zurich Vierteljahrsschr., vol. 11, p. 279, 1866; Miocene Flora von Nord-grönland: Flora fossilis arctica, vol. 1, p. 119, pl. 17, figs. 1a, 1b, 2c, 3, 4, 5a; pl. 21, fig. 17a, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 476, pl. 45, fig. 5b; pl. 52, fig. 8e, 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, pt. 1, no. 3, p. 16, pl. 3, figs. 4, 5, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 117, pl. 66, fig. 2, 1883.

A considerable variety of leaf forms were included by Heer under this species, in his descriptions of the Tertiary floras of Greenland, Spitsbergen, the Mackenzie River region of Canada, and the island of Sakhalin, some of which appear to be of doubtful identity and one of which,[19] from Sakhalin, he himself questioned. The only other author who mentioned or discussed the species in the light of new material was Kryshtofovich,[20] who identified a leaf from supposed Upper Cretaceous rocks of Sakhalin as belonging to the species, but the identity of this specimen with Heer's species is doubtful, as may be seen

[14] Berry, E. W., The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 325, pl. 92, fig. 2, 1916.

[15] Lesquereux, Leo, Botanical and paleontological report on the geological State survey of Arkansas, in Owen, D. D., Second report of a geological reconnaissance * * * of Arkansas, p. 319, pl. 6, fig. 1, 1860; On species of fossil plants from the Tertiary of the State of Mississippi: Am. Philos. Soc. Trans., vol. 13, p. 421, pl. 21, fig. 1, 1869.

[16] Dawson, J. W., Note on the plants collected by Mr. G. M. Dawson from the lignite Tertiary deposits near the 49th parallel, in Dawson, G. M., Report on the geology and resources of the region in the vicinity of the 49th parallel, appendix A, p. 330, pl. 16, fig. 10, British North American Boundary Commission, 1875; On the fossil plants of the Laramie formation of Canada; Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 31, pl. 2, fig. 19b, 1886.

[17] *Trapa americana,* from the Miocene (Payette formation) of Idaho.—Knowlton, F. H., The fossil plants of the Payette formation: U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 733, pl. 102, fig. 7a, 1898. *Trapa? occidentalis.*—Idem, p. 734, pl. 102, fig. 7b.

[18] *Trapa wilcoxensis,* from the Eocene (Lagrange formation) of Tennessee.—Berry, E. W., Two new Tertiary species of *Trapa:* Torreya vol. 14, p. 106, text figs. 1–3, 1914; The lower Eocene floras of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 326, pl. 101, figs. 7–9, 1916. *Trapa alabamensis,* from the Pliocene (Citronelle formation) of Alabama.—Torreya, vol. 14, p. 107, text figs. 4, 5, 1914; The flora of the Citronelle formation: U. S. Geol. Survey Prof. Paper 98, p. 203, pl. 47, figs. 9, 10, 1916.

[19] Heer, Oswald, op. cit., vol. 5, p. 44, pl. 7, fig. 9b.

[20] Kryshtofovich, African, On the Cretaceous flora of Russian Sakhalin: Imp. Univ. Tokyo Coll. Sci. Jour., vol. 40, art. 8, p. 59, text fig. 14, 1918.

by a comparison of the figures, and it is also significant that Heer's specimen from Sakhalin was the only one whose identity he questioned.

It may be noticed that the specimens represented by our figures appear as if distorted and laterally distended, and I am not certain whether this appearance is a result of distortion during the process of fossilization or is a natural character of the leaves. Our figure 1 and the fragment of a small leaf represented in figure 2 are most closely comparable with certain specimens figured by Heer, from Greenland [21] and Spitsbergen,[22] and the fragmentary large leaf represented by our figure 2 may be compared with another of Heer's specimens from Spitsbergen.[23]

Localities: West side of Herendeen Bay, Alaska Peninsula, north of location 19 (original no. 20); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5183) (pl. 98, figs. 1, 2). Nenana coal field, Tanana region, about 0.8 mile N. 48° E. of southwest corner of sec. 10, T. 9 S., R. 6 W., elevation 2,025 feet (original no. 5); collected by G. C. Martin and R. M. Overbeck in 1916 (lot 7264) (pl. 98, fig. 3).

Hedera auriculata Heer

Hedera auriculata Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 9, fig. 6, 1869.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 888, 1896.

This species is apparently known only in connection with the type specimen, described and figured by Heer, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region.

Genus ARALIA Linnaeus

Aralia delicatula Hollick, n. sp.

Plate 98, figure 4

Leaf trilobate, 3 centimeters in length from base to apex, 5.5 centimeters in width between the tips of the lateral lobes; middle lobe broadest; lateral lobes divergent, slightly ascending; base rounded-truncate; apex obtuse; margin entire; venation tripalmate or obscurely quinquepalmate, from the base, the basilar pair weak and poorly defined; secondary venation camptodrome, obscure, delicate, merging into the tertiary venation; secondary veins 2 or 3 on each side of the midrib, irregularly spaced, forming acute angles with the midrib, ascending and becoming campto-acrodrome.

This leaf was apparently thin of texture, with fine, delicate venation throughout. It certainly belongs in the Araliaceae and, apparently, in the genus *Aralia*, but I have failed to find any described species with which it may be compared.

Locality: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186).

Aralia? sp.

Plate 98, figures 5, 6

Leaf apparently tripartite, the divisions lanceolate-acuminate, approximately equal in size, about 7 centimeters in length by 2 centimeters in maximum width, minutely denticulate; secondary veins numerous.

These specimens are too fragmentary for satisfactory description, or for critical comparison with leaves of existing plants or with figures of fossil leaves. They are suggestive of the genera *Rhus*, *Dewalquea*, *Sterculia*, and *Aralia;* but more perfect specimens, in which the secondary venation might be more clearly defined, are necessary for generic determination. I am inclined to regard them as representing an undescribed species in one or another of the genera mentioned.

Locality: Summit of mountain half a mile east of head of north branch of Russell Creek, Alaska Peninsula (original no. P-24); collected by W. R. Smith in 1922.

Aralia? sp.

Plate 99, figure 5

This specimen is too fragmentary for even a generic identification that is anything more than provisional. In its entirety the leaf was evidently tripalmate and apparently trilobate, with entire margin and with widely spaced camptodrome venation. The general appearance is suggestive of *Aralia*, but further than that I would not venture an opinion. The specimen has been figured, in the hope that better-preserved material may be brought to light in the future which may serve to reconstruct and name it, in connection with the locality where it was found.

Locality: Three miles along trail from Portage (Balboa) Bay toward Herendeen Bay, Alaska Peninsula (original no. 8); collected by W. W. Atwood in 1908 (lot 5179).

Family CORNACEAE

Genus CORNUS Linnaeus

Cornus büchii Heer

Plate 98, figure 7

Cornus büchii Heer, Gartenflora, vol. 2, p. 295, pl. 66, figs. 6, 7, 1853; Flora tertiaria Helvetiae, vol. 3, p. 26, pl. 105, Winterthur, 1859.

This well-defined, perfect leaf is apparently identical with Heer's species from the Tertiary of Switzerland, the only difference being that in our specimen the blunt, apiculate apex is somewhat more pronounced. Also, they both resemble, very closely, *Cornus newberryi* Hollick,[24] from the Eocene breccias

[21] Heer, Oswald, op. cit., vol. 1, pl. 17, fig. 5a.
[22] Idem, vol. 2, no. 3, pl. 13, fig. 30.
[23] Idem, vol. 4, no. 1, pl. 18, fig. 2.

[24] Hollick, Arthur, in Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 124, pl. 37, figs. 2-4, 1898.

of Fort Union age in the Yellowstone National Park, as represented by figure 4 in the work cited, although the other two figures are quite different in shape and have long, slender, pointed apices. If figure 4 were the only one to represent the species it would be very difficult to differentiate it from *Cornus büchii.*

Another closely similar species is *Cornus ovalis* Lesquereux,[25] from the Miocene of California; but the figures of this species represent specimens that are too imperfect for satisfactory comparison. *Cornus büchii* has not been heretofore recorded from America, but it is possible that it may have been confused with the other species mentioned.

Locality: Yakutat-Copper River region, bed of creek from Mount Chezum, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846).

Cornus irregularis Hollick, n. sp.

Plate 99, figure 1

Leaf large, ovate, about 15 centimeters in length by 9.5 centimeters in maximum width at a distance of about 6.5 centimeters from the base; margin entire; midrib conspicuously thickened toward the base; venation strong, pinnate, acrodrome; secondary veins irregularly spaced, alternate except the lower two, which are opposite, all diverging at acute angles from the midrib, curving upward, thinning out, and disappearing near the margin; tertiary venation almost straight or occasionally slightly bent or flexed, horizontal throughout, dividing the spaces between the secondaries into quadrilateral areolae.

The irregularity in the secondary venation of this leaf can hardly fail to attract attention. In the conspicuously wide space between the upper two secondary veins on the right-hand side are two pseudosecondaries that merge into tertiaries; and a similar one may be seen between the upper two secondary veins on the left-hand side.

Its nearest analog appears to be *Cornus kelloggii* Lesquereux,[26] from the Miocene of California, but the secondary venation in that species is strictly opposite and symmetrically disposed.

Our specimen is included in the same collection that contains the smaller *Cornus* leaf that I have referred to *C. büchii* Heer, the species last described; but this can hardly be regarded in any other light than as a mere coincidence; although Saporta[27] figured two specimens of *Cornus platyphylla* Saporta, a somewhat similar species, that differ from each other in size quite as much as the two leaves above mentioned. The venation, however, is uniform in both of his figures, whereas in ours the differences are readily discernible.

Locality: Yakutat-Copper River region, bed of creek from Mount Chezum, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846).

Cornus hyperborea Heer?

Plate 99, figures 2, 3

Cornus hyperborea Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 476, pl. 50, figs. 3, 4, 1869.

The upper parts of our specimens compare exactly with Heer's figures of the type specimens of the species from the Tertiary (Eocene) of Greenland, but I feel compelled to question the identification, for the reason that the base of a leaf of the species has never been figured, although a number of fragmentary remains of doubtful identity, from Spitsbergen and Greenland, were referred to it by Heer.[28]

The species appears to have been limited in its distribution to the Arctic regions, although a fragmentary leaf specimen from the Eocene of California was referred to it by Lesquereux,[29] but this specimen was subsequently identified and listed by Knowlton[30] as *Magnolia inglefieldi* Heer. Incidentally, it may be remarked that certain of Heer's figures, other than those of the type specimens, are more suggestive of the genus *Magnolia* than they are of *Cornus.*

If we may assume that our specimens represent the species, they afford excellent material for supplementing the original specific description by Heer; and if, on the other hand, they represent a new species, a complete description, based upon the specimens from Alaska, would be appropriate in this place. Such a description is here given:

Leaf oblong-ovate, 14 centimeters in length by 4.75 centimeters in maximum width; apex rounded-cuneate; base rounded-truncate, obscurely inequilateral; margin entire; venation simply pinnate, campto-acrodrome; secondary veins about 12 on each side, irregularly spaced and disposed, subparallel, all except the lowest diverging at acute angles with the midrib, ascending, curving upward, thinning out and disappearing close to the margin.

[25] 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. 23, pl. 6, figs. 1, 2, 1878.

[26] Idem, p. 23, pl. 6, fig. 3.

[27] Saporta, Gaston, Prodrome d'une flore fossile des travertins anciens de Sézanne: Soc. géol. France Mém., sér. 2, vol. 8, no. 3, p. 391 (103), pl. 32 (11), figs. 8, 9, 1868.

[28] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 61, pl. 13, figs. 34, 35a, 1870; Nachträge zur Miocenen Flora Grönlands: Idem, vol. 3, no. 3, p. 23, pl. 3, fig. 16, 1874; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 79, pl. 18, fig. 1c, 1877.

[29] Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 29, pl. 15, fig. 3, 1888.

[30] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, pp. 194, 372, 1919.

Its affiliations are apparently with *Cornus studeri* Heer.[31]

Localities: Yakutat-Copper River regions, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3487) (pl. 99, fig. 2). Yakutat-Copper River region, bed of creek flowing into head of Canyon Creek from Mount Chezum, at an elevation of 2,000 feet (original no. 38); collected by A. G. Maddren in 1905 (lot 3846) (pl. 99, fig. 3).

Cornus orbifera Heer

Cornus orbifera Heer, Gartenflora, vol. 2, p. 293, pl. 66, fig. 9, 1853.
Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 448, pl. 10, fig. 6, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 262, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

The specimen on which Lesquereux based this specific identification was collected at Cook Inlet by W. H. Dall in 1880. The specimen is a mere fragment, but it evidently represents a species of *Cornus*. I am inclined to believe, however, that if it were perfect it would be found to represent *C. rhamnifolia* Weber,[32] rather than *C. orbifera.*

Genus NYSSA Linnaeus

Nyssa arctica Heer

Nyssa arctica Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 477, pl. 43, fig. 12c; pl. 50, figs. 5, 6, 6b, 7, 1869.
Nyssa arctica Heer, Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 447, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 261, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 226, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

Specimens of seeds, referred with question to this species by Lesquereux, were collected by W. H. Dall in 1880 on Unga Island, off the south coast of Alaska Peninsula. Unfortunately the specimens were not figured, but Lesquereux described them as of the same size and form as Heer's figures, which are very similar to though larger than seeds upon which Heer based the genus *Nyssidium*,[33] one species of which—*N. ekmani* Heer, the species next described—occurs in several of our collections.

Nyssa arctica, except for the provisional identification of the Alaskan specimens by Lesquereux, has been recorded only from the type locality in Greenland and from Spitsbergen.

[31] Heer, Oswald, Uebersicht der Tertiärflora der Schweiz: Naturf. Gesell. Zurich Mitt., vol. 3, p. 105, 1853; Flora tertiaria Helvetiae, vol. 3, p. 27, pl. 105, figs. 18–21, Winterthur, 1859.
[32] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 152, pl. 4, fig. 8, 1852.
[33] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 61, 1870.

Genus NYSSIDIUM Heer

Nyssidium ekmani Heer

Plate 30, figure 4b; plate 120, figures 8–12

Nyssidium ekmani Heer, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 62, pl. 15, figs. 1–7, 1870; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 118, pl. 92, fig. 8, 1883.

Abundant remains of these fruits were described and figured by Heer from Eocene deposits of Spitsbergen and Greenland, besides others closely similar in surficial characters,[34] and it is evident that they were also an abundant element in the Tertiary flora of Alaska. What are apparently the same or closely allied species, from the island of New Siberia, were also described and figured by Schmalhausen,[35] who discussed their similarity to Heer's *Nyssidium ekmani* and *N. fusiforme.*

They are apparently congeneric with similar fruits described and figured by Lesquereux[36] under the names *Carpolithes arachioides* and *Leguminosites? arachioides*, the only apparent difference between them being a matter of size. The fruits of *Nyssidium* are smaller than those of *Leguminosites? arachioides*, but in shape, surficial markings, mode of attachment to a central rachis, and some other features they are identical. Apparently they should both be included under one generic name and differentiated merely specifically or varietally. Neither of the two generic names, however, is botanically appropriate, as these imply relationship either to the Cornaceae or to the Leguminosae, and it is highly improbable that either of these implied relationships is correct.

Our specimen that is most nearly like *L. arachioides* is depicted in figure 8, plate 120. If this specimen were the only one for comparison it might be regarded almost equally well as either a small form or variety of *L. arachioides* or a large form of *Nyssidium ekmani.*

Localities: Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 30, fig. 4b; pl. 120, fig. 12). Matanuska coal field, Matanuska-Cook Inlet region, south of pond on top of mountain between Kings River and Youngs Creek, about 1 mile northwest of Kings River bridge; collected by G. C. Martin and F. J. Katz in 1910 (lot 5898) (pl. 120, figs. 8, 9).

[34] *Nyssidium crassum* Heer, Oswald, op. cit., vol. 2, no. 3, p. 62, pl. 15, figs. 8–14, 1870.
N. oblongum Heer, idem, p. 63, pl. 15, figs. 16–20.
N. fusiforme Heer, idem, p. 63, pl. 15, figs. 24, 25.
N. lanceolatum Heer, idem, p. 63, pl. 15, figs. 21–23; pl. 16, fig. 38c.
Nyssa arctica Heer, idem, vol. 2, no. 4, p. 447, pl. 43, fig. 12c; pl. 50, figs. 5, 6, 6b, 7, 1869.
[35] Schmalhausen, Johannes, Tertiäre Pflanzen der Insel Neusibirien: Acad. imp. sci. St.-Pétersbourg Mém., sér. 7, vol. 37, no. 5, p. 16, pl. 1, figs. 27–29 (*Nyssidium spicatum*); figs. 30, 30a (*N. geminatum*), 1890.
[36] Lesquereux, Leo, Lignitic formation and fossil flora: U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 403, 1873; The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 301, pl. 59, figs. 13, 14, 1878.

Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 120, figs. 10, 11).

Division GAMOPETALAE

Order ERICALES

Family ERICACEAE

Genus RHODODENDRON Linnaeus

Rhododendron crassum Hollick, n. sp.

Plate 99, figure 4

Leaf apparently normally ellipsoidal, 10 centimeters in length by about 4 centimeters in maximum width, terminating above in a slightly convex, bluntly apiculate apex, tapering below to a long, narrow, acutely cuneate base; texture apparently coriaceous; margin entire, undulate, reflexed; venation simply pinnate; midrib curved and bent in opposite directions at apex and base; secondary veins obscurely defined, apparently curving upward and becoming camptodrome in the marginal region; finer venation not discernible.

This specimen apparently represents a contorted leaf which, in its normal condition, was elongated-ellipsoidal. The texture was apparently thick and leathery, as indicated by the obscurely defined venation and the apparently reflexed margin. The characters are suggestive of *Rhododendron*, but a more perfect leaf, with characters better defined, might indicate some other generic relationship, such as *Anona*, *Magnolia*, or *Myrsine*. These three genera are represented by a number of species in the Tertiary flora of North America, but no fossil species of *Rhododendron* has been heretofore recorded from the New World, so far as I am aware, except remains of the existing species *R. lapponicum* Linnaeus in Pleistocene deposits of the Great Lakes region in Illinois.[37]

There does not appear to be any described New World fossil species with which our specimen may be compared with any degree of satisfaction, unless it might be *Andromeda eolignitica* Hollick,[38] from the Eocene of Louisiana; but among Old World fossil leaves that are more or less similar in appearance may be mentioned *Anona lignitum* Unger,[39] *Magnolia primigenia* Unger,[40] *Myrsine centaurorum* Unger,[41] *Rhododendron flos saturni* Unger,[42] *R. megiston* Unger,[43] and *Laurus obovata* Weber,[44] and it is possible that our specimen may be specifically identical with one or another of these.

[37] Baker, F. C., The life of the Pleistocene or glacial period: Illinois Univ. Bull., vol. 17, p. 186, 1920.

[38] Hollick, Arthur, A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 287, pl. 47, fig. 2, 1899.

[39] Unger, Franz, Sylloge plantarum fossilium, pt. 1, p. 25, pl. 10, figs. 1–7, 1860.

[40] Idem, p. 28, pl. 11, figs. 5, 6.

[41] Idem, pt. 3, p. 22, pl. 7, figs. 15–17, 1863.

[42] Idem, p. 38, pl. 12, fig. 15.

[43] Idem, p. 39, pl. 12, figs. 16–20.

[44] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, p. 180 (66), pl. 20 (3), fig. 4, 1851 [1852].

Locality: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847).

Family VACCINIACEAE

Genus VACCINIUM Linnaeus

Vaccinium friesii Heer

Vaccinium friesii Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 35, pl. 8, fig. 4, 1869. Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 225, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

The type specimen of this species, described and figured by Heer, was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. This constitutes the only record of the species, so far as I am aware; and it is very doubtful if the generic designation is valid, in which connection Heer remarked: "Determinatio generis adhuc dubia." The figure is well defined, however, and the species should be readily recognized in the event that other specimens are brought to light.

Vaccinium hollicki Knowlton

Vaccinium hollicki Knowlton, U. S. Geol. Survey Bull. 696, p. 638, 1919.

Vaccinium reticulatum Alex. Braun, in Bruckman, Ver. vaterl. Naturk. Württemberg Jahresh., vol. 6, p. 231, 1850.

Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 448, pl. 10, figs. 3–5, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 261, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 225, 1894; Geol. Soc. America Bull., vol. 5, p. 585, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

Not *Vaccinium reticulatum* Smith, 1819.

Three specimens (U. S. Nat. Mus. no. 1380), collected in 1880 by W. H. Dall at Cook Inlet, were described, figured, and referred to this species by Lesquereux. It has not been identified in any of the collections subsequently made in Alaska.

Vaccinium alaskanum Knowlton

Vaccinium alaskanum Knowlton, Alaska, vol. 4, p. 157, pl. 25, fig. 1, Harriman Alaska Expedition, 1904.

This species was based by Knowlton upon a specimen (U. S. Nat. Mus. no. 30077) collected by De Alton Saunders in 1899 at Kukak Bay, Alaska Peninsula. It has not been identified or recorded except in connection with the type specimen.

Vaccinium sp. Heer

Vaccinium sp. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 65, 1868.

The above generic identification by Heer was recorded in the list of fossil plants collected by Hjalmar

Furuhjelm at Port Graham, Alaska Peninsula. It probably represents the specimen subsequently described and figured by Heer under the name *Vaccinium friesii.* (See p. 160.)

Order EBENALES

Family EBENACEAE

Genus DIOSPYROS Linnaeus

Diospyros brachysepala Alex. Braun

Plate 105, figure 1

Diospyros brachysepala Alex. Braun, in Buckland, Geology and mineralogy considered with reference to natural theology, vol. 1, p. 513, London, 1836 [1837].
Unger, Haidinger's Naturwiss. Abh., vol. 3, pt. 1, p. 125 (5), pl. 14, fig. 15, Vienna, 1848–49 [1850].

The principal distinction that appears to have been recognized by Heer[45] between this species and his *Diospyros anceps*, the species next described, was the more rounded base of the latter; but this is so uncertain and inconstant a foliar character, subject to every possible degree of gradation, that it is impossible to determine, in connection with certain specimens, which specific name should be applied, and it appears to be doubtful if *D. anceps* should be recognized as a distinct and valid species.

Lesquereux[46] described and figured typical leaves of both species under the one specific name *D. brachysepala;* and comparison with certain other figures referred to the species, such as that of a specimen from the Upper Cretaceous Montana deposits of Wyoming, by Knowlton,[47] will at once demonstrate the futility of assuming the validity of any of the identifications unless accompanied by an illustration. Merely as a matter of possible interest, however, it may be noted that the previous American records for the species show a geographic distribution that includes Montana, Wyoming, Colorado, Oklahoma, Texas, and Tennessee and a vertical range that extends from the Montana group of the Upper Cretaceous to the Miocene Tertiary.

A critical examination of all published figures of specimens that have been referred to these two and certain other allied species would be necessary before definite conclusions could be deduced as to the areal or vertical distribution of any of the specific forms.

Locality: Yukon River, south bank, just above Rampart, central Yukon region (original no. 3AH 10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247).

[45] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, pp. 11–13, pl. 102, figs. 1–14b; pl. 153, fig. 39 (*Diospyros brachysepala*); pl. 102, figs. 15–18 (*Diospyros anceps*), Winterthur, 1859.

[46] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 232, pl. 40, figs. 7–10; pl. 63, fig. 6, 1878.

[47] Knowlton, F. H., Flora of the Montana formation: U. S. Geol. Survey Bull. 163, p. 74, pl. 18, fig. 3, 1900.

Diospyros anceps Heer

Plate 105, figure 2

Diospyros anceps Heer, Flora tertiaria Helvetiae, vol. 3, p. 12, pl. 102, figs. 15–18, Winterthur, 1859.
Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 448, pl. 10, figs. 1, 2, 1882 [1883]; U. S. Geol. Survey Terr. Rept., vol. 8, p. 261, 1883.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

Two fragmentary specimens of leaves, collected at Cook Inlet by W. H. Dall in 1880, were figured and referred to this species by Lesquereux. They do not bear a very close resemblance to Heer's figures of the type specimens of the species, but inasmuch as a considerable variety of leaf forms were subsequently included in it by Heer, certain of which were cited by Lesquereux, his reference of the Alaska specimens to the species was apparently justified.

Our specimen, although imperfect, may be seen to resemble very closely Heer's figures of the type specimens, especially his figure 17; although it must be recognized that it is often difficult to differentiate between *Diospyros anceps* Heer and *D. brachysepala* Alex. Braun, the species last described, and that definite identification under either specific name seldom appears to be conclusive or entirely satisfactory.

Diospyros anceps, as represented by our specimen, does not seem to have been identified in America from elsewhere than Alaska.

Locality: Kachemak Bay, Kenai Peninsula, near entrance to Fritz Creek, Matanuska-Cook Inlet region (original nos. 1 and 2); collected by C. E. Weaver in 1906 (lot 4131).

Diospyros alaskana Schimper

Diospyros alaskana Schimper, Traité de paléontologie végétale, vol. 2, p. 949, Paris, 1872.
Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.
Diospyros lancifolia Lesquereux. Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, pp. 65, 66, 1868; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 35, pl. 3, fig. 12, 1869.
Not *D. lancifolia* Alex. Braun, 1850.

Considerable uncertainty exists in connection with the specimen from Ninilchik, collected by Hjalmar Furuhjelm and described and figured by Heer under the name *Diospyros lancifolia* Lesquereux.[48] The original description by Lesquereux, based on a specimen from the Tertiary (Eocene?) of Washington, was not accompanied by a figure, and it may be regarded as doubtful if Heer's figure is representative of the species described by Lesquereux. The figure appears

[48] Lesquereux, Leo, On some fossil plants of recent formations: Am. Jour. Sci., vol. 27, p. 361, 1859.

to represent a species of *Rhamnus*, closely similar to *R. cleburni* Lesquereux.[49] Further than this, specimens from British Columbia, described and figured by Heer [50] and referred to *Diospyros lancifolia*, are quite different from the figure of the Alaska specimen and might better be referred to *Diospyros brachysepala* Alex. Braun (p. 161), which they resemble so closely as to be practically indistinguishable. In this connection it may be pertinent to recall that the varietal designation *Diospyros brachysepala lancifolia* was used by Heer [51] in his discussion of the Tertiary flora of Switzerland.

I have not seen the type specimen from Bellingham Bay, Wash., upon which the species *D. lancifolia* Lesquereux was based, nor, as previously mentioned, is any figure available. Hence I am not in a position to question Heer's identification of the Alaska specimen with it, and the species must be regarded as included in the Tertiary flora of Alaska only upon the assumed validity of Heer's identification. In any event, however, I am inclined to believe that the specimen from Ninilchik should be referred to the genus *Rhamnus* rather than to *Diospyros*.

In the circumstances it is evident that the status of the species is not well established and that any records based upon its identification of doubtful value. It was listed by Knowlton [52] from the Miocene of Oregon, and by Penhallow [53] from the Tertiary (Eocene?) of British Columbia.

Diospyros stenosepala Heer

Diospyros stenosepala Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 35, pl. 8, figs. 7, 8, 1869. Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 886, 1896.

This obscurely defined species does not appear to be definitely known except in connection with a calyx and the fragmentary type specimen of a leaf collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, described and figured by Heer, although it was recorded by Lesquereux [54] from the Upper Cretaceous (?) of Wyoming but was not subsequently mentioned by him. The species appears to be of doubtful validity.

[49] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 8, p. 280, pl. 53, figs. 1–3, 1878.

[50] Heer, Oswald, Ueber einige fossile Pflanzen von Vancouver und Britisch-Columbien: Soc. helvétique sci. nat. Nouv. mém., vol. 21, no. 3, p. 8, pl. 1, figs. 10–12; pl. 2, figs. 1–3, 1865.

[51] Heer, Oswald, Recherches sur le climat et la végétation du pays tertiaire, p. 87, Winterthur, 1861.

[52] Knowlton, F. H., Fossil flora of the John Day Basin, Oregon: U. S. Geol. Survey Bull. 204, p. 83, 1902.

[53] Penhallow, D. P., Report on Tertiary plants of British Columbia: Canada Geol. Survey Rept. 1013, p. 52, 1908.

[54] Lesquereux, Leo, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1871, p. 296, 1872.

Genus EBENOXYLON Felix

Ebenoxylon boreale Platen

Ebenoxylon boreale Platen, Naturf. Gesell. Leipzig Sitzungsber., vol. 34, p. 147, 1907 [1908].

Platen described a species of fossil wood from Alaska under the above name but without any reference to locality. He suggested, however, an Oligocene age and its probable relationship to the genus *Diospyros* and listed three Tertiary species (*D. anceps* Heer, *D. stenosepala* Heer, and *D. alaskana* Schimper) recorded from Alaska.

Family STYRACACEAE

Genus MOHRODENDRON Britton

Mohrodendron inopinum Hollick, n. sp.

Plate 60, figure 1b; plate 103, figures 1a, 2

Leaves lanceolate-ovate, 11 centimeters in length by about 4.75 centimeters in maximum width, rounded at the base, narrowly cuneate and acuminate at the apex; margin finely denticulate above, entire toward the base; venation pinnate; secondary veins curved or flexuous, the lower two on each side rather crowded, the others irregularly spaced and arranged, all diverging at angles of 45° to 50° from the midrib, occasionally branched from the under side, curving upward and becoming camptodrome, with fine tertiary veinlets extending from the secondary loops to the adjacent marginal dentitions; tertiary venation obscurely defined but apparently almost straight and at right angles to the secondaries throughout.

This genus has not been heretofore identified with any fossil plant remains except in connection with certain seeds from the Tertiary brown coal of Germany, described and figured under the name *Halesia dubia* Ludwig.[55] It was therefore with considerable interest that leaves in one of our collections from Alaska were identified as apparently referable to this genus, which in our living flora is represented by three species, natives of the southeastern United States. It would not be surprising, therefore, to find it represented in the Tertiary flora of the North American continent, associated with other living genera of similar distribution.

Our specimen closely resembles the average-sized leaves of *Mohrodendron carolinianum* (Linnaeus) Britton (=*Halesia tetraptera* Linnaeus), the silver-bell tree of our Middle and Southern States.

A leaf from the Eocene of the Yellowstone National Park that I am inclined to regard as specifically identical with our specimens was referred by Knowl-

[55] Ludwig, Rudolph, Fossile Pflanzen aus der jüngsten Wetterauer Braunkohle: Palaeontographica, vol. 5, no. 4, p. 98, pl. 21, figs. 5, 5a–5c, 1857.

ton,[56] with reservation, to *Elaeodendron polymorphum* Ward,[57] from the Eocene of Montana, the diverse leaves of which Ward discussed and compared with about a dozen different species in the genera *Celastrus*, *Euonymus*, *Elaeodendron*, *Fraxinus*, *Ilex*, *Salix*, *Aralia*, *Rhamnus*, *Cunonia*, etc. If the specimen figured by Knowlton is actually referable to Ward's species, then I would have no hesitation in referring our specimens also to the same species.

Localities: Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 60, fig. 1b). Kootznahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390) (pl. 103, fig. 1a). Matanuska River 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 103, fig. 2).

Order OLEALES

Family OLEACEAE

Genus FRAXINUS Linnaeus

Fraxinus juglandina Saporta

Plate 42, figure 4b; plate 100, figures 1–3; plate 101, figures 8–10

Fraxinus juglandina Saporta, Annales sci. nat. [Paris], sér. 5, Botanique, vol. 8, p. 89, pl. 7, fig. 6; pl. 9 [7 on plate], figs. 13–16a, 1867.

There appears to be so close a resemblance between our specimens and those from the Miocene of France, described and figured by Saporta, that I have not been able to note any characters which might serve to differentiate them, specifically, although in each lot the individual leaflets vary considerably among themselves; but not more so than the leaflets on the leaves of existing species of *Fraxinus*. Our several forms of leaflets often occur associated together in a single piece of matrix, although none have been found attached to a common petiole.

About a dozen Tertiary species of *Fraxinus* have been described from as many different localities in North America, but none appear to resemble ours from Alaska as closely as the species from France; but certain leaflets referred to other genera, such as *Ampelopsis tertiaria* Lesquereux [58] and *Staphylea acuminata* Lesquereux,[59] are more or less suggestive of the general type with which ours may be surficially compared.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 42, fig. 4b); (pl. 101, figs. 8, 9?). Matanuska coal field, Matanuska-Cook Inlet region, Chickaloon River, shales overlying 15-foot coal near Watson's tunnel 2 (original no. 1); collected by G. C. Martin in 1905 (lot 3672) (pl. 100, fig. 1). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 100, figs. 2, 3). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region. Bluff Point, 7 miles west of Homer, about 1½ miles west of Cook Inlet Coal Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 101, fig. 10).

Fraxinus inordinata Hollick, n. sp.

Plate 100, figure 4; Plate 101, figures 1–7

Leaflets of various sizes, either symmetrical or unsymmetrical, the larger ones about 8 centimeters in length by 3 centimeters in maximum width, the smaller ones about 5 centimeters in length by 1.75 centimeters in maximum width, ovate-lanceolate, tapering above to a narrow apiculate apex, rounded and tapering below to a sharply cuneate base; margin finely denticulate, except at the apex and toward the base, where it is entire; midrib straight, or curved in the unsymmetrical leaflets; venation pinnate; secondary veins irregularly spaced and disposed, more or less flexuous, diverging at angles of about 40° to 45° from the midrib, simple or rarely branched, curving abruptly upward close to the margin, where they either thin out and connect through fine cross venation or become craspedodrome through branchlets from the under sides or through fine veinlets to the adjacent denticulations.

I have grouped together, under a single specific name, these leaflets of various sizes and more or less diverse shapes, for the reason that they all possess many characters in common and appear to differ mainly in size. I have thought, therefore, that they probably represent leaflets of a compound leaf, with general characters that are suggestive of the genus *Fraxinus*, or at least of certain fossil leaflets that have been so referred, such as *Fraxinus mespilifolia* Lesquereux,[60] from the Miocene of Colorado—in fact, our smaller leaflets are so closely similar to those represented by Lesquereux's figures 11 and 12 that, if compared independently of the larger ones, they would be very difficult to differentiate. Relationship with *Fraxinus juglandina* Saporta, the species last described, is also clearly indicated—a relationship that was noted by Lesquereux in connection with *F. mespilifolia*.

Localities: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 100, fig. 4). Matanuska River,

[56] Knowlton, F. H., Fossil flora of the Yellowstone National Park: U. S. Geol. Survey Mon. 32, pt. 2, p. 734, pl. 97, fig. 1, 1899.

[57] Ward, L. F., Synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 555, pl. 54, figs. 6–12, 1886: Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 84, pl. 38, figs. 1–7, 1887.

[58] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 242, pl. 43, fig. 1, 1878.

[59] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 183, pl. 36, fig. 1 [excl. figs. 2–4], 1883.

[60] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 169, pl. 33, figs. 7–12, 1883.

4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 101, figs. 1–7).

Fraxinus? pseudobliqua Hollick, n. sp.

Plate 104, figures 6, 7a

Leaflets ovate-lanceolate-acuminate, slightly curved or falcate, about 4 centimeters in length by 1.5 to 1.75 centimeters in maximum width, tapering to a narrow attenuated apex and rounded at the base, sessile or very short petiolate, sharply serrate-dentate in the middle, with occasional intermediate minor denticulations, obscurely dentate distad, entire proximad; venation simply pinnate, craspedodrome; midrib slightly curved; secondary veins irregularly spaced and disposed, diverging at various angles from the midrib, those below more obtuse than those above, more or less branched distad, each secondary and each of its branches terminating in a marginal dentition.

These leaflets are closely similar, so far as the venation is concerned, to *Fraxinus juglandina* Heer, described above, but the relatively broad, rounded base in each of our specimens serves to distinguish them. They may be compared with certain of the leaves from the Tertiary of Switzerland that were described and figured under the name *Fraxinus praedicta* Heer [61], although Heer apparently regarded them as specifically identical with *Rhus obliqua* Alex. Braun.[62] The generic identification of these specimens and the others with which they may be compared may be regarded as uncertain.

Localities: Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3523) (pl. 104, fig. 6). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska, lowest of three horizons (original no. III); collected by W. W. Atwood in 1907 (lot 4392) (pl. 104, fig. 7a).

Fraxinus lateralis Hollick, n. sp.

Plate 105, figures 5, 6

Lateral leaflets from 3.5 to 5.5 centimeters in length by 1.75 to 3 centimeters in maximum width, somewhat unsymmetrical, cordate-lanceolate, obscurely falcate, broadest slightly below the middle, rounded at the base, tapering above to a cuneate, apiculate apex that is curved or turned to one side; margin finely and uniformly dentate; midrib curved; venation pinnate, craspedodrome; secondary veins numerous, irregularly spaced and disposed, diverging at obtuse angles, the lower ones right angles, from the midrib, mostly curved or bent upward and branched from the under sides toward their extremities, each secondary and each branch terminating in a dentition.

These specimens apparently represent lateral leaflets of a compound leaf resembling *Fraxinus*, although this generic identification may prove to be erroneous. I have not been able to match them satisfactorily with any described species and hence have described them as new.

Localities: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 105, fig. 5). Yakutat-Copper River region, elevation 1,000 feet above creek emptying into Berg Lake, where Happy Hollow trail passes around the shore (original no. 42); collected by G. C. Martin, Sidney Paige, and A. G. Maddren in 1905 (lot 3847) (pl. 105, fig. 6).

Fraxinus yukonensis Hollick, n. sp.

Plate 102, figures 1–4; plate 105, figure 4

Leaves or leaflets oblong or oblong-lanceolate, usually more or less inequilateral, petiolate, varying in size, the larger ones apparently about 18 centimeters in length by 7.5 centimeters in maximum width, tapering to the apex, rounded or curved-cuneate to the obliquely truncate or slightly cordate-truncate base; margin finely serrate-dentate or crenate-serrate-dentate, except close to the base, where it is entire; venation pinnate, craspedodrome; secondary veins irregularly disposed and spaced, diverging at obtuse angles, the lower ones at right angles from the midrib, those on the narrower or cuneate side of the leaf subtending angles less obtuse than those on the wider or rounded side, all more or less branched or forked distad, the extremities of the main veins and branches terminating in the marginal dentitions; tertiary venation well defined, conspicuous, approximately at right angles to the supporting secondaries, bent, curved, flexed, and frequently connected, forming a network of irregular areolae throughout.

These leaves are closely similar to *Fraxinus macrophylla* Heer,[63] from the Tertiary of Greenland, and I was at first inclined to regard them as identical; but our leaves appear to be prevailingly smaller and more oblong, with bases less conspicuously oblique.

Localities: Upper Yukon region, Seventymile Creek, half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 102, figs. 1–3). Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892) (pl. 102, fig. 4). Nenana coal field, Tanana region, Coal Creek just west of Healy Creek Coal Corporation's mine (original no. 23AC 7); collected by S. R. Capps in 1923 (lot 7622) (pl. 105, fig. 4).

Fraxinus johnstrupi Heer

Plate 105, figure 3

Fraxinus johnstrupi Heer, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 13, pl. 80, figs. 1–3, 1883.

---

[61] Heer, Oswald, Flora tertiaria Helvetiae, vol. 3, p. 22, pl. 104, figs. 13a–13g, Winterthur, 1859.

[62] Braun, Alex., in Stizenberger, Ernst, Uebersicht der Versteinerungen des Grossherzogthums Baden, p. 86, Freiberg, 1851.

[63] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 113, pl. 92, figs. 3, 4; pl. 93, figs. 1–4, 1883.

This species has been but sparingly identified anywhere, and to refer our specimen to it may seem somewhat hazardous, but a comparison of our figure with Heer's figures of the type specimens appears to indicate specific identity beyond any reasonable doubt. The only previous record for the species from other than the type locality in Greenland was based on the identification of a specimen from the Eocene of Louisiana.[64]

Locality: Matanuska coal field, 4,800-foot point on traverse of Matanuska River west from Moose Creek, Matanuska-Cook Inlet region (original no. 4); collected by Theodore Chapin in 1910 (lot 5901).

Fraxinus herendeenensis Knowlton

Fraxinus herendeenensis Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 224, pl. 9, fig. 7, 1894; Geol. Soc. America Bull., vol. 5, p. 584, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

This species was based by Knowlton on a single specimen (U. S. Nat. Mus. no. 3763) collected by C. H. Townsend in 1890 at Herendeen Bay, Alaska Peninsula. It has not been recognized except in connection with the type specimen.

Order RUBIALES

Family CAPRIFOLIACEAE

Genus VIBURNUM Linnaeus

Viburnum newberryanum Ward

Plate 106, figure 2

Viburnum newberryanum Ward, U. S. Geol. Survey 6th Ann. Rept., p. 557, pl. 64, figs. 10–12; pl. 65, figs. 1–3, 1886; U. S. Geol. Survey Bull. 37, p. 113, pl. 56, figs. 1–6, 1887.

This well-defined species has heretofore been recorded only from the Fort Union (Eocene) and Lance (Eocene?) formations of Montana and Wyoming by Ward and by Knowlton.[65] Ward's figures of the specimens from the type locality in Montana are the only ones published, other than the one of ours from Alaska, but there can be no question of their mutual specific identity, the only apparent difference being that in our specimen the secondary veins are more evenly and regular spaced than is indicated in most of Ward's figures; but his figure 3, plate 65, and figure 6, plate 56, show the secondary veins spaced exactly as in ours.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

[64] Hollick, Arthur, A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 287, pl. 44, fig. 1, 1899.

[65] Knowlton, F. H., The stratigraphic relations and paleontology of the "Hell Creek beds," "*Ceratops* beds," and equivalents: Washington Acad. Sci. Proc., vol. 11, p. 213, 1909.

Viburnum obliquum Hollick, n. sp.

Plate 105, figures 7, 8

Leaves oblong-lanceolate, inequilateral below the middle; apex apparently rounded-cuneate; base rounded on one side, oblique on the other; margin serrate-dentate; venation pinnate, craspedodrome; secondary veins alternate, ascending, diverging at more acute angles from the midrib on the oblique side than on the other, branched toward their extremities from the under sides, each vein and branch terminating in a marginal dentition.

This species has certain of the characters of *Viburnum castrae* Knowlton and Cockerell[66] and *V. woottonianum* Knowlton,[67] both of which are depicted as slightly inequilateral at their bases and with conspicuously ascending secondary veins. From *V. castrae* ours differs principally in its general shape, which is more oblong than lanceolate, and from *V. woottonianum* in the character of the margin, which in ours is dentate throughout, except near the base, while in *V. woottonianum* it is described as entire from about the middle downward. Knowlton's figure, however, appears to represent a specimen in which this part of the margin is not preserved.

In these three species we have a general type of leaf that differs but little, and a slight modification of the specific characters in anyone might readily confuse its specific identity.

Locality: Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

Viburnum contortum Lesquereux

Plate 106, figure 1

Viburnum contortum Lesquereux, U. S. Geol. and Geog. Survey Terr. Ann. Rept. for 1872, p. 396, 1873.

Viburnum marginatum Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 7, p. 223, pl. 38, fig. 2 (excl. fig. 11, pl. 37, and figs. 1, 3, 4, 5, pl. 38), 1878.

There can be hardly any question in regard to the specific identity of our specimen with the one from the Eocene of Wyoming described and figured by Lesquereux, although ours is a much larger leaf; but it has the same peculiar inequilateral, cuneate base and the same characteristic obovate outline.

Whether or not *Viburnum contortum* should be regarded as a form or variety of *V. marginatum* would appear to be more or less problematic. It was originally described by Lesquereux in 1873 as a distinct

[66] 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. 641, 1919, =*Viburnum lanceolatum* Newberry, J. S., Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 54, 1868; The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 131, pl. 33, fig. 10, 1898. Not *V. lanceolatum* Hill, 1868.

[67] 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. 347, pl. 111, fig. 6, 1917 [1918].

species and was subsequently included by him under *V. marginatum;* but later their specific distinction was reestablished by Knowlton [68] in connection with a specimen from the Eocene (Raton formation) of Colorado. The matter was also rendered somewhat more complicated by Heer,[69] who relegated both *contortum* and *marginatum* to a single species and another genus, under the name *Platanus marginata*, and introduced into the species a number of leaves from the Tertiary of Greenland that differed widely from any of Lesquereux's figures of either species. From a careful examination and comparison of all these figures it appears as if *Viburnum contortum* and *V. marginatum* as represented by Lesquereux's figures 1 and 4, plate 38, might be regarded as specifically identical with or merely as varietally different from each other, but that Heer's *Platanus marginata* could hardly be included in the same category with them and should be regarded not only as specifically but also as generically distinct.

Locality: Matanuska coal field, Matanuska-Cook Inlet region, strata beneath coal, Kings River; collected by Sidney Paige and Adolph Knopf in 1906 (lot 3955).

Viburnum antiquum (Newberry) Hollick

Plate 106, figure 3

Viburnum antiquum (Newberry) Hollick, in Newberry, U. S. Geol. Survey Mon. 35, p. 128, pl. 33, figs. 1, 2, 1898.
Tilia antiqua Newberry, Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 52, 1868.
Viburnum tilioides Ward, U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 61, figs. 1–7; pl. 62, figs. 1–6, 1886; U. S. Geol. Survey Bull. 37, p. 107, pl. 50, figs. 1–3; pl. 51, figs. 1–8; pl. 52, figs. 1, 2, 1887.

There can be little doubt that our specimen represents the lower part of one side of a leaf of this species, which is a common element in the Fort Union (Eocene) and Lance (Eocene?) formations of Montana, Wyoming, and North Dakota.

Locality: Upper Yukon region, Bryant Creek (original no. 3AP 348); collected by L. M. Prindle in 1903 (lot 3227).

Viburnum evexum Hollick, n. sp.

Plate 119, figure 2

Leaf apparently obovoid-oblong; margin undulate-dentate; venation pinnate-subpalmate, craspedodrome; secondary veins subtending acute angles with the midrib, the lowest on each side of the midrib simulating a lateral primary with numerous branches from the under side, those above ascending, curved upward, and more or less branched distally, each vein and branch terminating in a marginal dentition.

This is not a satisfactory specimen upon which to base a new species; but it does not appear to be identifiable with any species heretofore described, and it possesses characters that should serve to identify it with more perfect specimens should these be found. The shape may be seen to be rather peculiar and suggestive of certain figures of leaves from the Eocene of Montana, described by Ward [70] under the name *Viburnum tilioides* (=*V. antiquum* (Newberry) Hollick).[71] These leaves do not appear to be referable to the species originally described and figured by Newberry, but they do appear to be more or less similar to our specimen from Alaska, except for their more conspicuous, well-defined dentition.

Locality: Chignik, about 200 yards south of native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519).

Viburnum aequale Hollick, n. sp.

Plate 119, figure 1

Leaf apparently oblong-ellipsoidal, about 12 centimeters in length by 9 centimeters in maximum width, narrowed below and terminating in a curved-truncate base; margin coarsely crenate-dentate or bluntly serrate-dentate; venation pinnate, craspedodrome; secondary veins irregularly spaced and disposed, ascending, diverging at acute angles from the midrib, the lower two subopposite, basilar, branched from their under sides, the branches forming acute angles with their supporting secondaries; upper secondaries branched distad from the under sides, the branches in places branched in a similar manner, each main vein, branch, and branchlet terminating in one of the marginal dentitions; tertiary veins apparently mostly simple, fixed or curved or occasionally bent, subtending various angles with the midrib and secondaries.

I am inclined to think that this leaf may represent a large specimen of one or another of the several closely related forms of *Viburnum*, from the Eocene of Montana, described and figured under the names *V. limpidum*, *V. elongatum*, etc., by Ward;[72] although in our specimen the marginal dentitions appear to be more uniformly bluntly dentate, and the base more distinctly truncate than in any of the specimens figured in the works cited. This general type of *Viburnum* leaf is abundant in the Eocene rocks of the West-

[68] 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. 346, pl. 108, fig. 3, 1917 [1918].

[69] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 97, pl. 98, figs. 3–5; pl. 99, figs. 2, 3; pl. 101, fig. 5, 1883.

[70] Ward, L. F., A synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 61, figs. 1, 2, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, pl. 50, fig. 1; pl. 51, fig. 2, 1887.

[71] Hollick, Arthur, in Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 128, pl. 33, figs. 1, 2, 1898, =*Tilia antiqua* Newberry, Notes on the later extinct floras of North America: Lyceum Nat. Hist. [New York] Annals, vol. 9, p. 52, 1868.

[72] Ward, L. F., A synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 63, figs. 1–4; p. 557, pl. 63, figs. 8, 9, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 110, pl. 53, figs. 3–6; p. 112, pl. 54, figs. 4, 5, 1887.

ern States, and it is interesting to find the type represented in the Tertiary of Alaska by a form that is closely comparable.

Incidentally it may also be compared with a fragmentary leaf from the Eocene of Greenland, which Heer [73] described as *Sorbus grandifolia*. This, however, appears to be a very different leaf from one from the Eocene of Spitsbergen subsequently referred to the species by the same author.[74]

Locality: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186).

Viburnum schmidtianum Heer?

Plate 106, figure 4

Viburnum schmidtianum Heer, Miocene Flora der Insel Sachalin: Flora fossilis arctica, vol. 5, no. 3, p. 43, pl. 11, figs. 4–8, 1878; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 114, pl. 89, fig. 10; pl. 94, fig. 4, 1883.

Viburnum schmidtianum appears to have been a species that was limited in its distribution to the Tertiary of the Arctic regions. A considerable diversity of leaf forms were included by Heer in his illustrations of the species from Sakhalin and Greenland, and several of the forms do not agree with his description. Our specimen may be compared with his figures 4, 5, and 6 (vol. 5), except that the base appears to have been truncate rather than rounded, as shown in his figure 4. On the other hand, his figure 10 (vol. 7) has a base that is almost exactly like ours.

I am also inclined to regard as specifically identical with *Viburnum schmidtianum* a leaf included by Heer [75] in *V. nordenskiöldi* Heer,[76] to which, however, the figure does not appear to bear even a remote resemblance.

More recently Konstantow [77] identified as *V. schmidtianum* and figured a leaf from the Eocene of eastern Siberia, which closely resembles our specimen, but unfortunately the basal portion is missing. I have little doubt that our specimen is specifically identical with certain of the Tertiary leaves from the Arctic region that have been included under *V. schmidtianum*, but in view of its fragmentary condition the identification is regarded as tentative. The probability that it may represent a new species appears to be negligible.

Incidentally it may be mentioned, in connection with *V. schmidtianum*, that Kryshtofovich [78] questioned the Tertiary age of certain of the strata on the island of Sakhalin in which the specimens of *V. schmidtianum* described by Heer were found. It is possible, therefore, that all the specimens included in the species by Heer may not properly belong in it.

Locality: North of upper Nenana River, northwest of Wells Creek, Tanana region (original no. 13AP 51); collected by F. H. Moffit and J. E. Pogue in 1913 (lot 6567).

Viburnum nordenskiöldi Heer

Plate 107, figures 1–3

Viburnum nordenskiöldi Heer, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 3, fig. 13, 1869; Beiträge zur fossilen Flora Spitzbergens: Idem, vol. 4, no. 1, p. 77, pl. 15, fig. 5a; pl. 18, fig. 7; pl. 23, fig. 4b; pl. 29, fig. 5, 1876; Die Miocene Flora des Grinnell-Landes; Idem, vol. 5, no. 6, p. 36, pl. 4, fig. 4d; pl. 7, figs. 5–7, 1878; Beiträge zur Miocenen Flora von Nord-Canada; Idem, vol. 6, pt. 1, no. 3, p. 15, pl. 1, fig. 8, 1880; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 115, pl. 92, fig. 11; pl. 96, fig. 2, 1883.

Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 225, 1894; Geol. Soc. America Bull., vol. 5, p. 583, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 887, 1896.

This is a widely distributed Tertiary species in the Arctic region. The specimen upon which Heer founded the species was collected by Hjalmar Furuhjelm at Ninilchik, Kenai Peninsula, and other specimens were described and figured by Heer from Canada, Grinnell Land, Greenland, and Spitsbergen. Specimens were also described and figured from the Eocene of North Dakota and Montana by Lesquereux [79] and by Ward.[80] It was also identified in the Tertiary of Siberia by Konstantow [81] and from Manchuria by Florin.[82]

Localities: Chignik Bay, Alaska Peninsula, west side of Anchorage Bay, near upper end, about 300 yards north of Indian settlement (original no. 962); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3524) (pl. 107, fig. 1). Nenana coal field, Tanana region, California Creek, 0.47 mile S. 42° W. of northeast corner of sec. 15, T. 9 S., R. 6 W. (original no. 2); collected by G. C. Martin and R. M. Overbeck in 1916 (lot 7261) (pl. 107, figs. 2, 3).

Viburnum whymperi Heer

Plate 107, figures 4–7

Viburnum whymperi Heer, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 475, pl. 46, fig. 1b, 1869; Die Miocene Flora und Fauna Spitzbergens: Idem, no. 3, p. 60, pl. 13, figs. 3–23, 1870; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 115, pl. 102, fig. 13, 1883.

[73] Heer, Oswald, Contributions to the fossil flora of North Greenland: Flora fossilis arctica, vol. 2, no. 4, p. 483, pl. 14, fig. 4, 1869.

[74] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 68, pl. 14, fig. 16, 1870.

[75] Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, pp. 115–116, pl. 96, fig. 2, 1883.

[76] Heer, Oswald, Fossile flora von Alaska: Flora fossilis arctica, vol. 2, no. 2, p. 36, pl. 3, fig. 13, 1869.

[77] Konstantow, S. W., Die tertiäre Flora des Bjelogorje Aufschlusses am Unterlauf des Fl. Bureja: Com. géol. Mém., n. sér., no. 113, p. 23, pl. 2, fig. 3, 1914.

[78] Kryshtofovich, African, On the Cretaceous flora of Russian Sakhalin: Imp. Univ. Tokio Coll. Sci. Jour., vol. 40, art. 8, p. 60, 1918.

[79] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 230, pl. 46A, figs. 6, 7, 1883.

[80] Ward, L. F., A synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 557, pl. 65, figs. 4–6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 114, pl. 57, figs. 1–3, 1887.

[81] Konstantow, S. W., Die tertiäre Flora des Bjelogorje Aufschlusses am Unterlauf des Fl. Bureja: Com. géol. Mém., n. sér, no. 113, p. 23, pl. 2, fig. 1b, St. Petersburg, 1914.

[82] Florin, Rudolph, Zur alttertiären Flora der südlichen Mandschurei: Palaeontologia sinica, vol. 1, no. 1 (A), p. 13, pl. 11, fig. 15, Peking, 1922.

The several figures of this species given by Heer vary considerably, but his figure 13, plate 102, representing a leaf from the Tertiary of Spitsbergen, may be compared with our figures 4 and 6, the main difference between them being that in our specimens the lateral primaries are more strictly opposite than they are depicted in Heer's figure. Our figures 6 and 7 are included in the species with some doubt. They might, perhaps, be described under a new specific name.

Two leaves from the Upper Cretaceous of Wyoming were doubtfully referred to the species by Lesquereux,[83] and an examination and comparison of these figures, in connection with Heer's, will at once indicate that generic relationship is all that could be reasonably claimed for them; and it is of interest to note that one of them (fig. 23, pl. 61) was subsequently included in a new species, *Viburnum anomalinervum*, by Knowlton,[84] whose comment was as follows: "It has for a long time been apparent that the little leaf from Point of Rocks, Wyo., referred by Lesquereux to Heer's *Viburnum whymperi*, could not belong to that species; and I have ventured to refer it to the present species."

Three specimens from the Upper Cretaceous (Montana group) of Wyoming were described, figured, and referred with some doubt to the species by Knowlton,[85] but only one of these figures (fig. 3, pl. 19) appears to show any resemblance that might justify the reference, and this one was subsequently referred by Knowlton [86] to *Viburnum hollicki* Berry.[87]

We may say, therefore, that it is very doubtful if any of the specimens identified as *Viburnum whymperi* from any Upper Cretaceous formation really belong to the species; but a specimen from the Eocene (Fort Union formation) of Montana, described and figured by Ward,[88] is somewhat more suggestive of the species as figured by Heer.

Indications of the presence of the species as an element in the fossil flora of any part of the Old World, exclusive of Spitsbergen, are very meager. It was recorded from the Tertiary of Ireland by Williamson and Baily,[89] who gave a figure of a leaf (fig. 3a) and one of a fruit (fig. 3b), but the leaf does not appear to resemble the species even remotely, and the fruit is entirely problematic. It was also recorded from the Tertiary of Bohemia by Menzel,[90] on the strength of a poorly defined fruit or seed, the identity of which is more than doubtful; and these appear to be the only references to the species in connection with the fossil flora of the Old World.

Localities: Upper Yukon region, Mission Creek, about 2 miles above junction with Excelsior Creek (original no. 3AP 432); collected by L. M. Prindle in 1903 (lot 3231) (pl. 107, figs. 4, 5). Upper Yukon region, Seventymile Creek, half a mile below mouth of Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711) (pl. 107, figs. 6, 7).

Viburnum duriusculum Hollick, n. sp.

Plate 105, figure 9

Leaf coarse in texture, ovate, 5.5 centimeters in length by 4 centimeters in width just below the middle; base rounded-truncate; apex rounded-cuneate; margin sharply triangular-spinose dentate; venation strong, pinnate, craspedodrome; secondary veins irregularly spaced and branched or forked, each main vein and subdivision terminating in one of the dentitions.

This leaf is described as a new species, although it may be specifically identical with *Viburnum dichotomum* Lesquereux [91] from the Eocene of Wyoming, from which it differs merely in the more rigid midrib and the forking rather than branching of the secondary veins, or with *Viburnum dakotense* Lesquereux [92] from the Eocene of North Dakota.

It is evident that in these three species we have leaves that might be regarded as varietal forms of one and the same species, and, as a matter of fact, they differ from each other less than the leaves on individual bushes of certain living species of *Viburnum.*

Locality: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5186).

Fruit of Viburnum? sp.

Plate 107, figures 8, 9

The seeds or fruit figured as above appear to be at least generically identical with those described and figured by Ward [93] and discussed under *Viburnum tilioides.* Whether or not they are properly referable to that species, or even to the genus *Viburnum*, may,

[83] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 225, pl. 38, fig. 7; pl. 61, fig. 23, 1878.

[84] Knowlton, F. H., Fossil floras of the Vermejo and Raton formations of Colorado and New Mexico: U. S. Geol. Survey Prof. Paper 101, pp. 275–276, pl. 45, fig. 4, 1917 [1918].

[85] 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.

[86] Knowlton, F. H., A catalogue of the Mesozoic and Cenozoic plants of North America: U. S. Geol. Survey Bull. 696, p. 646, 1919.

[87] Berry, E. W., New species of plants from the Matawan formation: Am. Naturalist, vol. 37, p. 683, figs. 5, 6, 1903.

[88] Ward, L. F., A synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 557, pl. 63, fig. 5, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 111, pl. 54, fig. 1, 1887.

[89] Williamson, W. C., and Baily, W. H., Second report of the committee * * * appointed for the purpose of collecting and reporting on the Tertiary (Miocene) flora, etc., of the basalt of the North of Ireland: British Assoc. Adv. Sci. 50th Rept., p. 109, pl. 3, firs. 3a, 3b, 1880.

[90] Menzel, Paul, Die Flora des tertiären Polierschiefers von Sulloditz im böhmischen Mittelgebirge: Naturwiss. Gesell. Isis zu Bautzen Sitzungsber u. Abh., 1896–97, p. 64 (45), pl. 1, fig. 8, 1897.

[91] Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 225, pl. 38, fig. 6, 1878.

[92] Lesquereux, Leo, The Cretaceous and Tertiary floras: U. S. Geol. Survey Terr. Rept., vol. 8, p. 231, pl. 46A, fig. 9, 1883.

[93] Ward, L. F., A synopsis of the flora of the Laramie group: U. S. Geol. Survey 6th Ann. Rept., p. 556, pl. 62, figs. 2–6, 1886; Types of the Laramie flora: U. S. Geol. Survey Bull. 37, p. 107, pl. 51, figs. 4–8, 1887.

however, be regarded as an open question; but it is a significant fact that, like Ward's specimens, they were found more or less closely associated with leaves that undoubtedly belong to the genus, and hence I have provisionally included them in it.

Ward's specimens were obtained from the Eocene (Fort Union formation) of Montana, and somewhat similar remains were described and figured by Heer [94] under *Viburnum whymperi* Heer and *V. macrospermum* Heer, from the Tertiary (Eocene?) of Spitsbergen; but whether or not these should all be included, along with ours, in one generic category, and in the genus *Viburnum*, must be, for the present at least, regarded as problematic, especially as surficially similar fruits were described under the genus *Nyssa* by Weber [95] and Velenovsky.[96]

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

SPERMATOPHYTA OF UNDETERMINED ORDINAL AND FAMILY RELATIONSHIP

Genus NORDENSKIÖLDIA Heer

Nordenskiöldia borealis Heer

Plate 120, figures 1, 2

Nordenskiöldia borealis Heer, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 65, pl. 7, figs. 1–13, 1870.

This well-defined organism, representing a fruit of undetermined botanical relationship, first described and figured under that name from specimens discovered in Spitsbergen, was subsequently identified in specimens from Greenland [97] which had been originally described as the fruit of *Diospyros*.

It was recorded by Dawson [98] from the Mackenzie River region of Canada and by Newberry [99] from the Green River shales of Wyoming. It was heretofore recorded only from the places mentioned and only in connection with deposits of Eocene age.

Locality: Portage (Balboa) Bay, Alaska Peninsula (original no. 6); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5178).

[94] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, p. 60, pl. 13, figs. 7–23, 24, 25a, 26a, 27–28b, 1870.

[95] Weber, C. O., Die Tertiärflora der niederrheinischen Braunkohlenformation: Palaeontographica, vol. 2, pp. 184 (70), 185 (71), pl. 20 (3), 1851 (1852), = *N. rugosa, obovata,* and *maxima.*

[96] Velenovsky, Josef, Die Flora aus den ausgebrannten tertiären Letten von Vrsovic bei Laun: K. böhm. Gesell. Wiss. Abh., ser. 6, vol. 11, p. 37, pl. 6, figs. 20–24, 1881, = *N. vertumni* Unger.

[97] Heer, Oswald, Nachträge zur fossilen Flora Grönlands: Flora fossilis arctica, vol. 6, pt. 1, no. 2, p. 13, pl. 6, fig. 8, 1880, = *Diospyros* fruit, Miocene Flora von Nordgrönland: Idem, vol. 1, p. 117, pl. 47, figs. 4b, 5, 5f, g, 1868.

[98] Dawson, J. W., On fossil plants collected by Mr. R. A. McConnell on Mackenzie River and by Mr. T. C. Weston on Bow River: Roy. Soc. Canada Trans., vol. 7, sec. 4, p. 71, pl. 10, fig. 6, 1889.

[99] Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 137, pl. 68, figs. 4–6, 1898.

Genus ANTHOLITHES Brongniart

Antholithes castaneoides Hollick, n. sp.

Plate 120, figure 5

Remains consisting of stellate clusters of petaloid and stamenoid organs apparently attached to a common stalk or rachis; clusters about 75 millimeters in diameter.

These rather obscurely defined remains are suggestive of amentaceous inflorescence similar to that of *Quercus*, *Fagus*, *Castanea*, etc. A number of remains with which they might be compared were described and figured by Heer [1] under the name *Cyperites microcarpus*, from the Tertiary of the Arctic regions, and of these the specimen that he regarded as representing the male inflorescence of *Castanea ungeri* is strikingly like ours and may well be generically identical with it. Specific identity with the leaf, however, is too uncertain, and it would seem to be the better course to give to our specimen a name which would merely imply an inflorescence resembling that of *Castanea.*

Locality: Matanuska River, 4,200 feet below Moose Creek, Matanuska-Cook Inlet region (original no. 3); collected by G. C. Martin in 1910 (lot 5892).

Genus PALAEANTHUS Newberry

Palaeanthus prindlei Hollick, n. sp.

Plate 60, figure 2

Organism consisting of a long, stout petiole, 4 centimeters or more in length by about 3.5 millimeters in width, terminated by what is apparently the remains of an inflorescence, which includes an obscurely defined receptacle to which are attached a cluster of inwardly concave, linguloid sepals or petals that average about a centimeter in length.

This peculiar specimen presents very much the appearance of a flattened and partly dismembered composite flower. The petaloid appendages must have been of a firm or coriaceous texture and are apparently more or less curved longitudinally and laterally, forming a concave inner surface, suggestive of infolding and overlapping.

It is similar in general appearance to the organisms described and figured by Newberry [2] from the Upper Cretaceous clays at Amboy, N. J., under the name *Palaeanthus* (*Williamsonia*) *problematica.* Indeed, the resemblance of our specimen to certain of New-

[1] Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 97, pl. 45, figs. 4, 4b, 5, 5b, c, d, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 2, p. 466, pl. 55, figs. 11, 12, 1869.

Castanea ungeri Heer, idem, vol. 2, no. 2, p. 470, pl. 45, figs. 1b, 1bb. *Nymphaea arctica* Heer, Die Miocene Flora und Fauna Spitzbergens: Idem, vol. 2, no. 3, p. 64, pl. 14, figs. 6, 7, 1870.

Platanus marginata Lesquereux sp. Heer, Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 97, pl. 99, fig. 3b, 1883.

[2] Newberry, J. S., The flora of the Amboy clays: U. S. Geol. Survey Mon. 26, p. 125, pl. 35, figs. 1–9, 1895.

berry's figures (figs. 2, 5, and 8) is so striking that, if found in rocks of equivalent age, the generic identity of our specimen, at least, would probably not be questioned. Apparently the only surficial difference is that our specimen is smaller than those figured by Newberry.

What the exact botanical relationships of these organisms are it is impossible to determine satisfactorily. Newberry, in his discussion, remarked:

It is evident * * * that the material composing these florets of the ray was more substantial and persistent than that of most helianthoid flowers, but it is well known that many of the Compositae, like *Gnaphalium, Heliochrysum*, etc., have the ray florets scarious or woody. * * * Flowers of the Compositae would not be out of place, and we should not hesitate to accept the obvious inference that these were such if it were not that a group of flowerlike organs—I mean the flowers called *Williamsonia*—had been found in Mesozoic rocks, * * * which are not without resemblance to, and perhaps not without botanical affinity with, these, and which have been proved to be the florescence of cycads.

It would be profitless to enter here upon a discussion of the probable botanical relationship of our specimen and incidentally of the genera *Palaeanthus* and *Williamsonia;* but those who may be interested in the subject may refer to Wieland's work on fossil cycads.[3]

I am not prepared to express any definite opinion, but it may perhaps be pertinent to remark that whereas we have not found any other plant remains in Alaska that are suggestive of the Compositae, well-defined remains of cycads occur in both the Cretaceous and the Tertiary rocks of the Territory. On the other hand, however, it may be remarked that the long petiole is suggestive of connection with a flower of the Compositae rather than with one of the Cycadaceae. In the circumstances it seems advisable, at least for the present, to consider the family relationship of the genus *Palaeanthus* undetermined.

The specific name is given in honor of the collector, Mr. L. M. Prindle.

Locality: Bryant Creek, upper Yukon region (original no. 3AP 350); collected by L. M. Prindle in 1903 (lot 3229).

Genus PHYLLITES Brongniart

Phyllites saundersi Knowlton

Phyllites saundersi Knowlton, Alaska, vol. 4, p. 157, pl. 25, fig. 2; pl. 33, fig. 2, Harriman Alaska Expedition, 1904.

This species, consisting of a catkinlike organism, is represented by two specimens, collected by De Alton Saunders in 1899 at Kukak Bay, Alaska Peninsula (U. S. Nat. Mus. nos. 30078 and 30091).

In his description of the specimens Knowlton said:

At first sight certain of the detached specimens have the appearance of being catkins of something like *Salix* or *Populus*, but, as may be seen in the figures, they stand erect on short, thick branches, quite unlike the conditions obtaining in either of these genera. It may be that they are the branches of a conifer beset with numerous thick leaves, but neither do they meet all the requirements necessary for such a reference.

Phyllites arctica Knowlton

Phyllites arctica Knowlton, U. S. Nat. Mus. Proc., vol. 17, p. 230, pl. 9, figs. 10, 11, 1894; Geol. Soc. America Bull., vol. 5, p. 587, 1894; U. S. Geol. Survey 17th Ann. Rept., pt. 1, p. 890, 1896.

The specimens described under the above name were collected by C. H. Townsend in 1890 at Herendeen Bay, Alaska Peninsula (U. S. Nat. Mus. no. 3766). They are strongly suggestive of the genus *Acer*, as noted by Knowlton [4] in his discussion of their possible generic affinities.

Dicotyledonous leaf (gen. and sp.?)

Plate 11, figure 1b

This specimen consists of the fragmentary remnant of the basal part of a leaf that was, apparently, coarse in texture, with a stout midrib and long petiole. The secondary venation is simply pinnate, and the veins appear to be widely spaced. The base of the leaf appears to be acutely cuneate and the margin entire. The characters, however, are too incompletely preserved for either adequate or satisfactory description, and even a tentative generic reference would be of little or no value.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4389).

Dicotyledonous leaf (gen. and sp.?)

Plate 22, figure 5c

This fragment may represent a median portion of a platanoid leaf; but it would be useless to attempt any discussion of its probable specific or generic relationship.

Locality: Chignik, about 200 yards south of native village, Chignik Bay, Alaska Peninsula (original no. 956); collected by T. W. Stanton in 1904 (lot 3519).

Genus CARPOLITHES Schlotheim

Carpolithes auriformis Hollick, n. sp.

Plate 120, figures 6, 7

Ear-shaped organisms, about 8 millimeters in length by 4 millimeters in width across the broadest part, with gibbous, spatulate nuclei surrounded, except at the smaller, open end, by narrow borders that are minutely denticulate on the outer rim.

These organisms present the appearance of seeds or carpels that have been split open, exposing the interior; and the smaller ends look as if they might represent former points of attachment. They are also

[3] Wieland, G. R., American fossil cycads: Carnegie Inst. Washington Pub. 34, vol. 2 (Taxonomy), especially ch. 12 and bibliography, pp. 239–248, 1916.

[4] Knowlton, F. H., op. cit. (U. S. Nat. Mus.), p. 231.

suggestive of nodal diaphragms, similar to those of *Equisetum;* but the shape and the apparently open end are disturbing features which would require interpretation in such connection.

Locality: Cliff 1 mile south of small bay on south shore of King Salmon Lake, Alaska Peninsula (original no. P-21); collected by W. R. Smith in 1922.

Carpolithes elytraeformis Hollick, n. sp.

Plate 120, figures 3, 4

Organism apparently oblong or oblong-ovate, about 1.75 centimeters in length by 0.75 centimeter in maximum width, entire, punctate in a series of about six regular rows that extend throughout its length.

Our two figures of this peculiar organism represent counterparts of a single specimen. It is suggestive of an elytron of a coleopterous insect, such as are depicted by Heer[5] from the Tertiary of Spitsbergen, and of a similar object described and figured by the same author[6] under the name *Chrysomelites alaskanus*, based on a specimen collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, to which it is possible that our specimens may ultimately be referred, if further confirmatory evidence should be forthcoming.

[5] Heer, Oswald, Die Miocene Flora und Fauna Spitzbergens: Flora fossilis arctica, vol. 2, no. 3, pl. 16, figs. 1-4, 1870.

[6] Heer, Oswald, Flora fossilis alaskana: Idem, vol. 2, no. 2, p. 39, pl. 10, figs. 6, 6b, 1869.

Taking all of the facts and circumstances into consideration, however, I think it advisable to regard our specimens, at least tentatively, as belonging in the vegetable kingdom.

Locality: Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 141); collected by R. S. Tarr in 1905 (lot 3879).

Genus CARPITES Schimper

Carpites sp. Knowlton

Carpites sp. Knowlton, U. S. Geol. Survey 18th Ann. Rept., pt. 3, p. 195, 1898.

This generic identification by Knowlton is included in a list of fossil plant remains collected by J. E. Spurr in 1896 at Miller's [Drew] coal mine, on the north bank of the Yukon River, about 25 miles above the mouth of Minook Creek, in the central Yukon region.

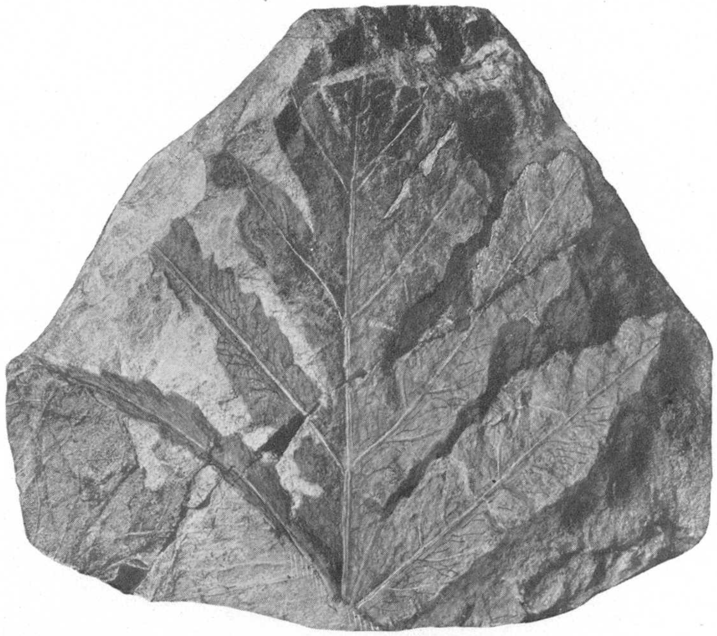
Fruit or nut?

Fruit or nut?, Thomas, A. O., Iowa Acad. Sci. Proc., vol. 24, pp. 113-117, pl. 5, figs. 1-4, 1917.

This problematic fossil, or possibly concretion, was described and figured but not named. It was found by Dr. George F. Kay in 1910 in the shales of the Tokun formation, in the Bering River coal field, and it is included in this paper without discussion or comment merely as a matter of record.

PLATES

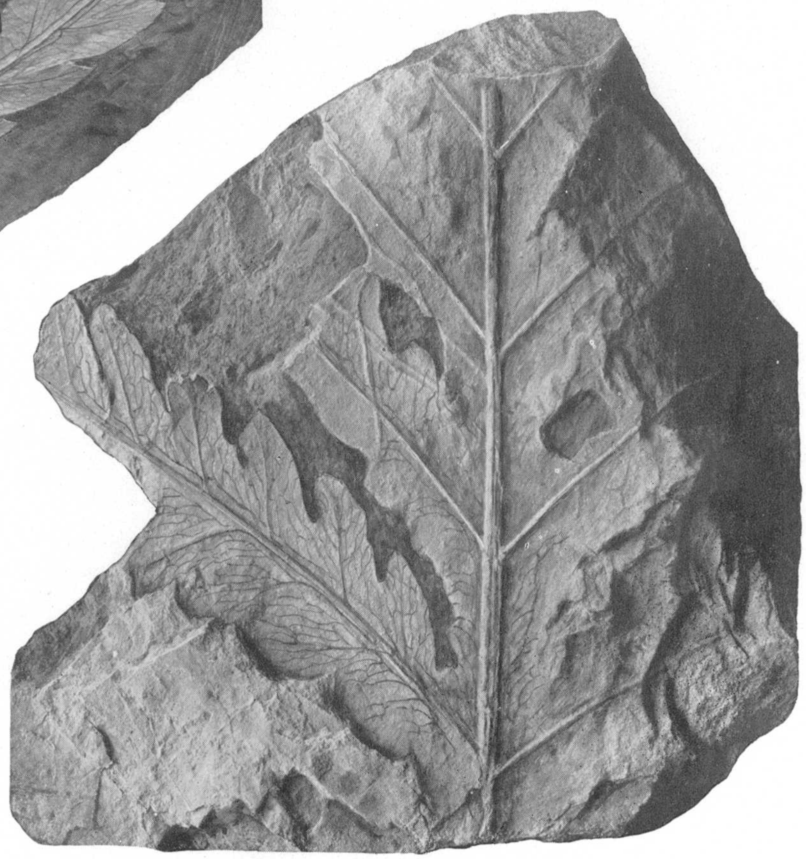
1



2

4

5



3

TERTIARY FLORAS OF ALASKA.

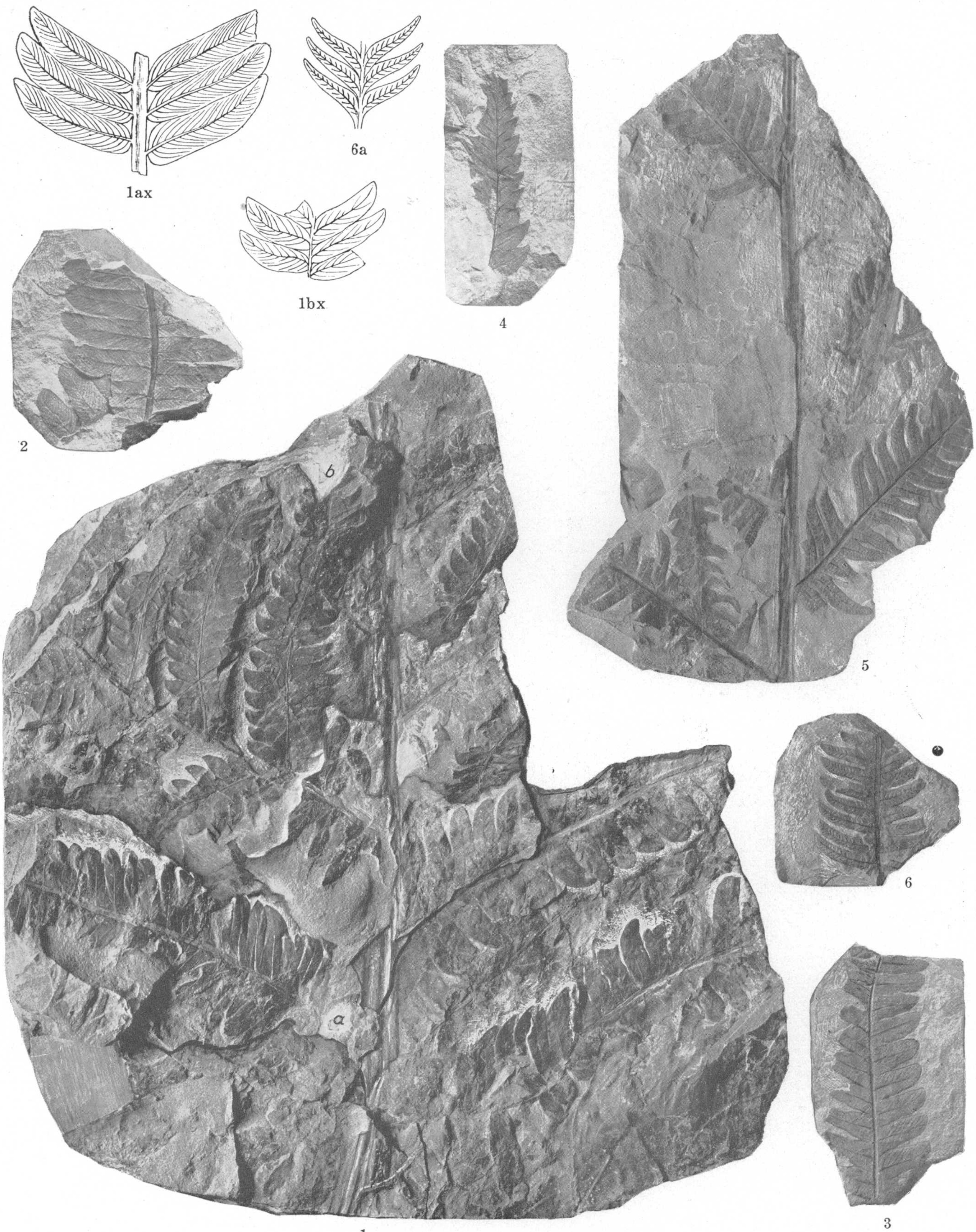
1a. *Osmunda doroschkiana* Goeppert (U.S.N.M. 38657; p. 40).
1b. *Comptonia cuspidata* Lesquereux (U.S.N.M. 38658; p. 74).
2, 3. *Onoclea sensibilis* Linnaeus (U.S.N.M. 38659; pp. 35–36).
4. *Onoclea sensibilis* Linnaeus (U.S.N.M. 38660; pp. 35–36).
5. *Dennstaedtia blomstrandi* (Heer) Hollick (U.S.N.M. 38661; p. 38).

1ax

1

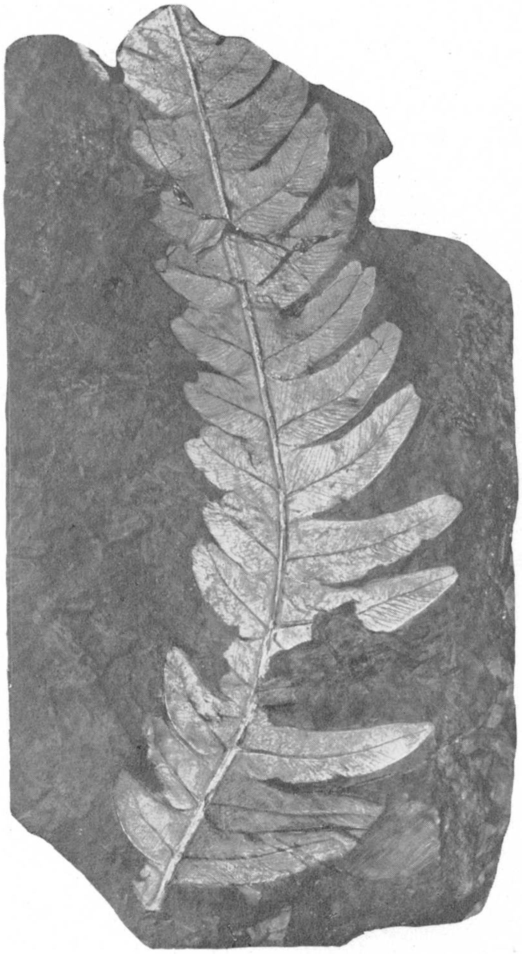
TERTIARY FLORAS OF ALASKA.

1. *Asplenium alaskanum* Hollick, n. sp. (sterile frond) (U.S.N.M. 38662; p. 38). **1a.** Median part of a pinna of figure 1 (p. 38).
1ax. Part of figure 1a enlarged (p. 38).

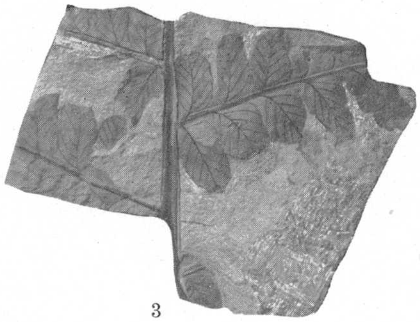


TERTIARY FLORAS OF ALASKA.

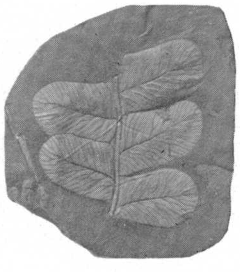
1–6a. *Asplenium alaskanum* Hollick, n. sp. (U.S.N.M. 38664; p. 38).
1. Sterile frond.
1a. Median or proximal part of frond.
1b. Distal part of frond.
1ax. Part of a median or proximal pinna enlarged.
1bx. Part of a distal pinna enlarged.
2. Median fragment of a proximal sterile pinna.
3. Median-distal fragment of distal sterile pinna.
4. Distal fragment of a distal sterile pinna.
5. Fertile frond.
6. Median fragment of a fertile pinna.
6a. Part of a fertile pinna showing shape and arrangement of the sori.



1



3



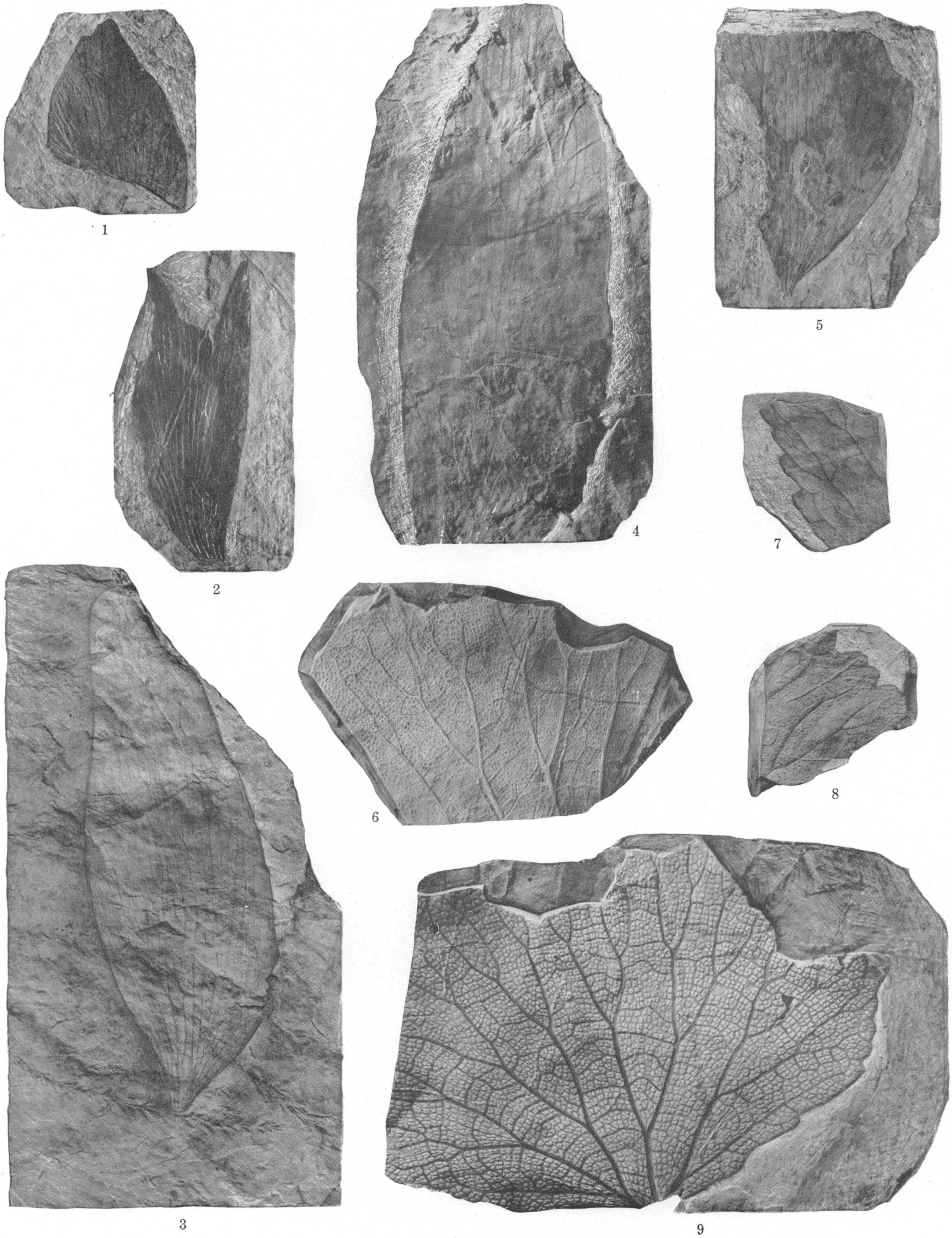
2

4

5

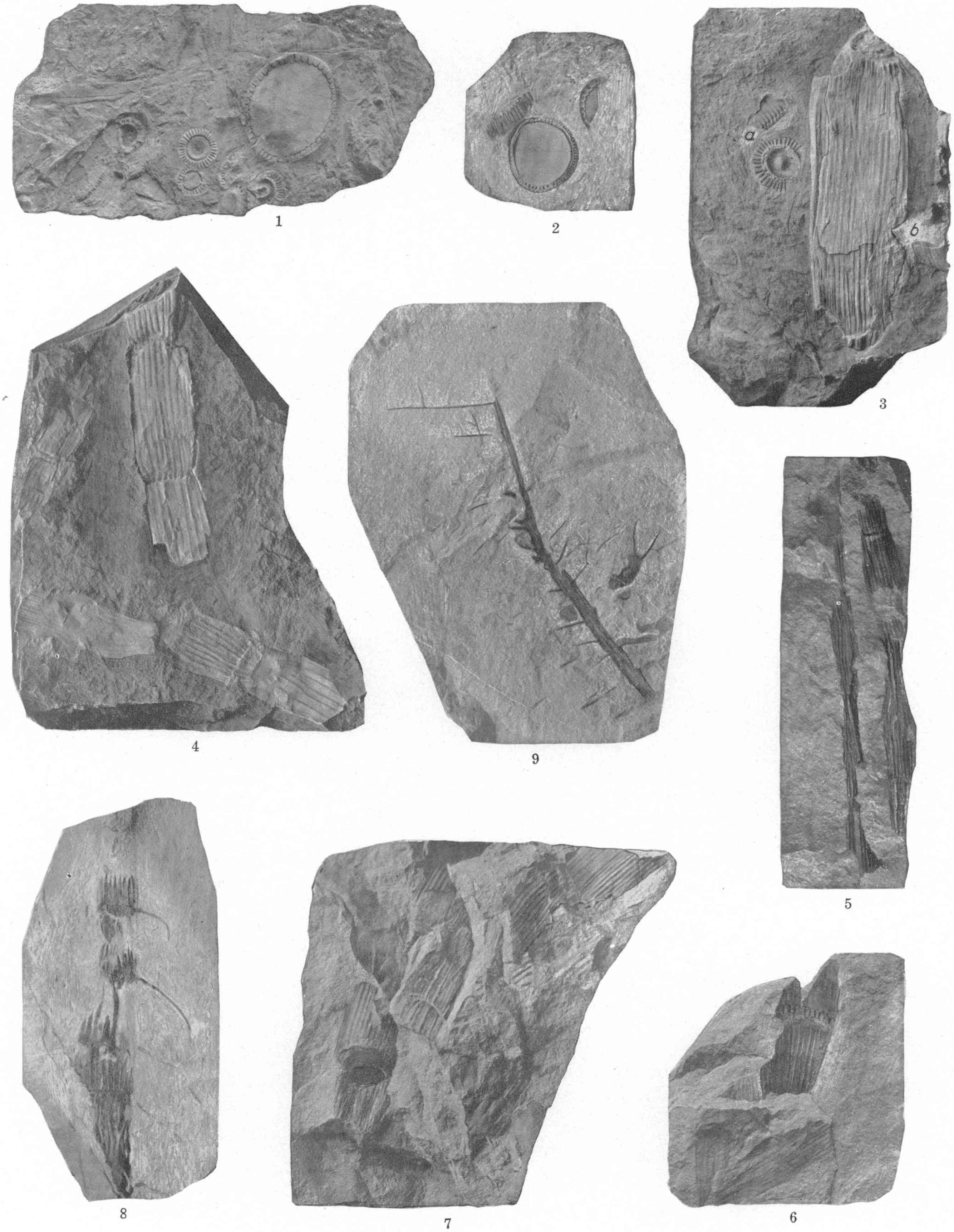
TERTIARY FLORAS OF ALASKA.

1. *Pteris inequilateralis* Hollick, n. sp. (U.S.N.M. 38665; pp. 38–39).
2. *Osmunda dubiosa* Hollick, n. sp. (U.S.N.M. 38666; p. 40).
3–4. *Asplenium alaskanum* Hollick, n. sp., fragments of a median-distal part of a sterile frond (U.S.N.M. 38663; p. 38).
5. *Asplenium alaskanum* Hollick, n. sp., median-proximal pinnae of a sterile frond (U.S.N.M. 38662; p. 38).



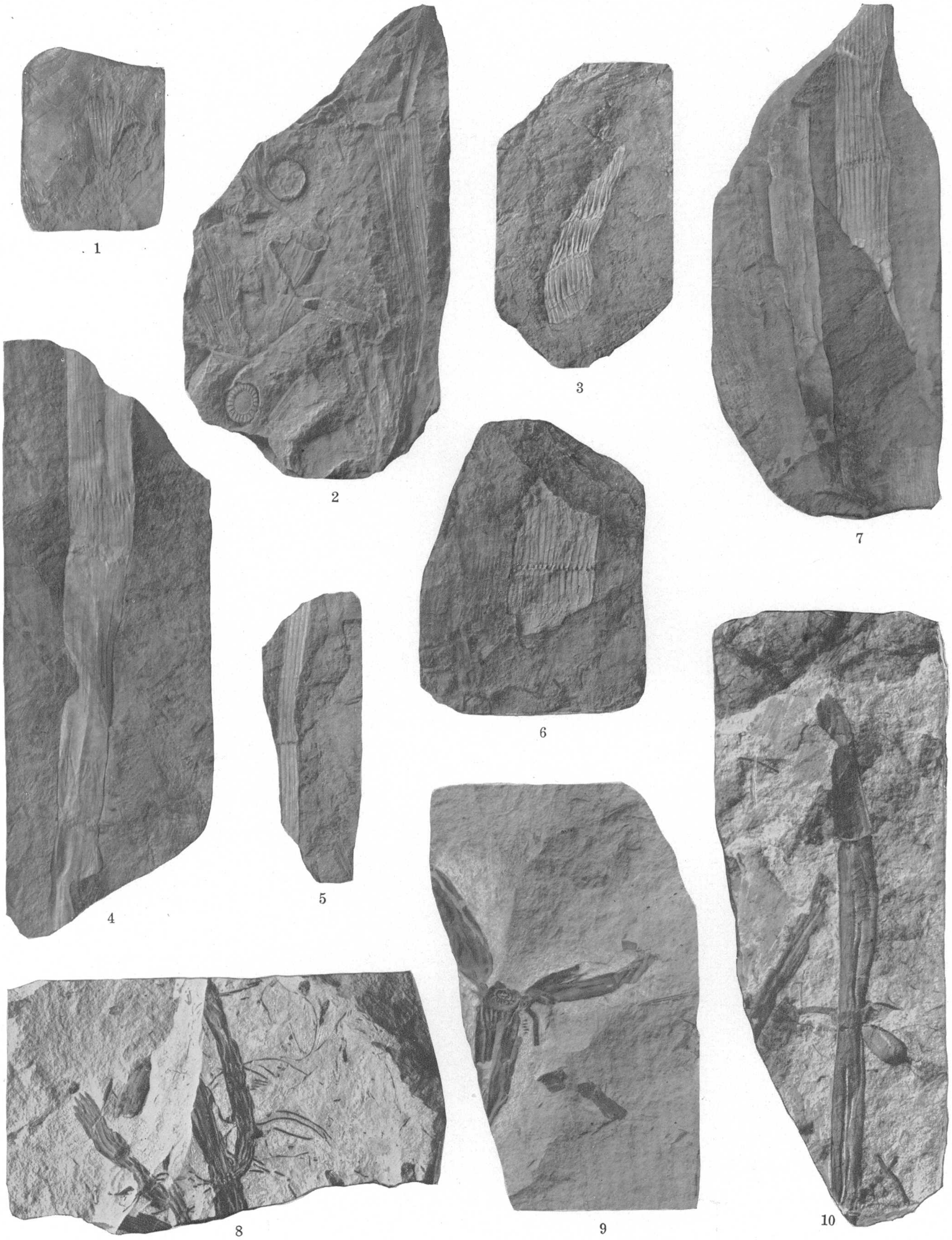
TERTIARY FLORAS OF ALASKA.

1–5. *Anthrophyopsis hamiltonensis* Hollick, n. sp. (U.S.N.M. 38668, 38669; p. 41). **6–9.** *Hausmannia atwoodi* Hollick ,n. sp. (U.S.N.M. 38671; pp. 36–37).



TERTIARY FLORAS OF ALASKA.

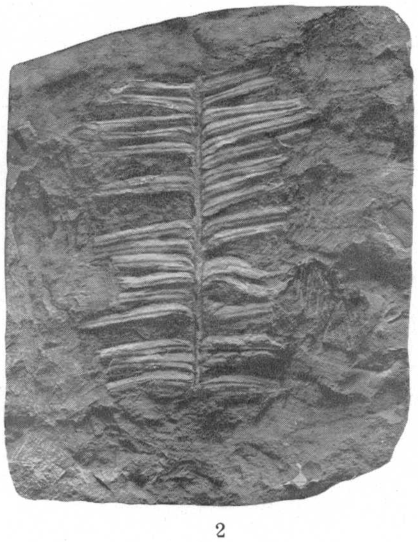
1–9. *Equisetum arcticum* Heer.
1–3a. Nodal diaphragms (U.S.N.M. 38672; pp. 41, 42).
3b. Fragment of a stem (U.S.N.M. 38672; p. 42).
4–7. Fragments of stems (U.S.N.M. 38673, 38674; p. 42).
8. Fragment of a stem with sheaths (and leaves?) (U.S.N.M. 38674; pp. 41, 42).
9. Rhizome with rootlets (U.S.N.M. 38674; pp. 41, 42).



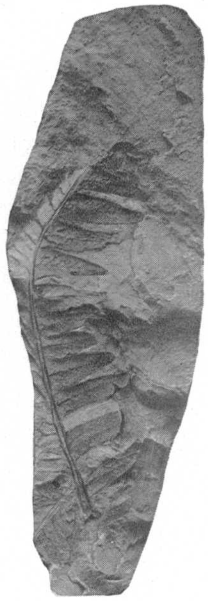
TERTIARY FLORAS OF ALASKA.

1–10. *Equisetum arcticum* Heer.
1. Sheath (U.S.N.M. 38676; p. 42).
2. Nodal diaphragms and fragments of stems (U.S.N.M. 38675; p. 42).
3. Fragment of a stem with sheaths (U.S.N.M. 38675; pp. 41, 42).
4–6. Fragment of a stem (U.S.N.M. 38675; p. 42).
7. Fragments of stems (U.S.N.M. 38677; p. 42).
8. Rhizome with rootlets (U.S.N.M. 38679; pp. 41, 42).
9. Fragment of a rhizome (U.S.N.M. 38679; pp. 41, 42).
10. Rhizome with tubercle (U.S.N.M. 38679; pp. 41, 42).

1



2

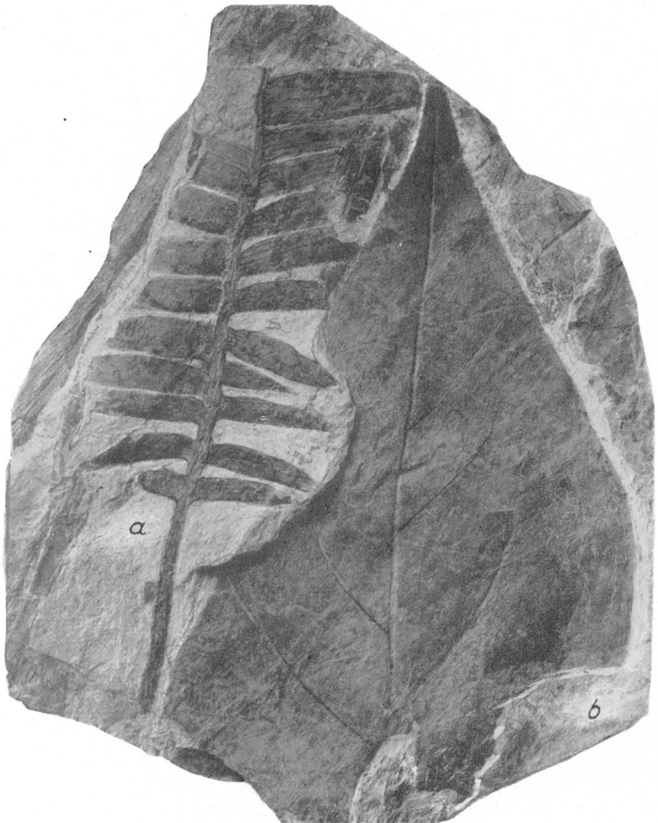


3

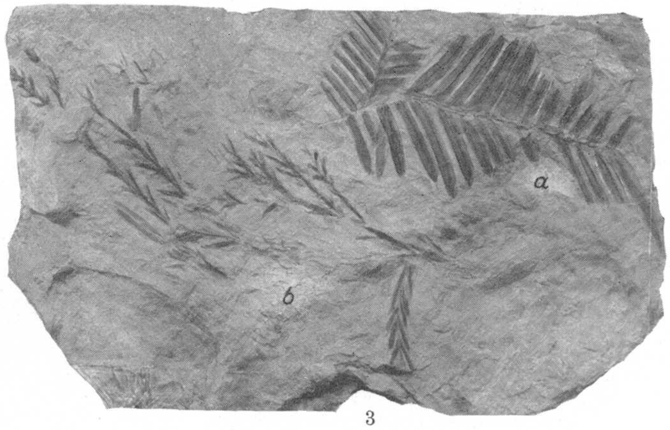
4

TERTIARY FLORAS OF ALASKA.

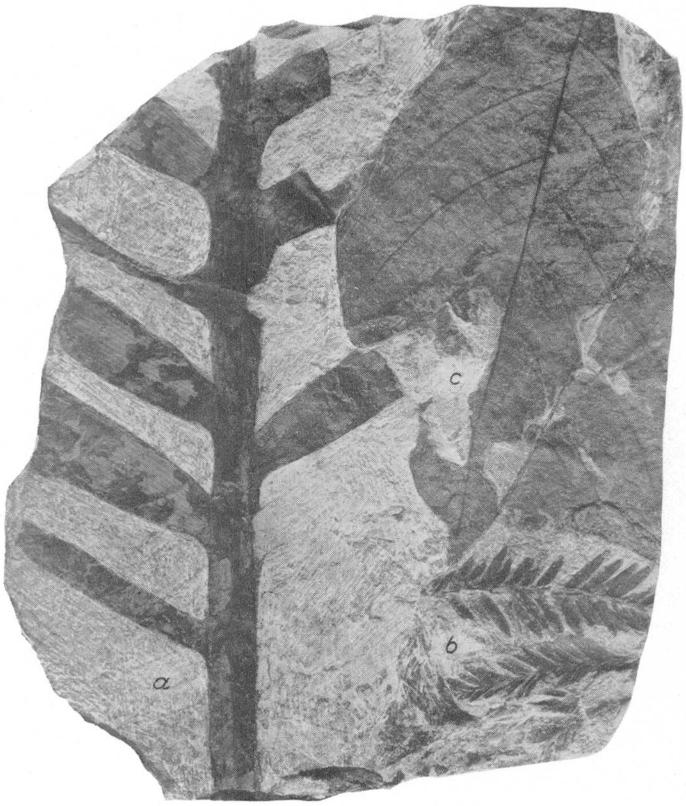
1a. *Sequoia langsdorfii acuta* Heer (U.S.N.M. 38680; pp. 47, 48).
1b. Pistillate ament of *Betula* sp.? (U.S.N.M. 38681; pp. 92, 93).
2. *Sequoia langsdorfii acuta* Heer (U.S.N.M. 38682; pp. 47, 48).
3. *Pteris oeningensis* Unger? (U.S.N.M. 38684; p. 39).
4a. *Dioön inopinus* Hollick (U.S.N.M. 38685; p. 43).
4b. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38686; pp. 47-48).
4c. *Magnolia inglefieldi* Heer? (U.S.N.M. 38687; p. 114).



1



3

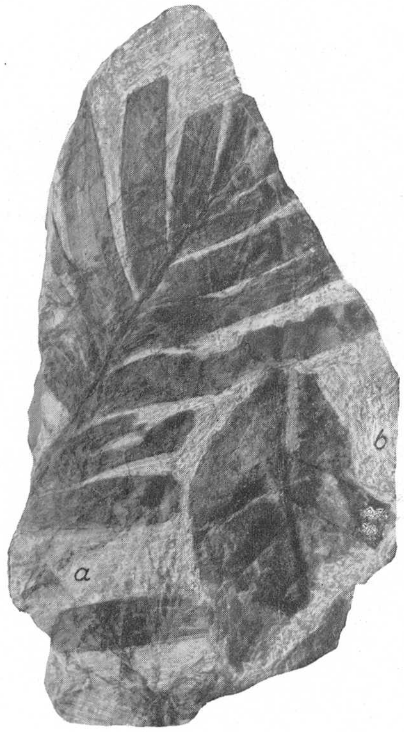


2

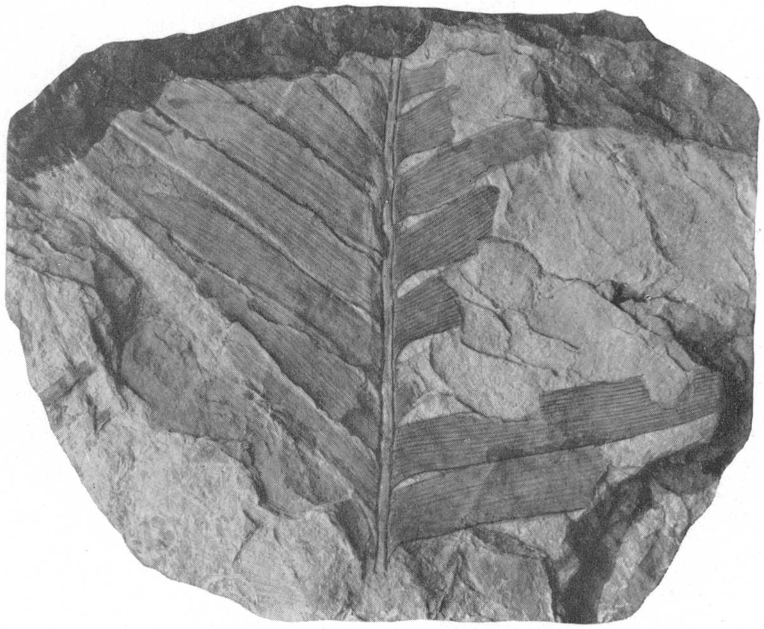
4

TERTIARY FLORAS OF ALASKA.

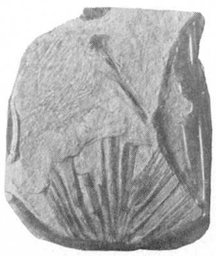
1a. *Dioön praespinulosum* Hollick (U.S.N.M. 38688; p. 43).
1b. *Juglans longiapiculata* Hollick, n. sp. (U.S.N.M. 38689; p. 79).
2a. *Dioön inopinus* Hollick (U.S.N.M. 38685; p. 43).
2b. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38686; pp. 47–48).
2c. *Juglans longiapiculata* Hollick, n. sp. (U.S.N.M. 38689; p. 79).
3a. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38690; pp. 47–48).
3b. *Glyptostrobus europaeus* (Brongniart) Unger (U.S.N.M. 38691; pp. 51–52).
4. *Taxodium tinajorum* Heer (U.S.M.N. 38692; pp. 50–51).



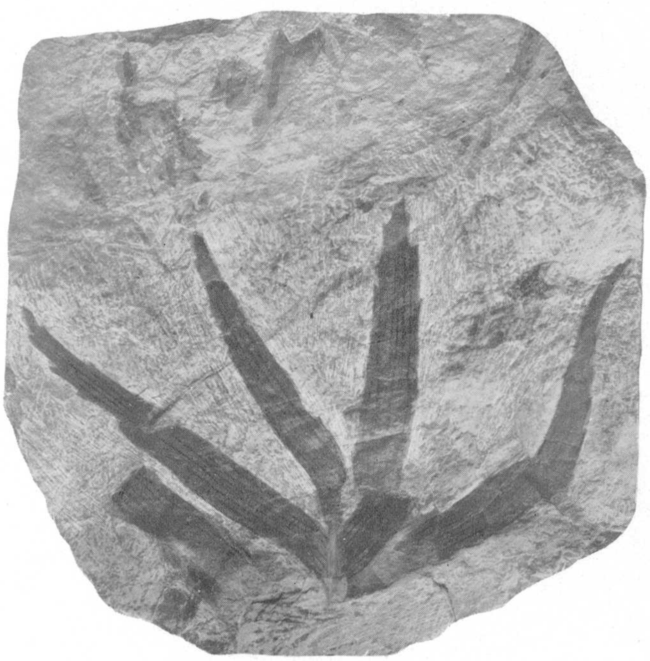
1



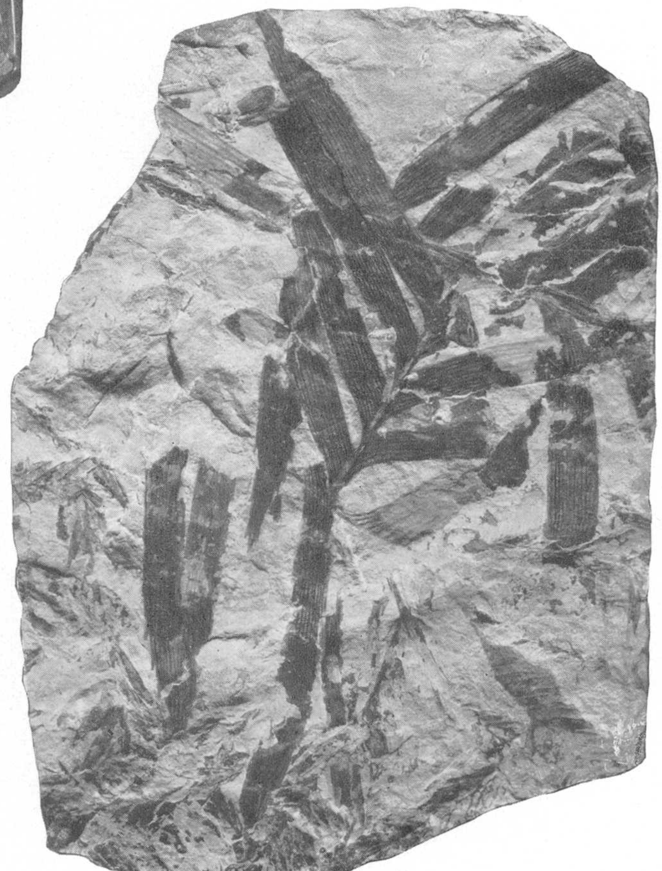
4



5



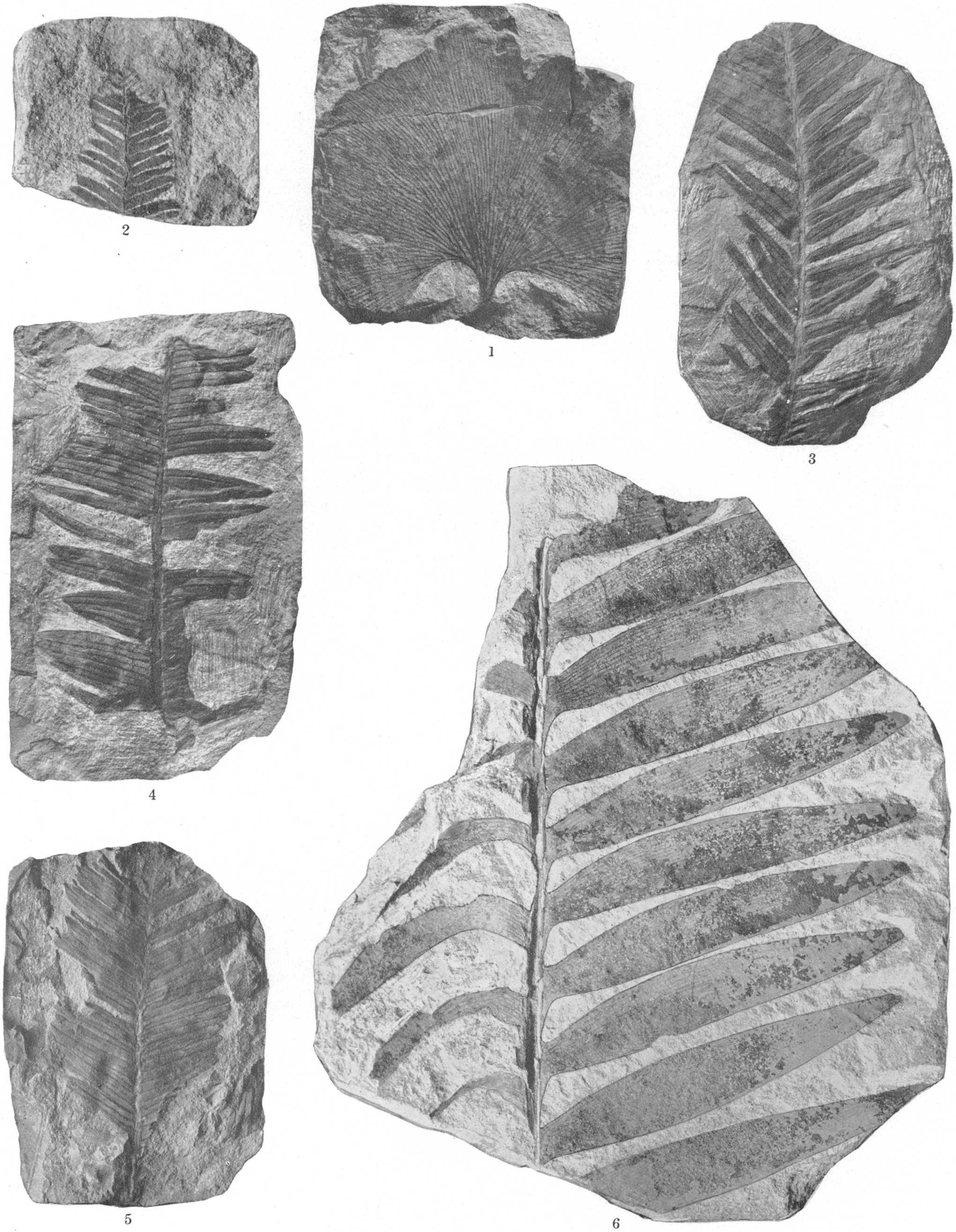
2



3

TERTIARY FLORAS OF ALASKA.

1a. *Dioön praespinulosum* Hollick (U.S.N.M. 38688; p. 43). **1b.** Dicotyledonous leaf (gen. and sp. ?) (U.S.N.M. 38694; p. 170).
2–5. *Dioön praespinulosum* Hollick (U.S.N.M. 38688, 38693; p. 43).



TERTIARY FLORAS OF ALASKA.

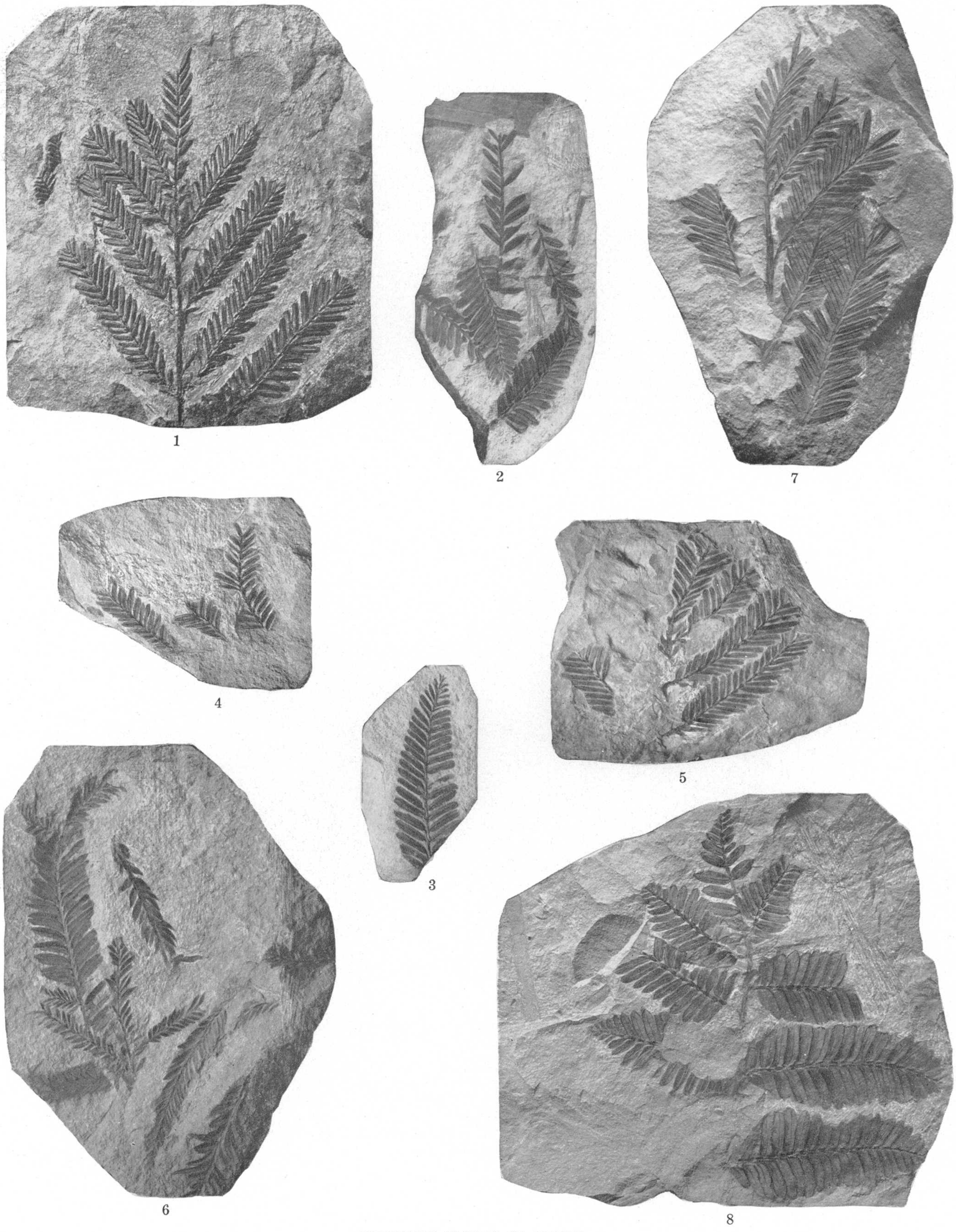
1. *Ginkgo reniformis conformis* Hollick, n. var. (U.S.N.M. 38695; p. 44).
2. *Sequoia langsdorfii* (Brongniart) Heer? (U.S.N.M. 38696; pp. 47–48).
3–5. *Sequoia langsdorfii angustifolia* Heer (U.S.N.M. 38697, 38698; pp. 47, 48)
6. *Ceratozamia wrightii* Hollick (U.S.N.M. 38700; pp. 42–43).

TERTIARY FLORAS OF ALASKA.

1. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38690; pp. 47–48).
2, 3. *Taxodium tinajorum* Heer (U.S.N.M. 38702, 38703; pp. 50–51).
4a. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38701; pp. 47–48).
4b. *Taxodium dubium normale* Massalongo (U.S.N.M. 38701; p. 49).
4c. *Taxodium tinajorum* Heer (U.S.N.M. 38701; pp. 50–51).
5, 6. *Taxodium tinajorum* Heer (U.S.N.M. 38704, 38705; pp. 50–51).

TERTIARY FLORAS OF ALASKA.

Sequoia langsdorfii (Brongniart) Heer (U.S.N.M. 38686; pp. 47, 48).



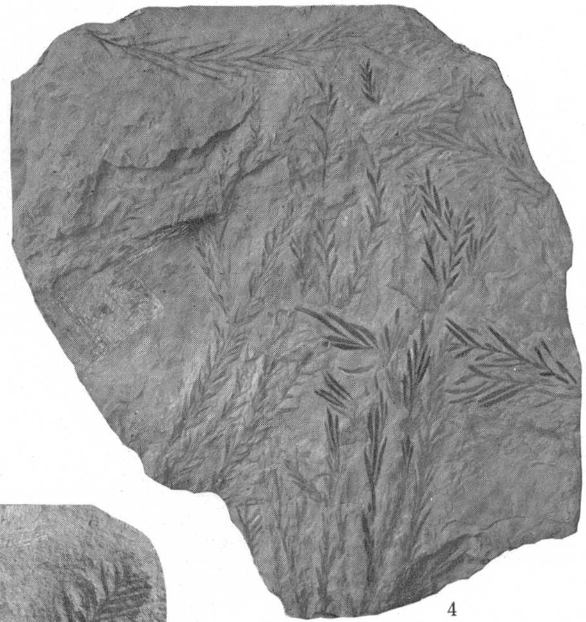
TERTIARY FLORAS OF ALASKA.

1-6. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38690, 38707-38709; pp. 47-48). **7.** *Sequoia disticha* Heer (U.S.N.M. 38710; p. 47).
8. *Sequoia brevifolia* Heer (U.S.N.M. 38711; pp. 46-47).

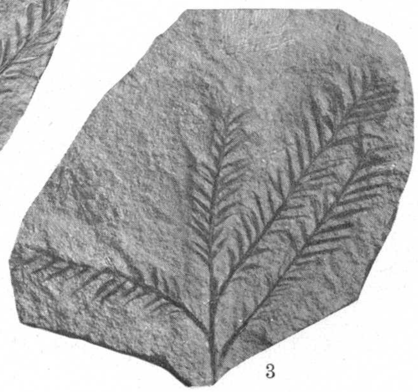
TERTIARY FLORAS OF ALASKA.

1. *Taxodium dubium normale* Massalongo (U.S.N.M. 38712; p. 49).
2. *Taxites olriki* Heer (U.S.N.M. 38714; p. 44).
3. *Taxodium occidentale* Newberry (U.S.N.M. 38717; p. 50).
4. *Taxodium dubium longifolium* Massalongo (U.S.N.M. 38718; p. 49).
5. *Taxodium dubium* (Sternberg) Heer (U.S.N.M. 38719; pp. 48–49).
6–8. *Taxites olriki* Heer (U.S.N.M. 38713, 38715, 38716; p. 44).
9. *Taxodium crassum* Hollick, n. sp. (U.S.N.M. 38720; p. 48).

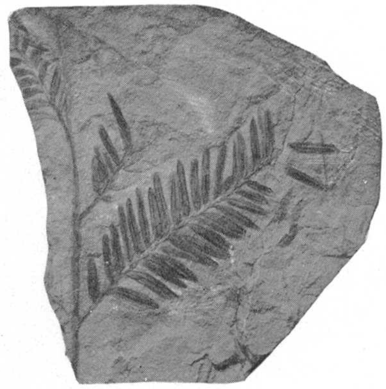
1



4



3



5

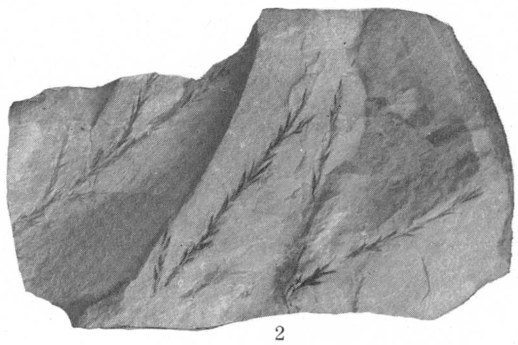
2

6

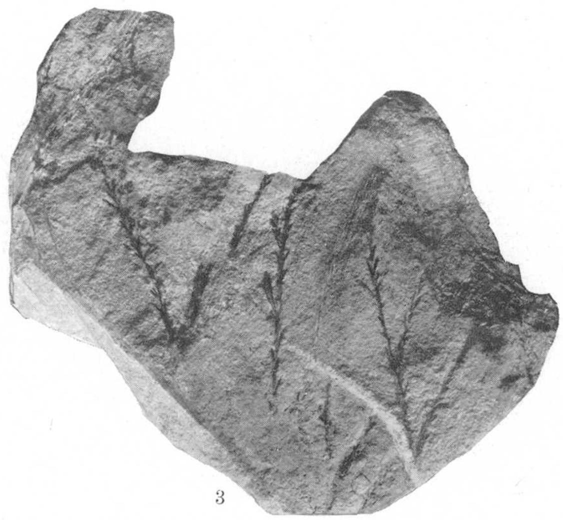
TERTIARY FLORAS OF ALASKA.

Glyptostrobus europaeus (Brongniart) Unger (U.S.N.M. 38721, 38722, 38723; pp. 51–52).

1



2



3

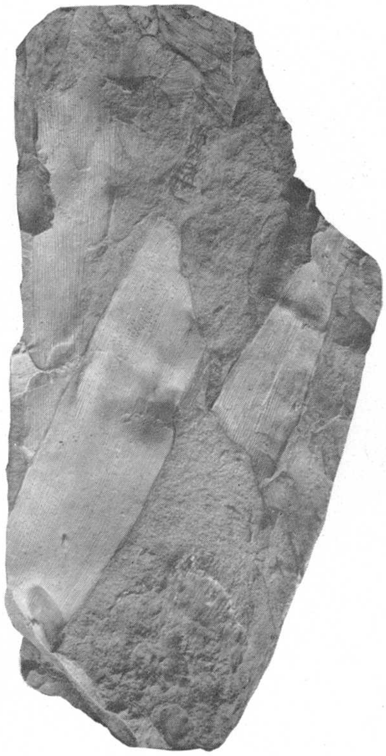
4

5

TERTIARY FLORAS OF ALASKA.

1–5a. *Glyptostrobus europaeus* (Brongniart) Unger (U.S.N.M. 38722, 38724–38726; pp. 51–52).
5b. *Taxodium tinajorum* Heer (U.S.N.M. 38702; pp. 50–51).


1


3


4


2


7

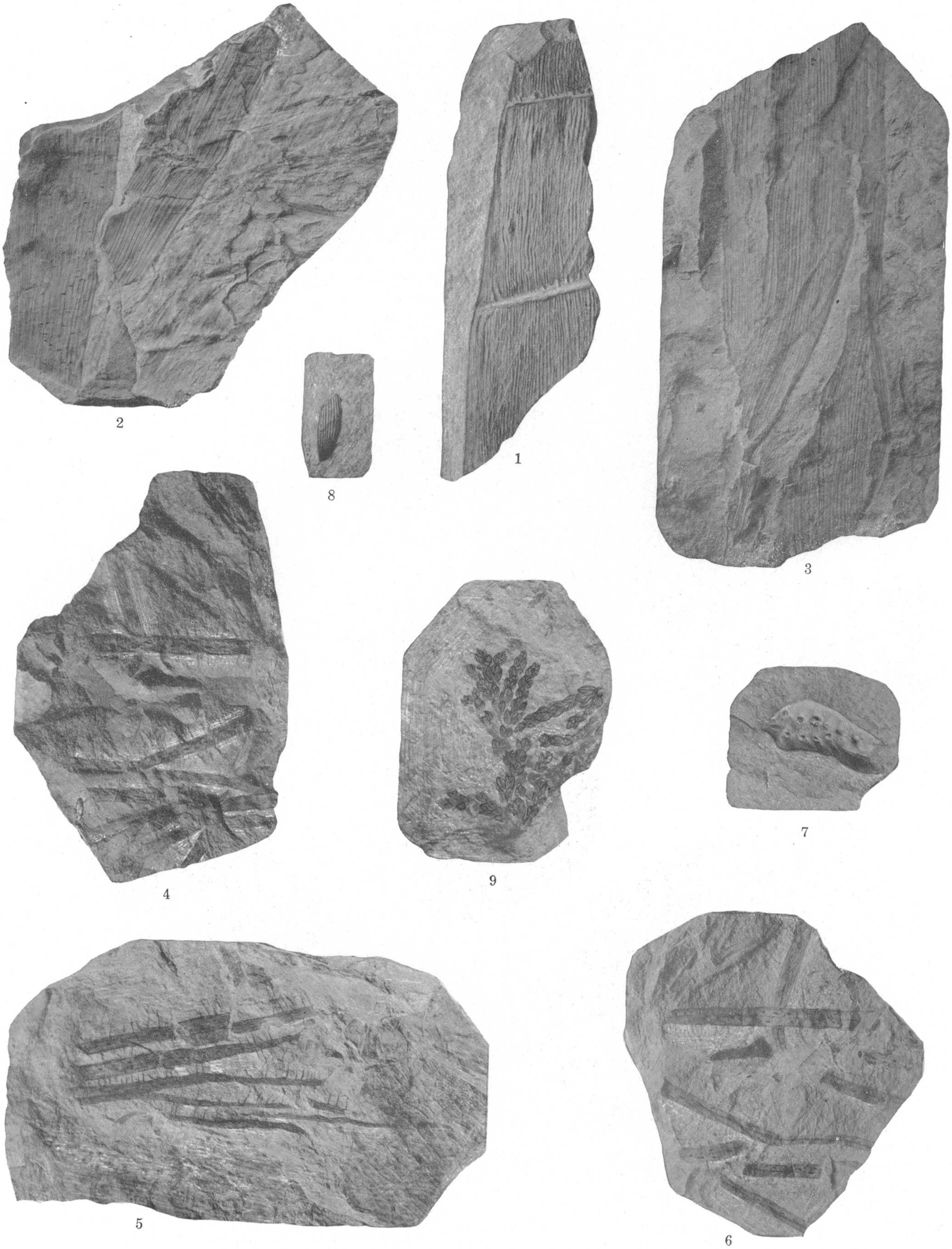

6


5


8

TERTIARY FLORAS OF ALASKA.

1, 2. *Glyptostrobus europaeus* (Brongniart) Unger (U.S.N.M. 38727; pp. 51–52). **3–8.** *Arundo pseudogoepperti* Berry? (U.S.N.M. 38728; pp. 54–55).

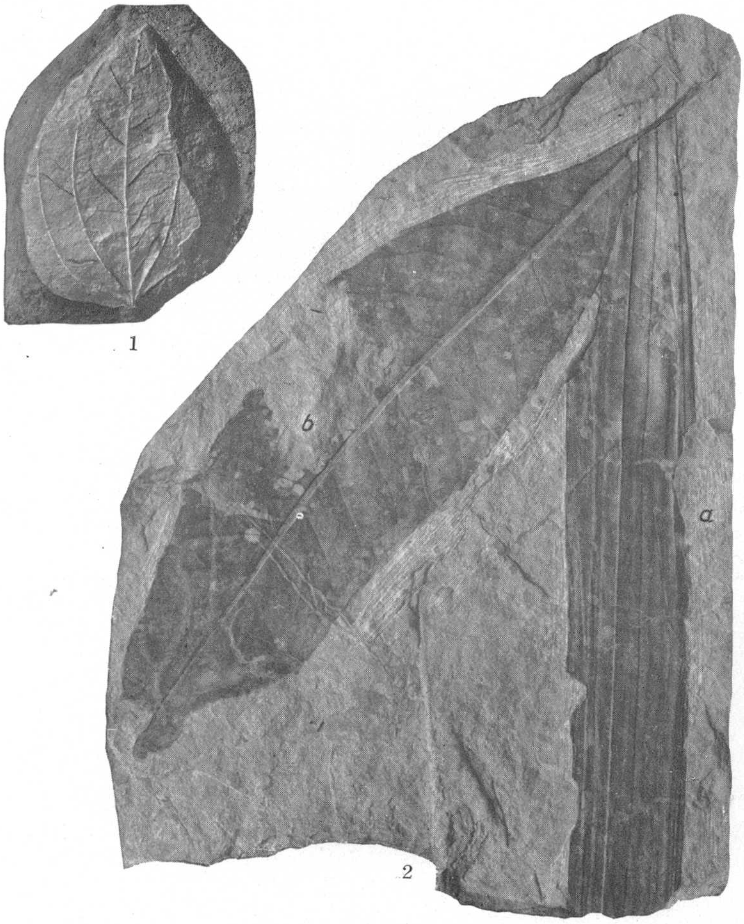


TERTIARY FLORAS OF ALASKA.

1–8. *Arundo pseudogoepperti* Berry? (U.S.N.M. 38728, 38729; pp. 54–55). **9.** *Thuites ehrenswärdi* Heer (U.S.N.M. 38730; p. 53).

TERTIARY FLORAS OF ALASKA.

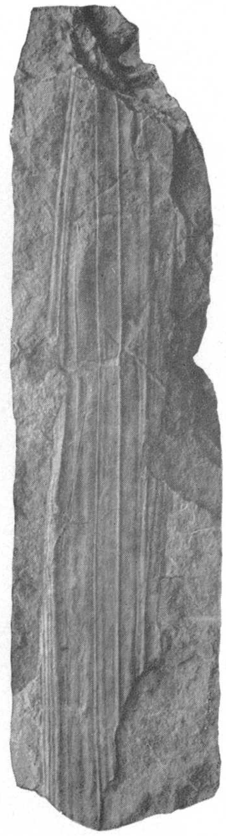
Flabellaria florissanti Lesquereux (U.S.N.M. 38731; pp. 56–57).



1

2

4

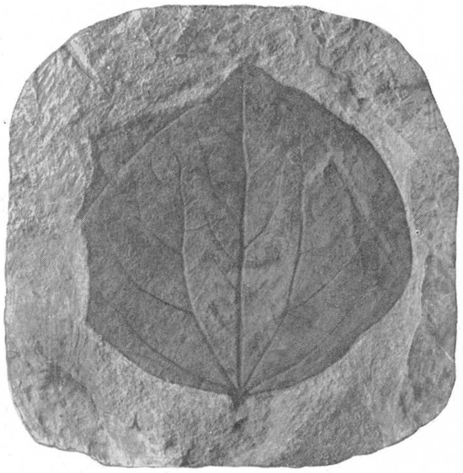


3

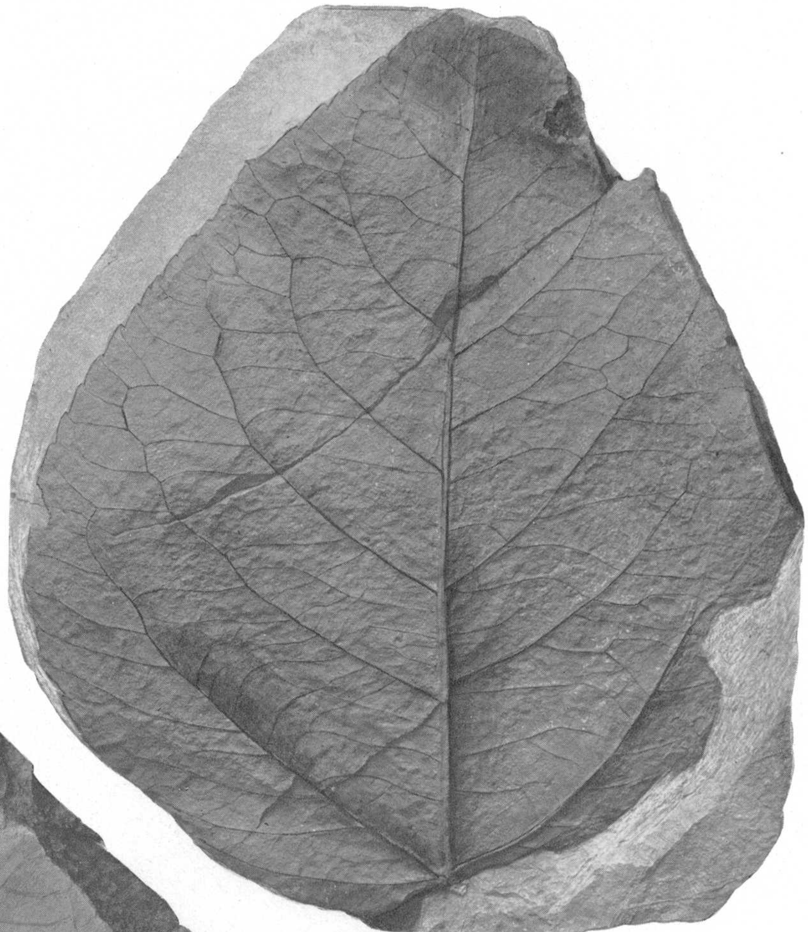
5

TERTIARY FLORAS OF ALASKA.

1. *Smilax reticulata* Heer (U.S.N.M. 38732; p. 58).
2a, 3. *Flabellaria alaskana* Hollick, n. sp. (U.S.N.M. 38733; pp. 57–58).
2b. *Juglans egregia* Lesquereux (U.S.N.M. 38734; pp. 79–80).
4. *Arundo pseudogoepperti* Berry? (U.S.N.M. 38736; pp. 54–55).
5a. *Populus arctica* Heer (U.S.N.M. 38737; pp. 60–61).
5b. *Alnus kefersteinii* (Goeppert) Unger (U.S.N.M. 38738; p. 94).
5c. Dicotyledonous leaf (gen. and sp.?) (U.S.N.M. 38739; p. 170).

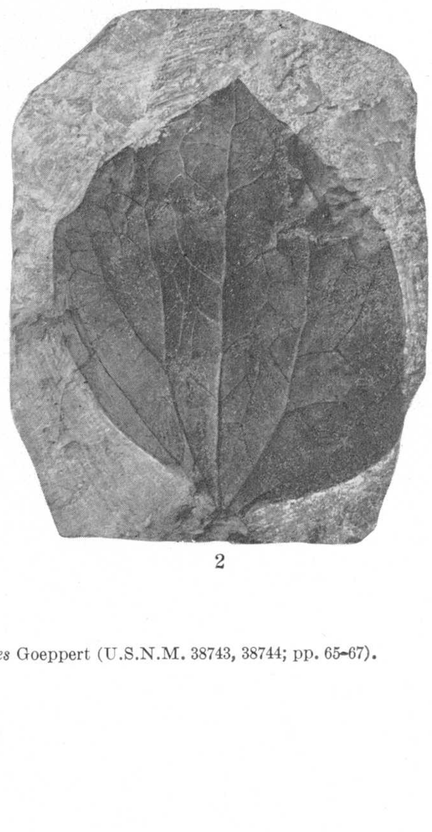


1



3

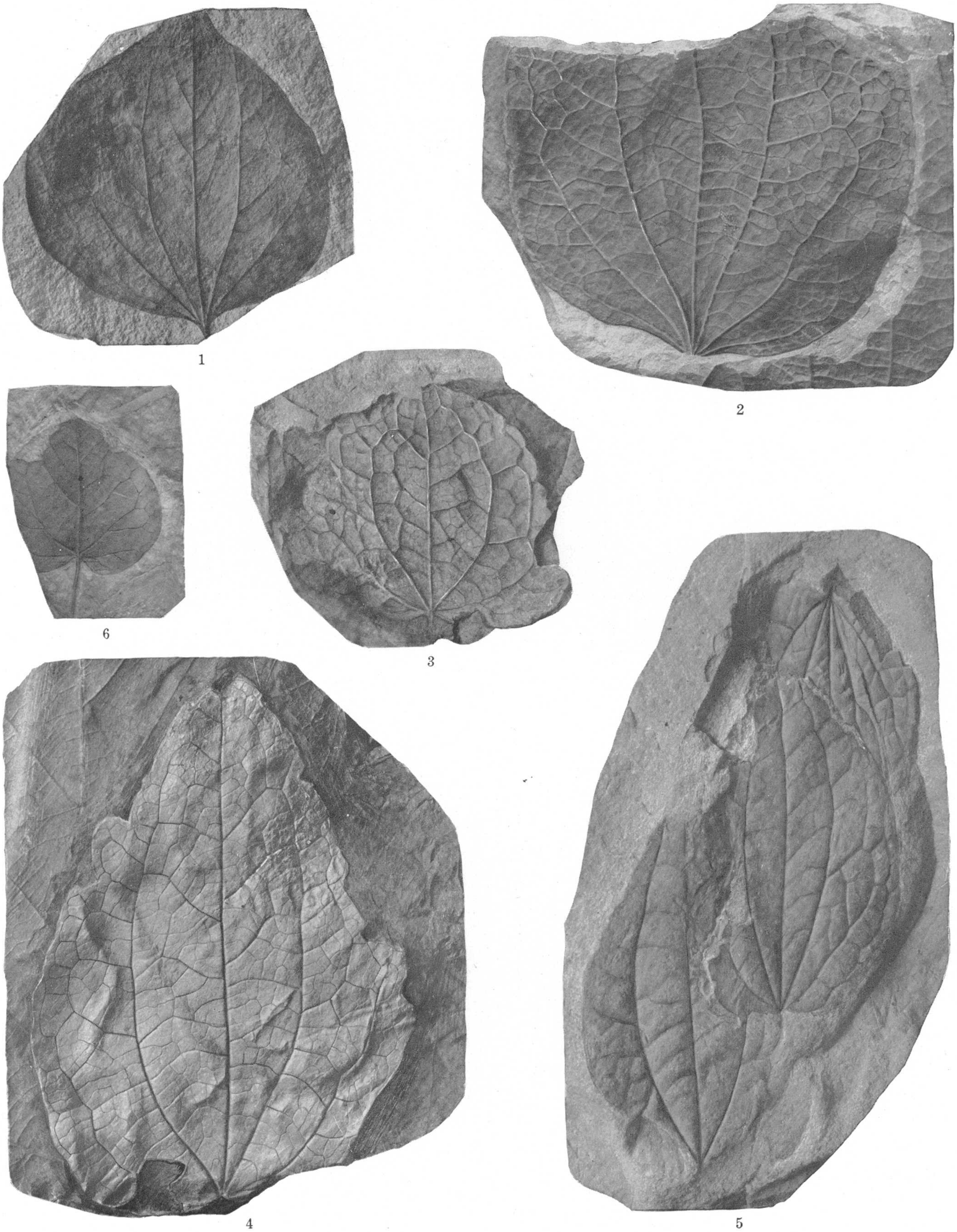
4



2

TERTIARY FLORAS OF ALASKA.

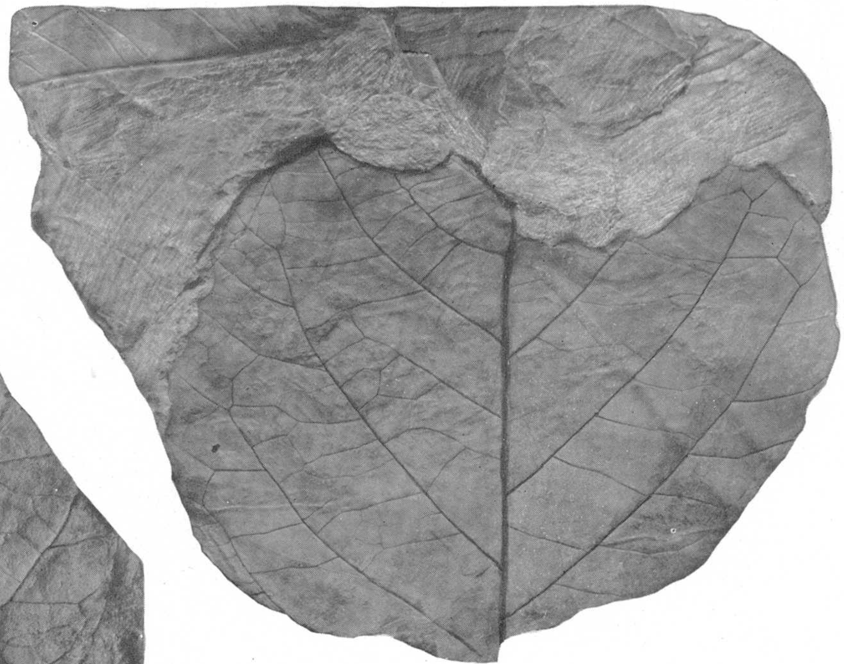
1, 2. *Populus arctica* Heer (U.S.N.M. 38741, 38742; pp. 60–61). **3, 4.** *Populus balsamoides* Goeppert (U.S.N.M. 38743, 38744; pp. 65–67).



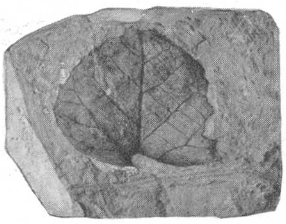
TERTIARY FLORAS OF ALASKA.

1–3. *Populus arctica* Heer (U.S.N.M. 38746, 38747; pp. 60–61). **4, 5.** *Populus zaddachi* Heer? (U.S.N.M. 38748, 38749; p. 69).
6. *Populus hookeri* Heer (U. S. N. M. 38751; p. 65).

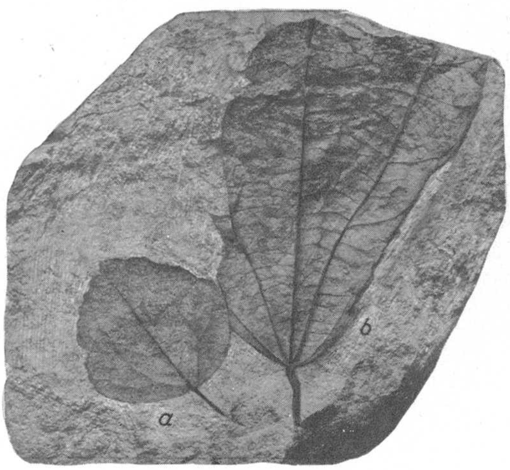
2



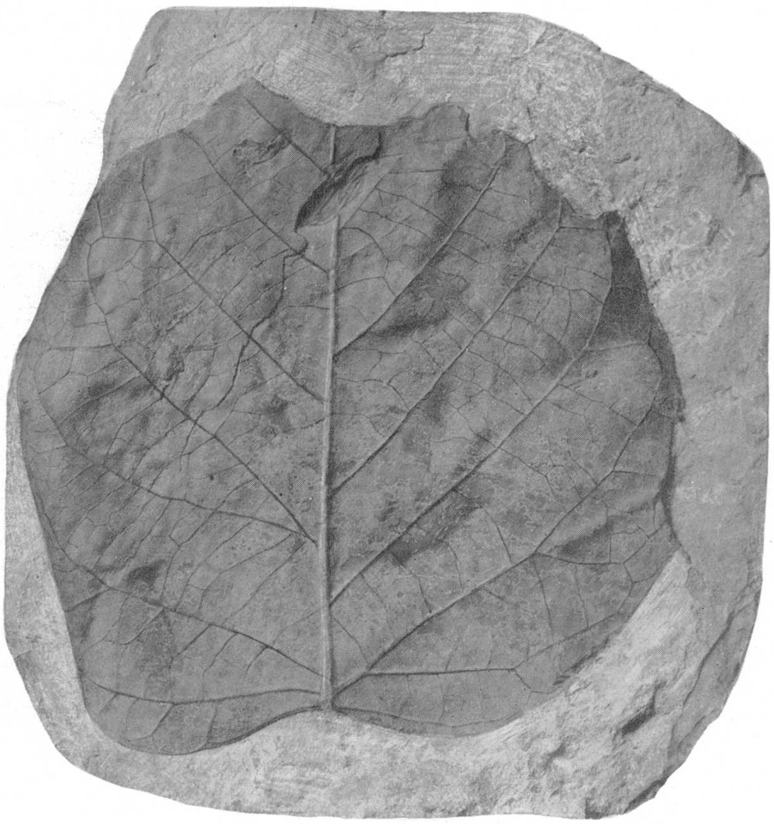
1



4



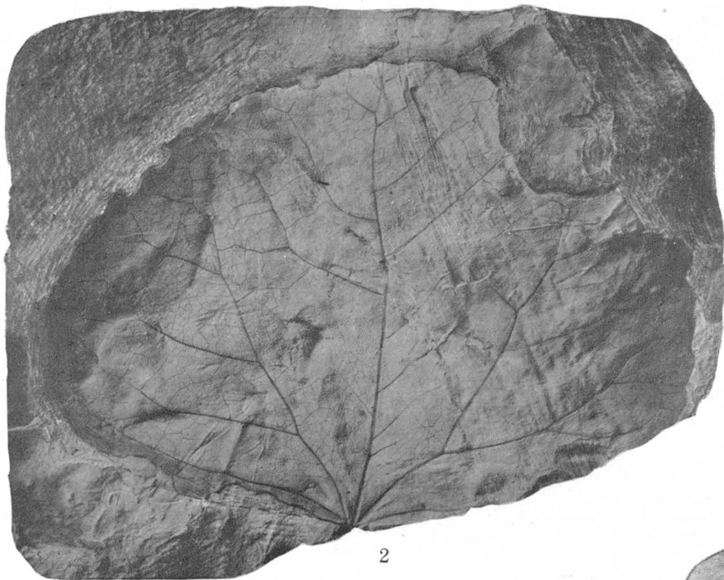
5



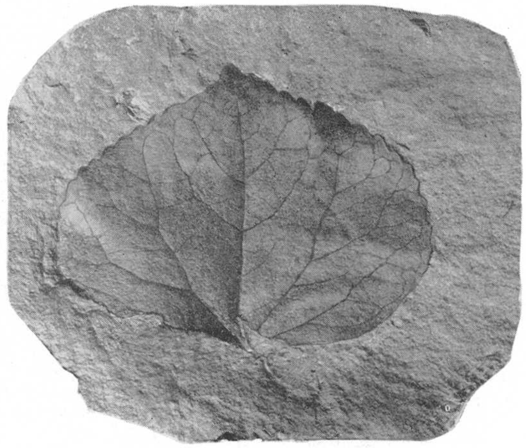
3

TERTIARY FLORAS OF ALASKA.

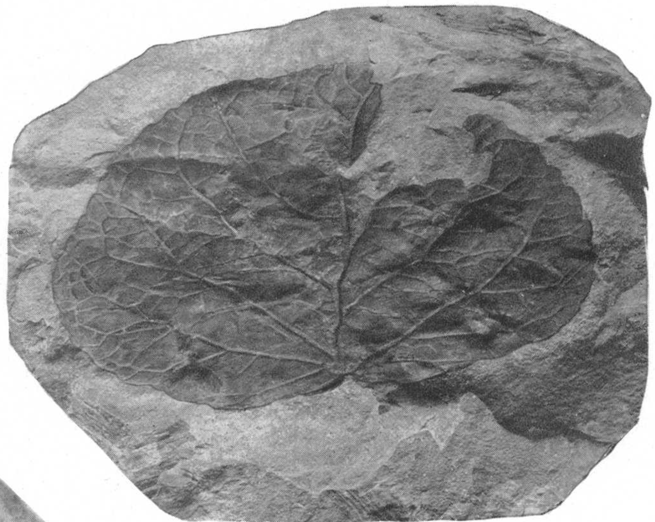
1. *Populus balsamoides* Goeppert? (U.S.N.M. 38752; pp. 65–67).
2, 3. *Populus gaudini* Fischer-Ooster (U.S.N.M. 38753, 38754; p. 67).
4. *Populus latior* Alex. Braun (U.S.N.M. 38755; pp. 64–65).
5a. *Populus amblyrhyncha* Ward? (U.S.N.M. 38756; p. 63).
5b. *Macclintockia chignikensis* Hollick, n. sp. (U.S.N.M. 38757; p. 112).



2

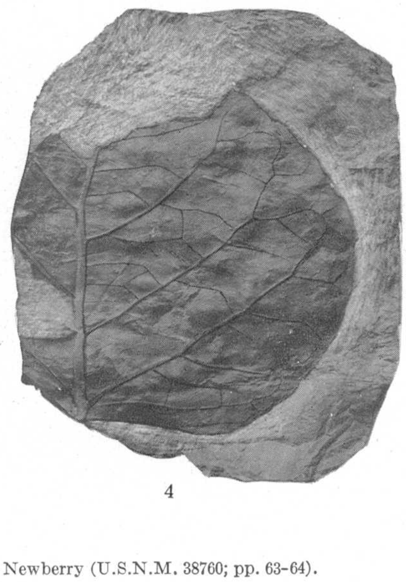


1



3

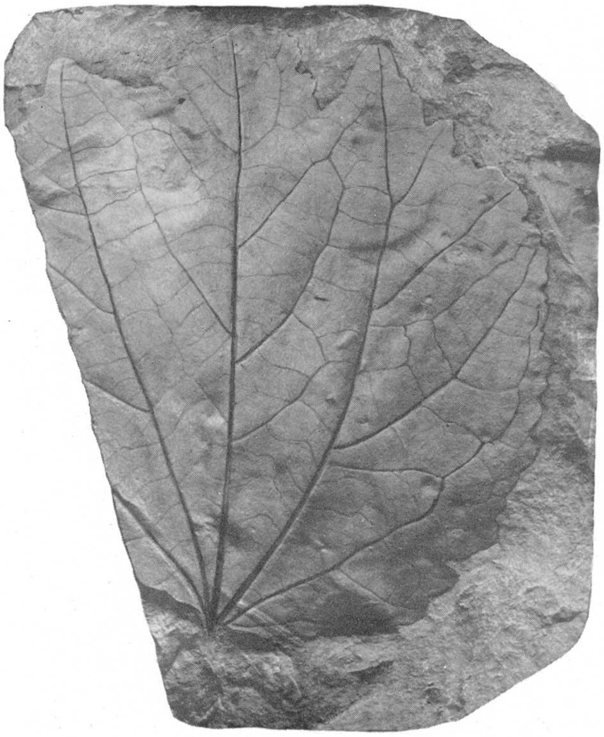
5



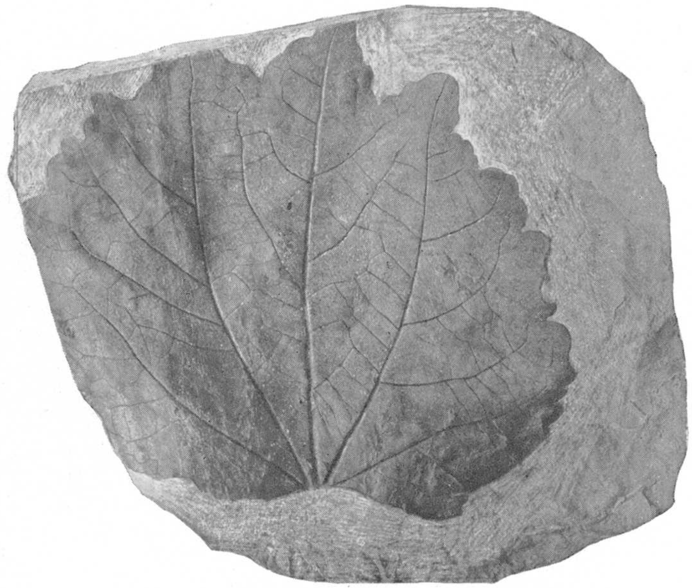
4

TERTIARY FLORAS OF ALASKA.

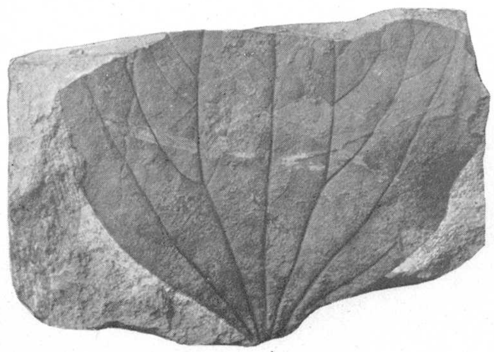
1-4. *Populus latior* Alex. Braun (U.S.N.M. 38758, 38759; pp. 64-65). **5.** *Populus genetrix* Newberry (U.S.N.M. 38760; pp. 63-64).



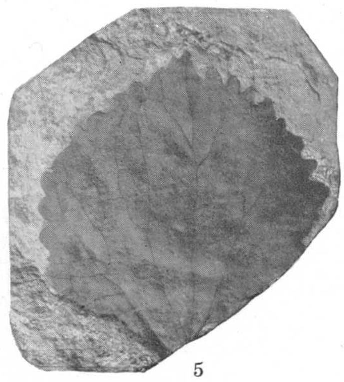
1



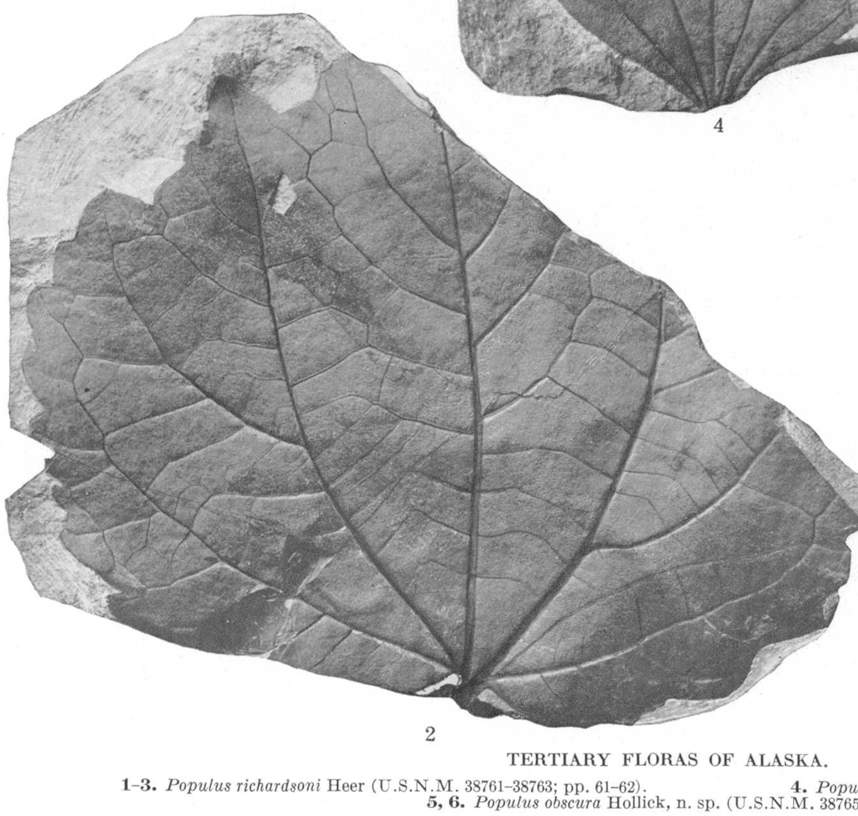
3



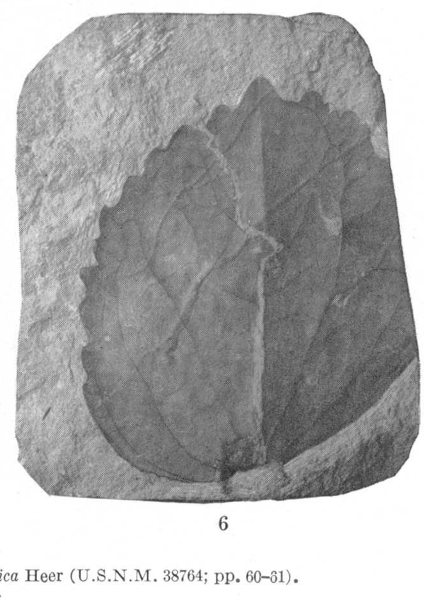
4



5



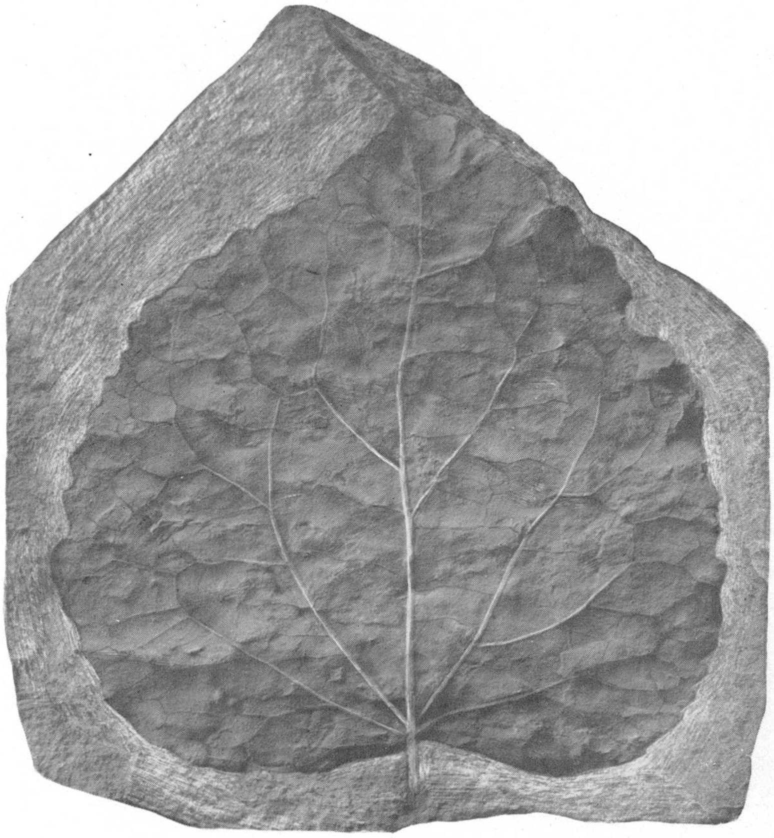
2



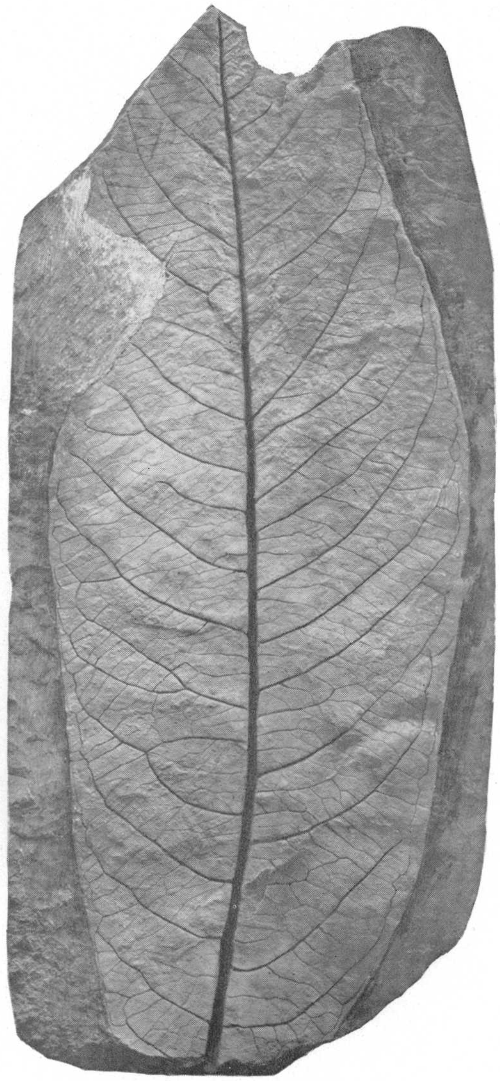
6

TERTIARY FLORAS OF ALASKA.

1–3. *Populus richardsoni* Heer (U.S.N.M. 38761–38763; pp. 61–62). **4.** *Populus arctica* Heer (U.S.N.M. 38764; pp. 60–61).
5, 6. *Populus obscura* Hollick, n. sp. (U.S.N.M. 38765; p. 68).



1



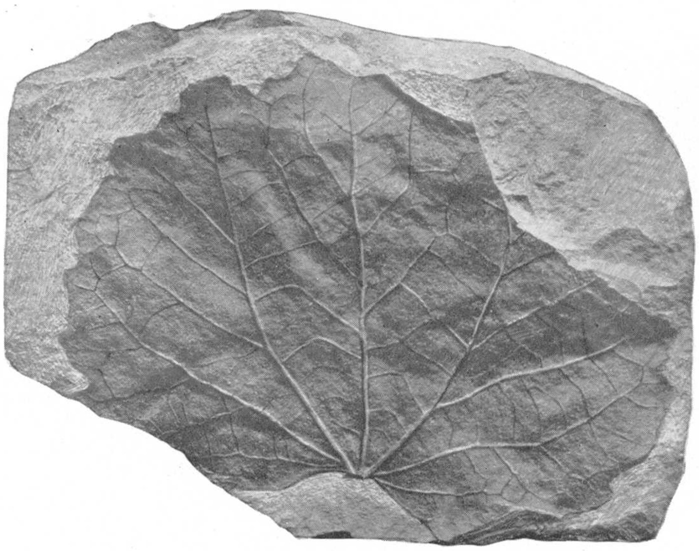
3

2

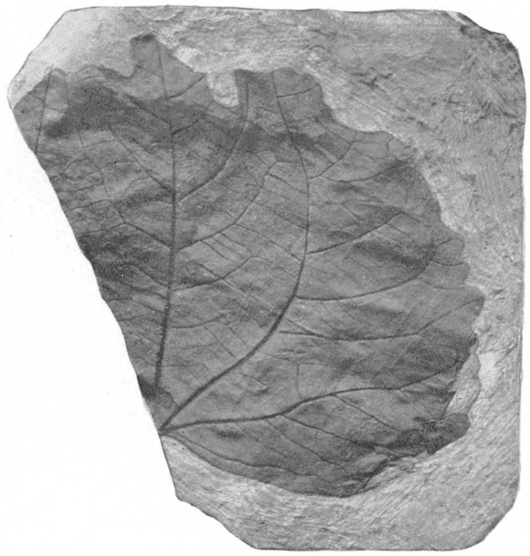
4

TERTIARY FLORAS OF ALASKA.

1. *Populus amblyrhyncha* Ward (U.S.N.M. 38683; p. 63).
2. *Populus richardsoni* Heer (U.S.N.M. 38762; pp. 61–62).
3. *Juglans salicifolia* Goeppert (U.S.N.M. 38768; p. 79).
4. *Salix grandifolia* Weber (U.S.N.M. 38770; p. 72).



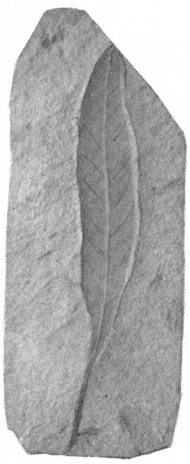
1



2

3

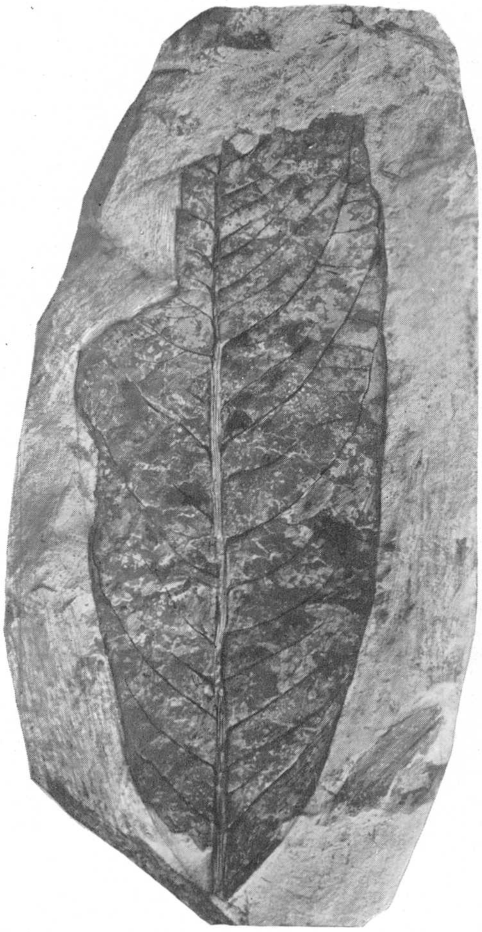
4



5

TERTIARY FLORAS OF ALASKA.

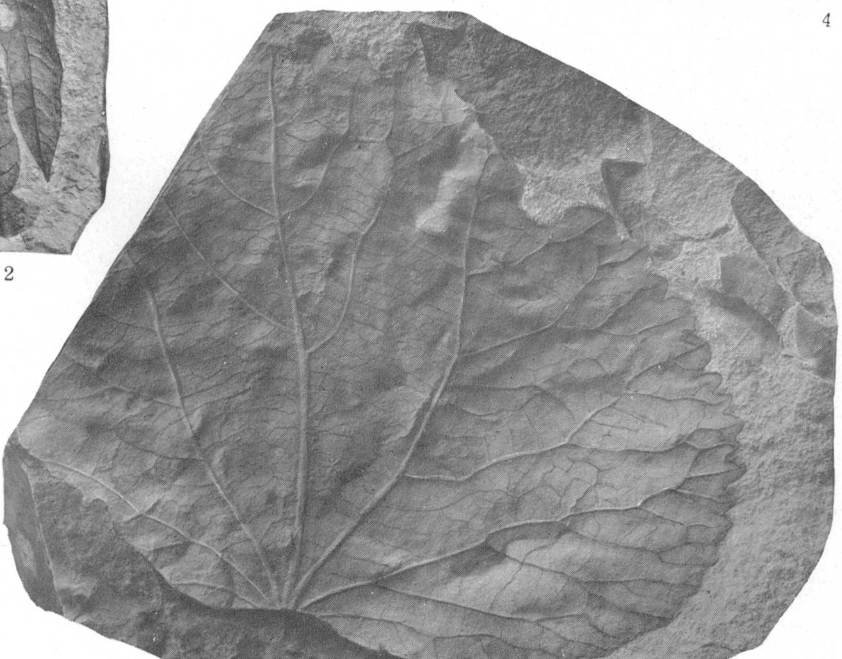
1-3. *Populus richardsoni* Heer (U.S.N.M. 38761, 38762, 38771; pp. 61–62). **4, 5.** *Salix angusta* Alex. Braun (U.S.N.M. 38773; p. 70).



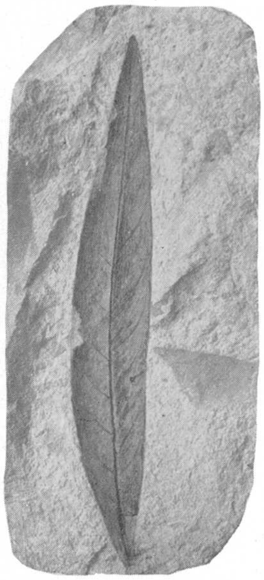
1

2

4



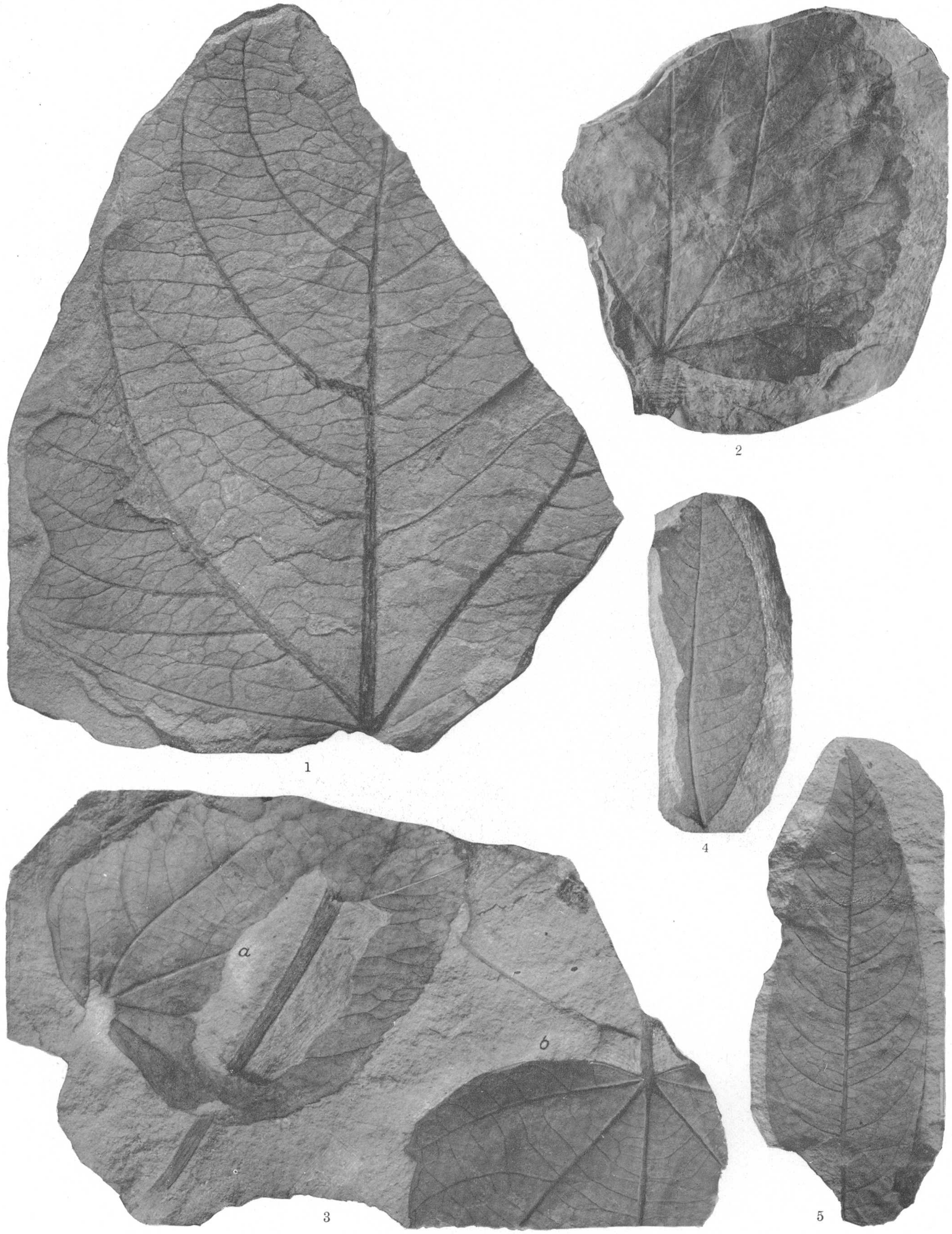
5



3

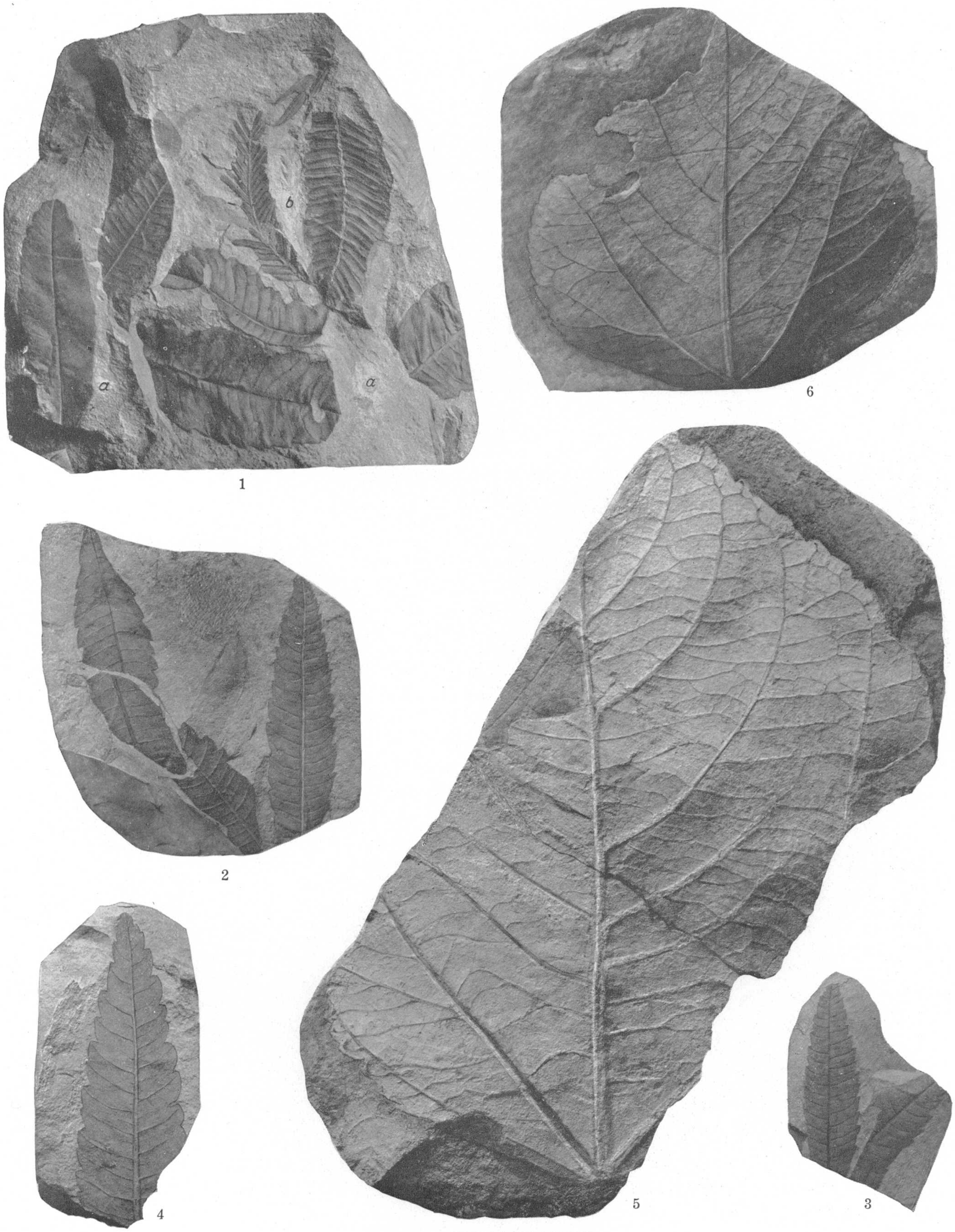
TERTIARY FLORAS OF ALASKA.

1. *Salix grandifolia* Weber (U.S.N.M. 38774; p. 72).
2. *Salix abbreviata* Goeppert (U.S.N.M. 38776; p. 73).
3. *Salix angusta* Alex. Braun (U.S.N.M. 38777; p. 70).
4a. *Populus amblyrhyncha* Ward (U.S.N.M. 38780; p. 63).
4b. *Nyssidium ekmani* Heer (U.S.N.M. 38781; pp. 159–160).
5. *Populus flexuosa* Hollick, n. sp. (U.S.N.M. 38699; p. 63).



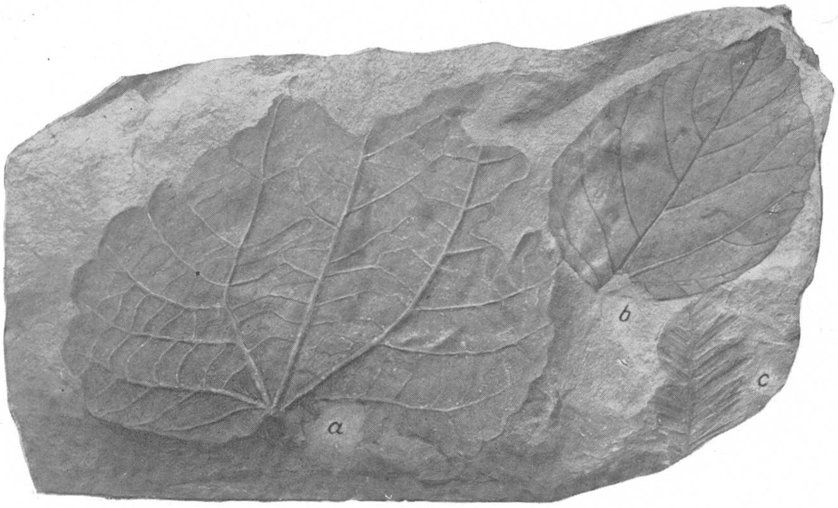
TERTIARY FLORAS OF ALASKA.

1. *Populus glandulifera* Heer (U.S.N.M. 38782; p. 65).
2. *Populus speciosa* Ward? (U.S.N.M. 38783; pp. 62-63).
3a. *Zizyphus meigsii* (Lesquereux) Berry? (U.S.N.M. 38784; p. 140).
3b. *Abutilon* sp.? (U.S.N.M. 38785; p. 150).
4. *Salix alaskana* Hollick, n. sp. (U.S.N.M. 38786; pp. 69-70).
5. *Salix varians* Goeppert (U.S.N.M. 38787; p. 71).

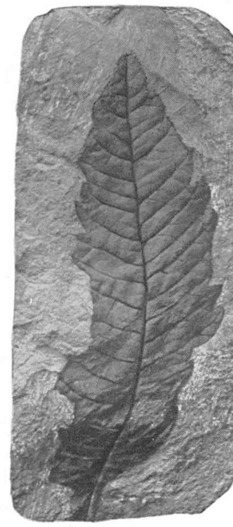


TERTIARY FLORAS OF ALASKA.

1a. *Myrica speciosa* Unger (U.S.N.M. 38788; p. 77).
1b. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38789; pp. 47, 48).
2, 3. *Myrica banksiaefolia curta* Hollick, n. var. (U.S.N.M. 38790; pp. 75–76).
4. *Myrica* (*Dryandroides*) *lignitum* (Unger) Saporta (U.S.N.M. 38791; pp. 76–77).
5, 6. *Populus glandulifera* Heer (U.S.N.M. 38782, 38792; p. 65).



1



3

2

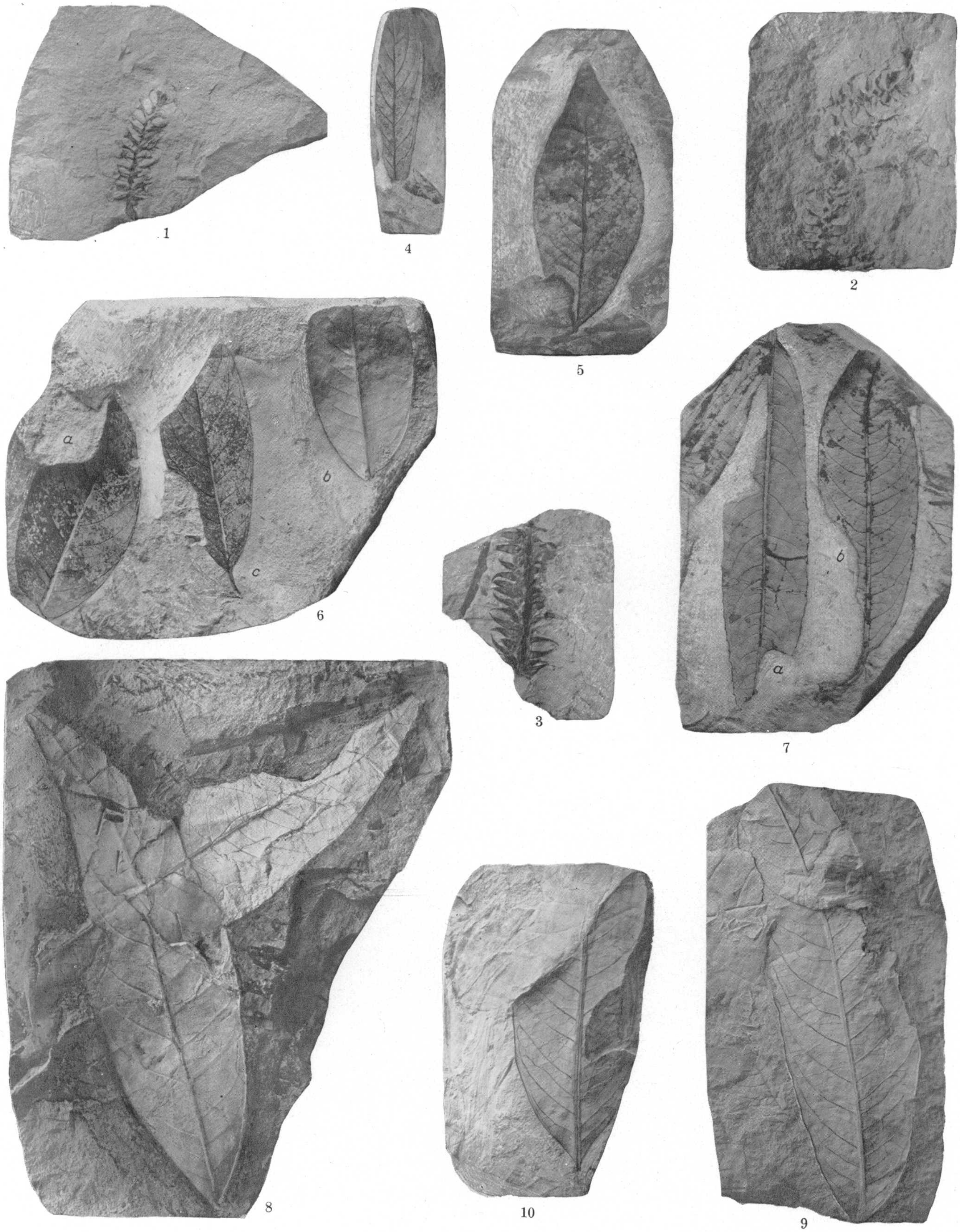
4

5

6

TERTIARY FLORAS OF ALASKA.

1a. *Populus richardsoni* Heer (U.S.N.M. 38762; pp. 61–62).
1b. *Populus mutabilis* Heer (U.S.N.M. 38793; p. 68).
1c. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 38690; pp. 47–48).
2. *Populus flexuosa* Hollick, n. sp. (U.S.N.M. 38794; p. 63).
3. *Myrica speciosa* Unger (U.S.N.M. 38788; p. 77).
4–6. *Comptonia cuspidata* Lesquereux (U.S.N.M. 38658 ;p. 74).



TERTIARY FLORAS OF ALASKA.

1, 2. Pistillate aments of *Betula* sp.? (U.S.N.M. 38795, 38796; pp. 92–93).
3. Pistillate ament of *Salix* sp.? (U.S.N.M. 38775; p. 74).
4. *Salix libbeyi* Lesquereux (U.S.N.M. 38797; p. 73).
5, 6a. *Salix raeana* Heer (U.S.N.M. 38798; pp. 72–73).
6b, 6c. *Salix libbeyi* Lesquereux (U.S.N.M. 38797; p. 73).
7a, 7b. *Salix lavateri* Alex. Braun (U.S.N.M. 38799; p. 70).
8–10. *Salix tenera* Alex. Braun (U.S.N.M. 38800, 38801; p. 72).

1

2

TERTIARY FLORAS OF ALASKA.

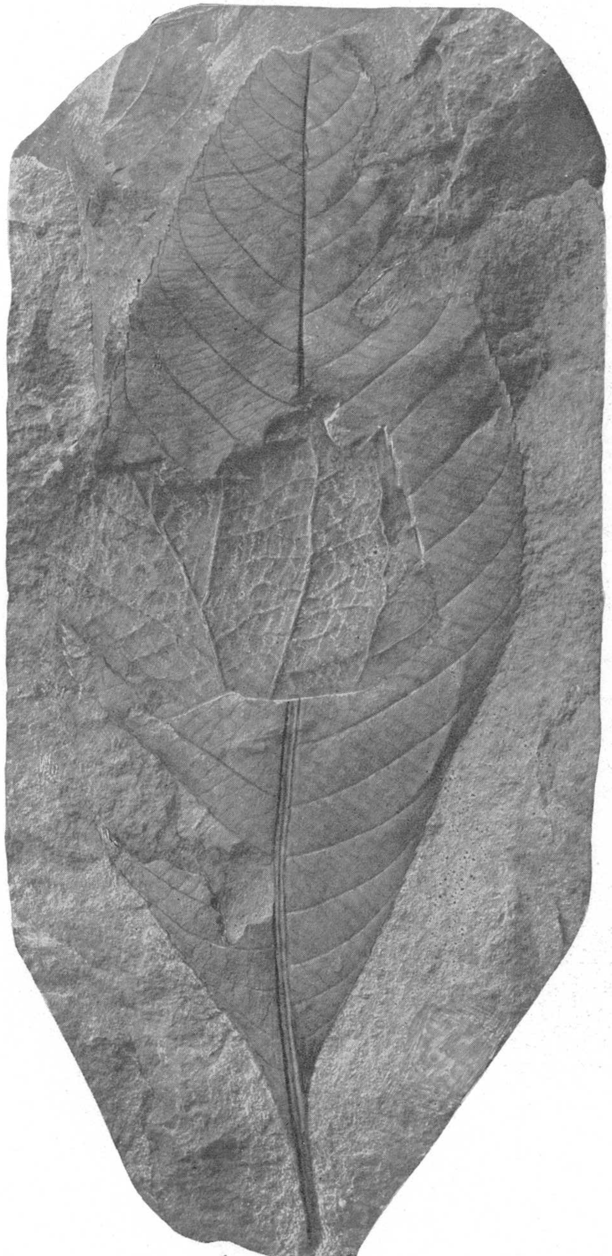
Hicoria magnifica Knowlton (U.S.N.M. 38772; pp. 83-84).

1

2

TERTIARY FLORAS OF ALASKA.

Hicoria magnifica Knowlton (U.S.N.M. 38772; pp. 83–84).



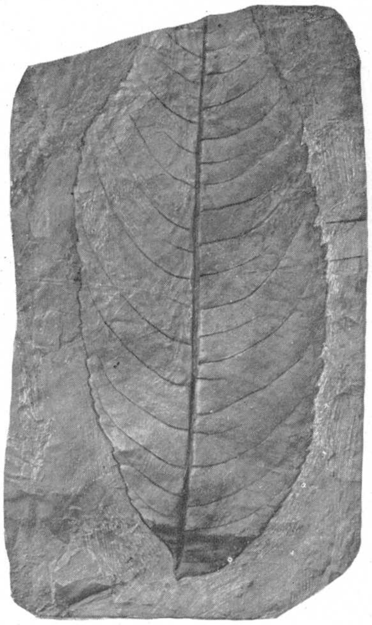
1

2

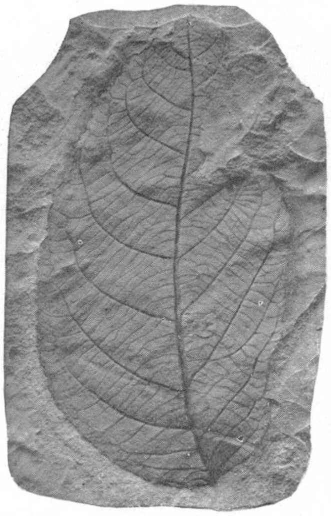
TERTIARY FLORAS OF ALASKA.

1. *Hicoria antiquora* (Newberry) Knowlton (U.S N.M. 38802; p. 83).

2. *Juglans picroides* Heer (U.S.N.M. 38803; p. 82).



5

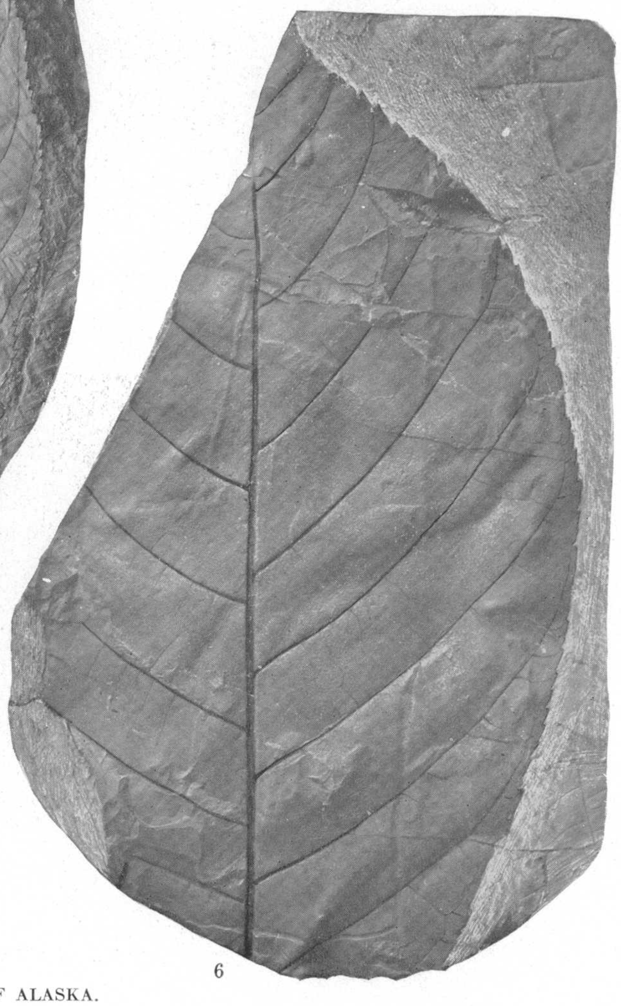


4

3

1

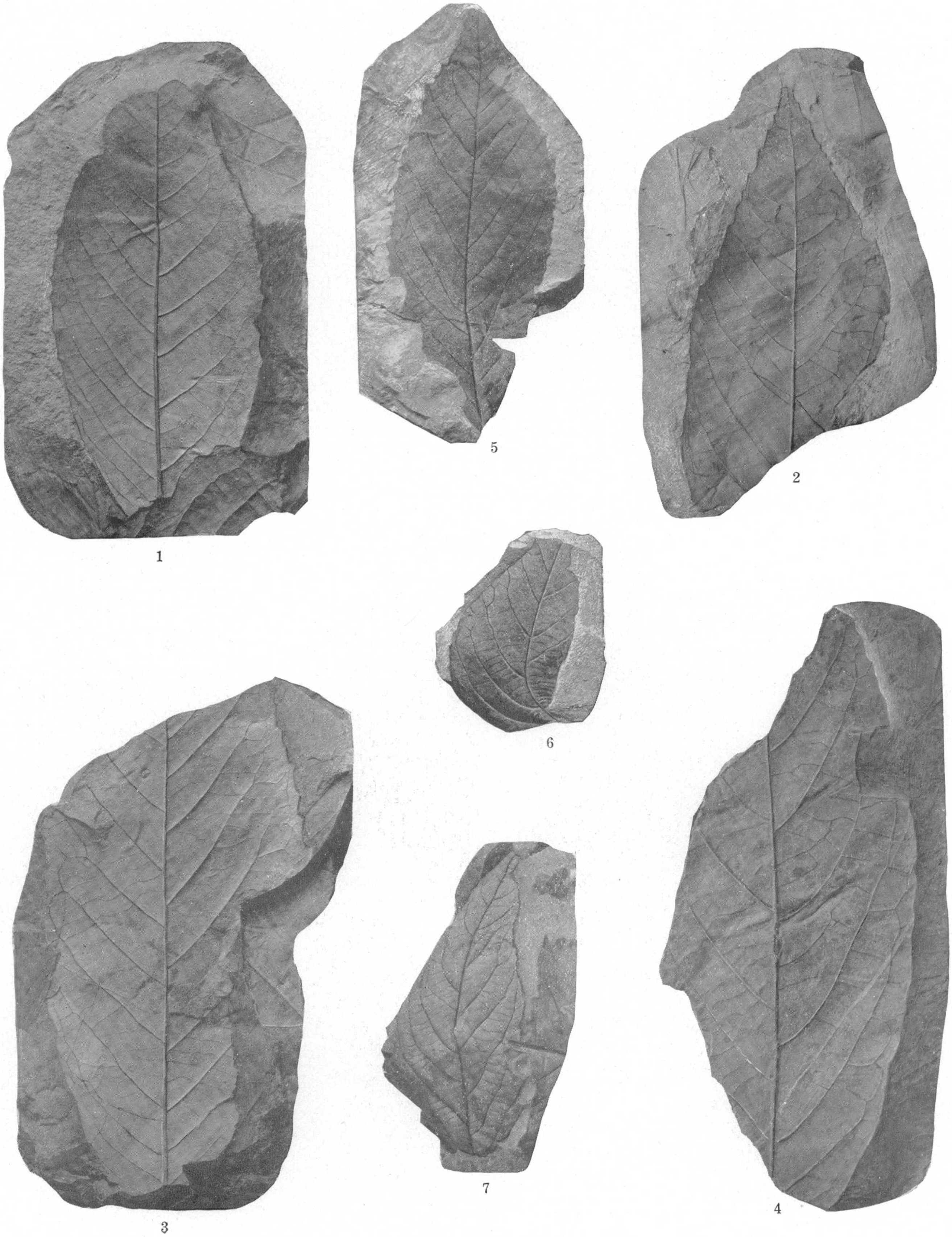
2



6

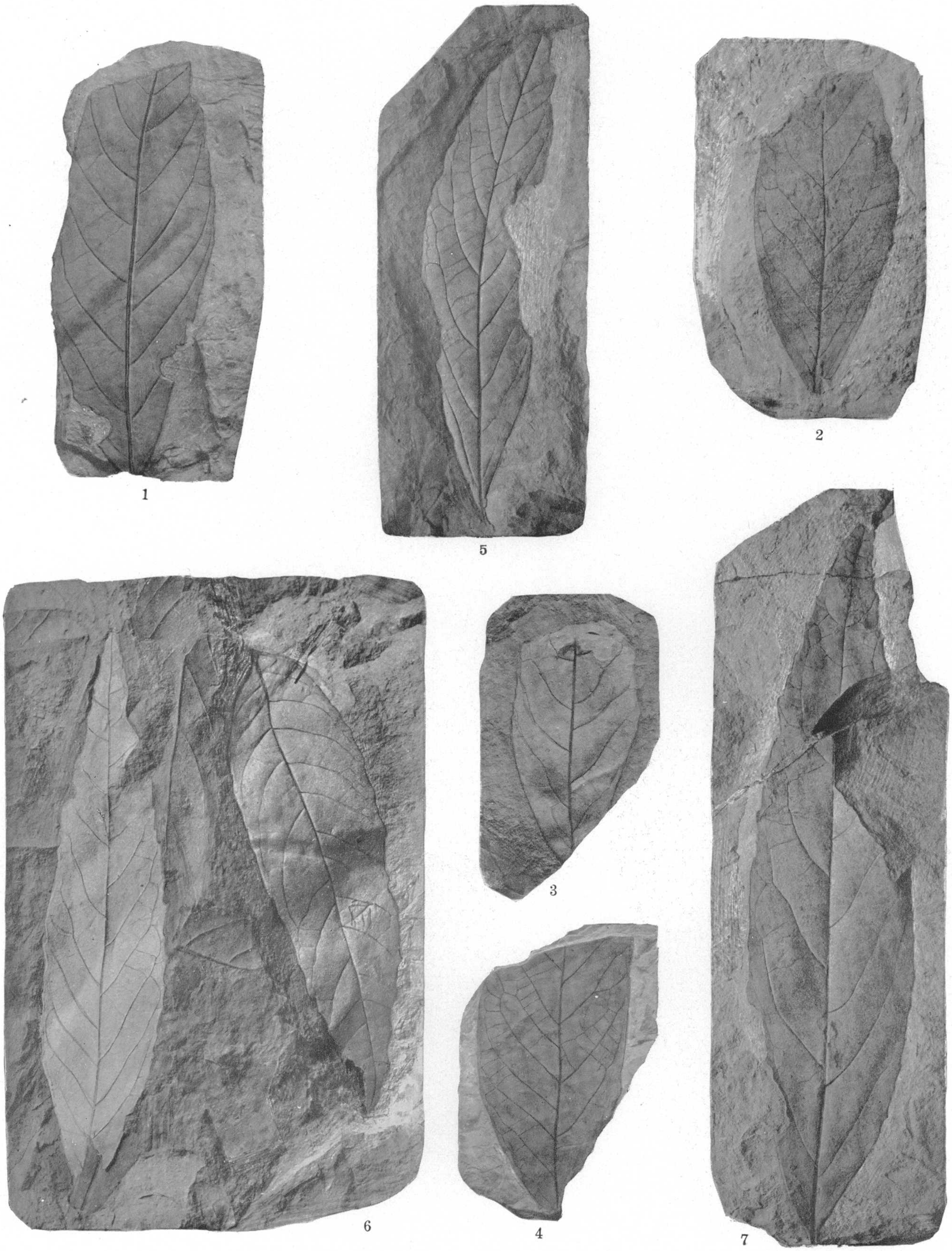
TERTIARY FLORAS OF ALASKA.

1-5. *Juglans nigella* Heer (U.S.N.M. 38805, 38807, 38808; pp. 81-82). **6.** *Hicoria magnifica* Knowlton (U.S.N.M. 38809; pp. 83-84).



TERTIARY FLORAS OF ALASKA.

1–4, 5?, 6?,. *Juglans juglandiformis* (Sternberg) Giebel (U.S.N.M. 38810, 38811; pp. 80–81).

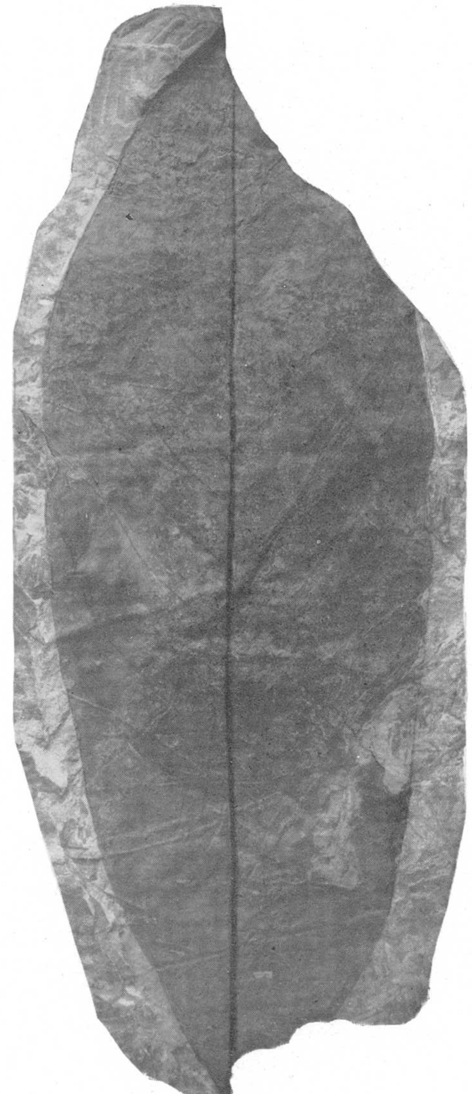


TERTIARY FLORAS OF ALASKA.

1–4. *Juglans crossii* Knowlton (U.S.N.M. 38812; p. 80). **5–7.** *Pterocarya septentrionale* Hollick, n. sp. (U.S.N.M. 38813; p. 84).

1

3

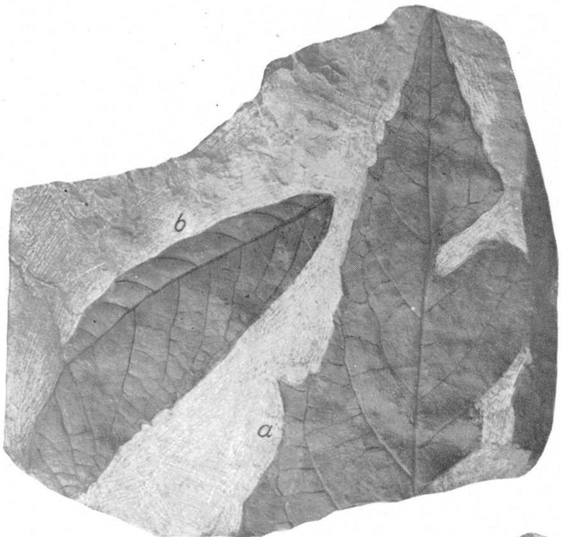


2

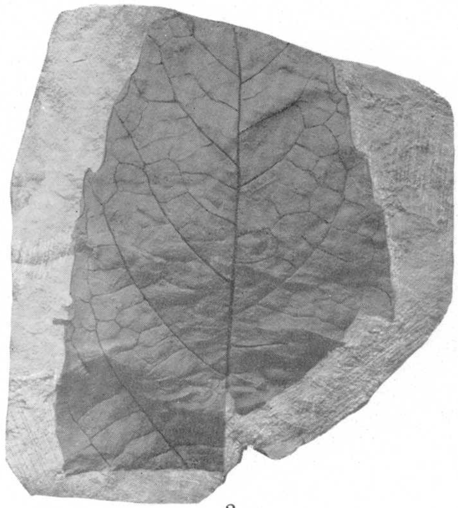
TERTIARY FLORAS OF ALASKA.

1, 2. *Juglans longiapiculata* Hollick, n. sp. (U.S.N.M. 38820 p. 79.)

3. *Juglans acuminata latifolia* (Alex. Braun) Heer (U.S N.M. 38821; pp. 78–79)

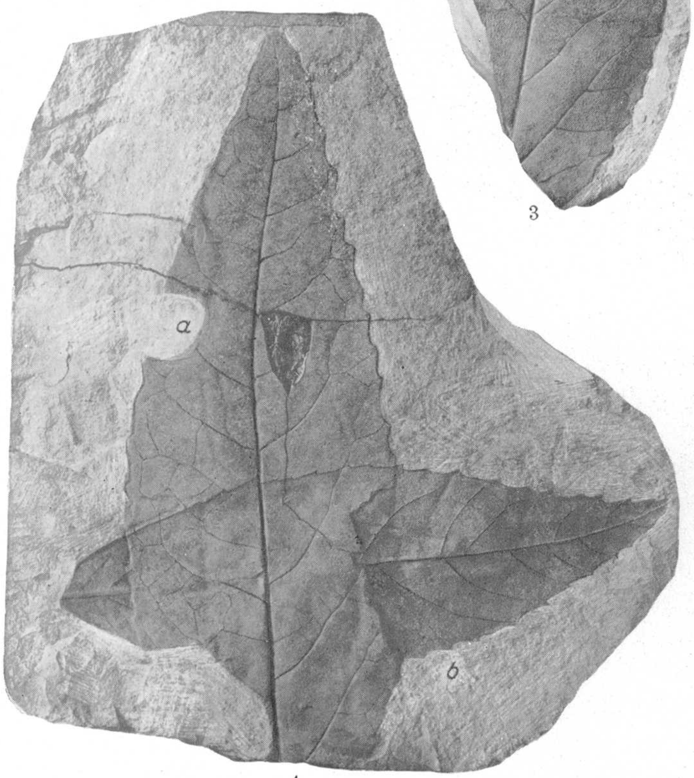


1

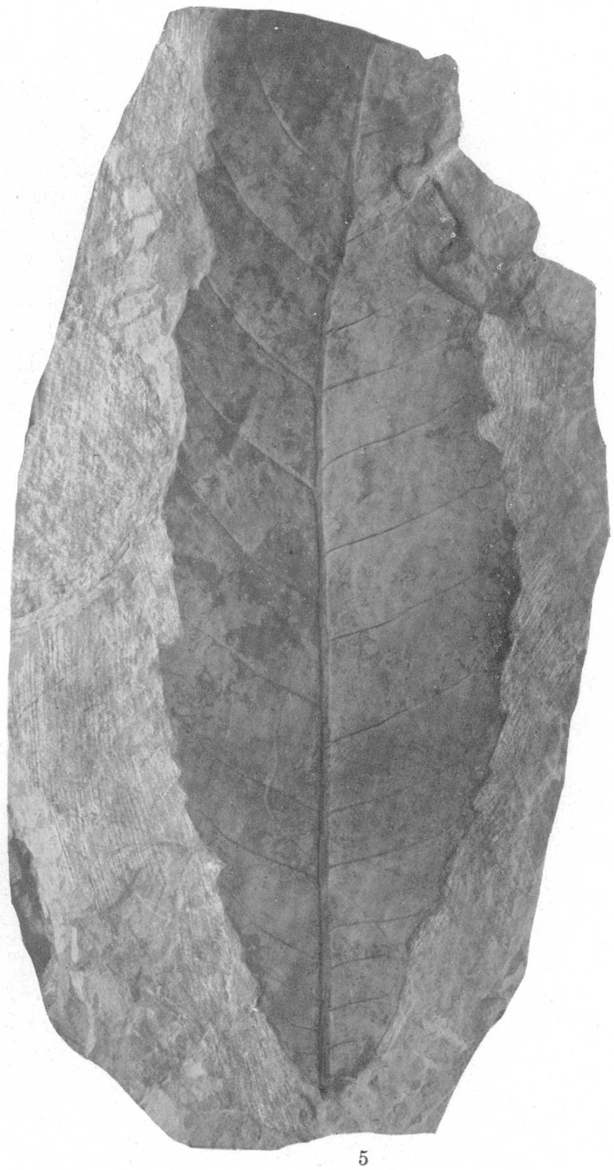


2

3



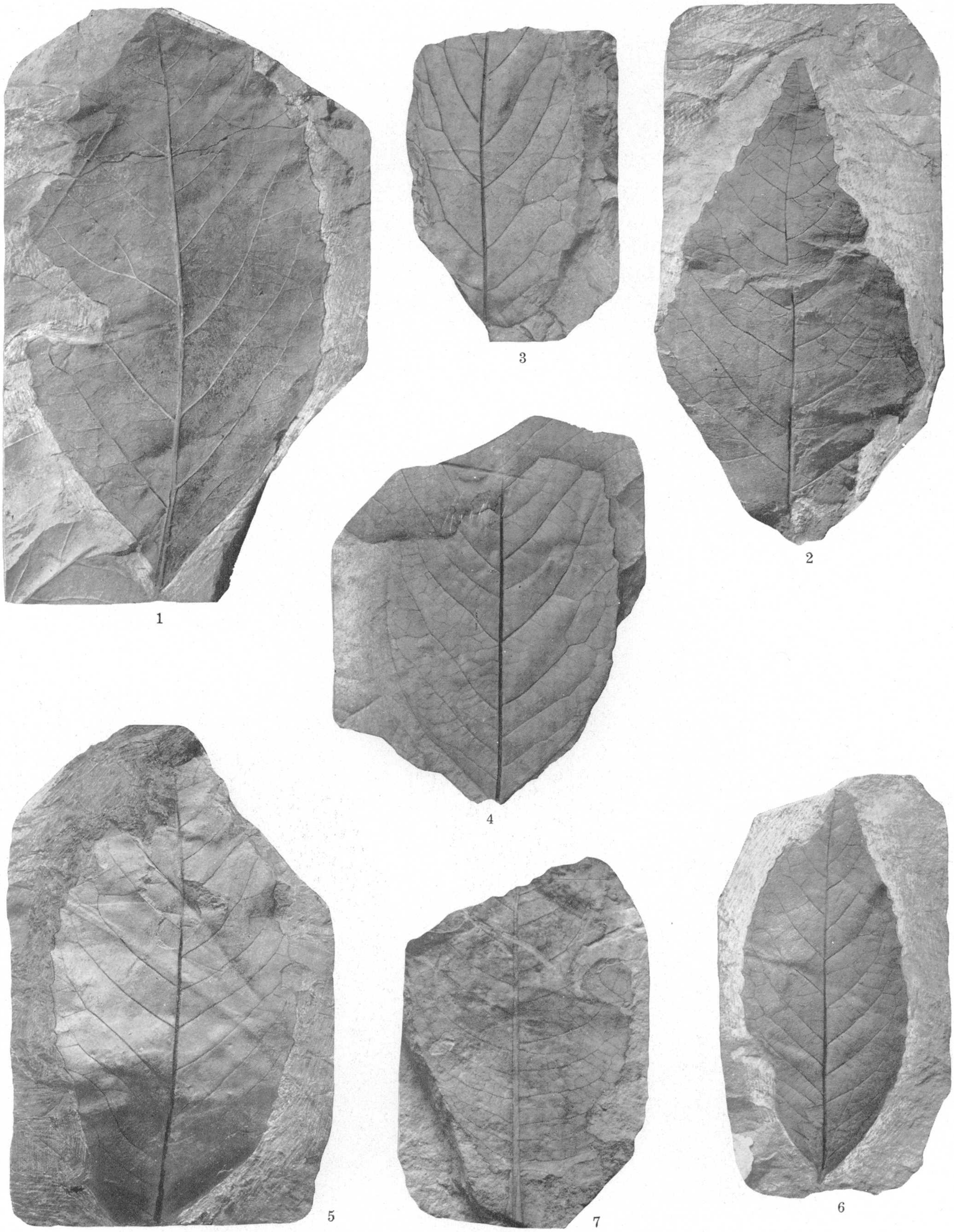
4



5

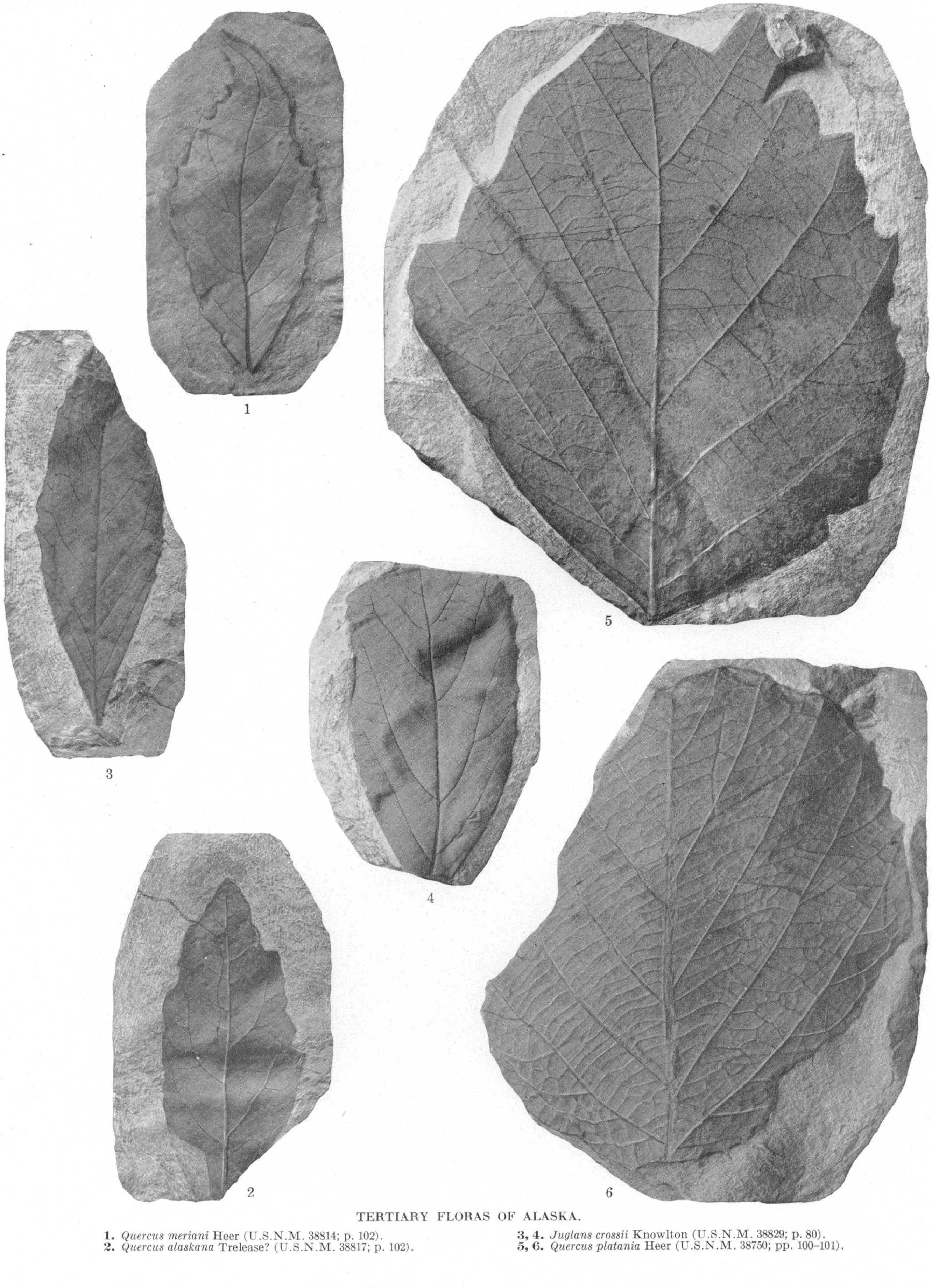
TERTIARY FLORAS OF ALASKA.

1a. *Quercus juglandina* Heer? (U.S.N.M. 38822; p. 101).
1b. *Juglans* sp.? (U.S.N.M. 38823; p. 83).
2. *Quercus juglandina* Heer? (U.S.N.M. 38822; p. 101).
3, 4a. *Quercus conjunctiva* Hollick, n. sp. (U.S.N.M. 38824, fig. 3; 38818, fig. 4a pp. 101–102).
4b. *Fraxinus juglandina* Saporta (U.S.N.M. 38819; p. 163).
5. *Dryophyllum longipetiolatum* Knowlton (U.S.N.M. 38825; p. 104).



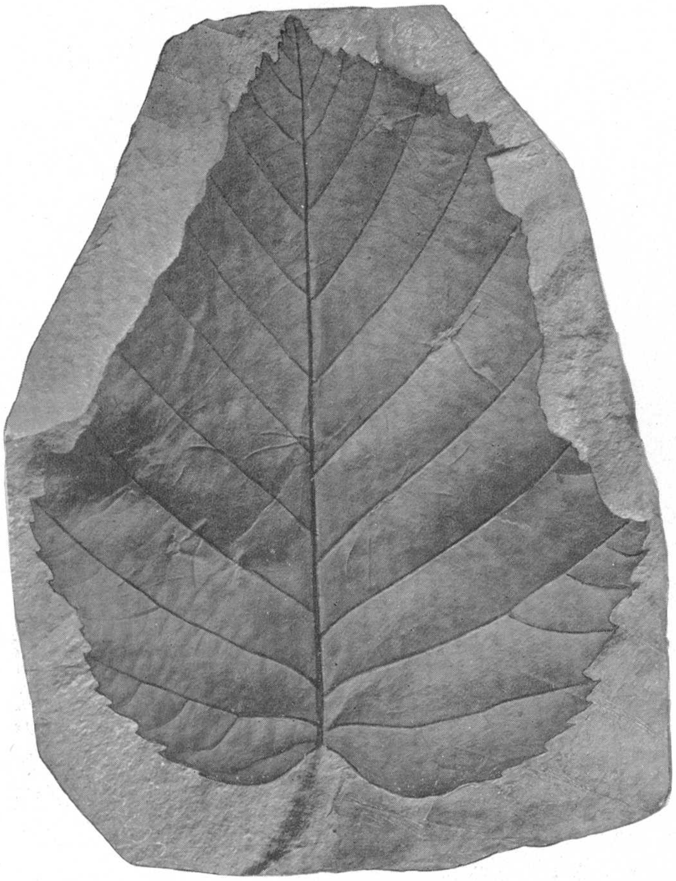
TERTIARY FLORAS OF ALASKA.

1. *Quercus artocarpites* Ettingshausen (U.S.N.M. 38816; p. 102).
2. *Quercus juglandina* Heer? (U.S.N.M. 38826; p. 101).
3–5. *Juglans juglandiformis* (Sternberg) Giebel (U.S.N.M. 38810; pp. 80–81).
6. *Dryophyllum aquilonium* Hollick, n. sp. (U.S.N.M. 38827; p. 104).
7. *Juglans picroides* Heer (U.S.N.M. 38828; p. 82).



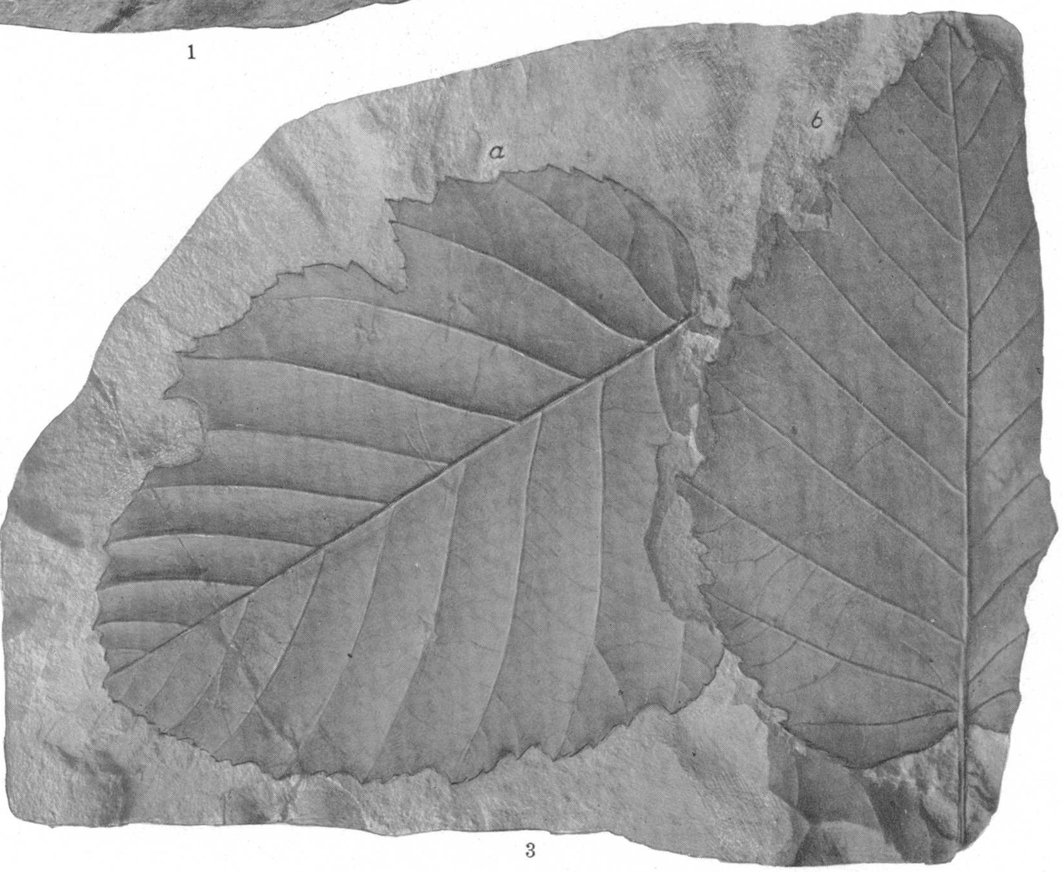
TERTIARY FLORAS OF ALASKA.

1. *Quercus meriani* Heer (U.S.N.M. 38814; p. 102).
2. *Quercus alaskana* Trelease? (U.S.N.M. 38817; p. 102).
3, 4. *Juglans crossii* Knowlton (U.S.N.M. 38829; p. 80).
5, 6. *Quercus platania* Heer (U.S.N.M. 38750; pp. 100–101).



1

2

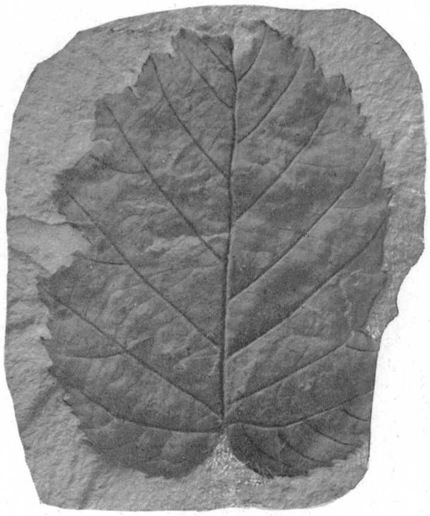


3

TERTIARY FLORAS OF ALASKA.

1–3a. *Corylus kenaiana* Hollick, n. sp. (U.S.N.M. 38831; pp. 87–88). **3b.** *Corylus americana fossilis* Newberry (U.S.N.M. 38832; p. 86).

1

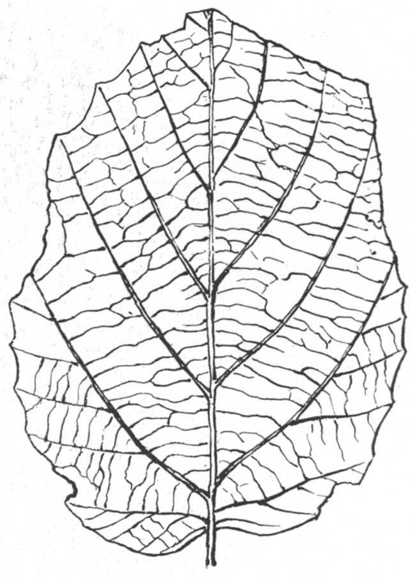


2

5

4

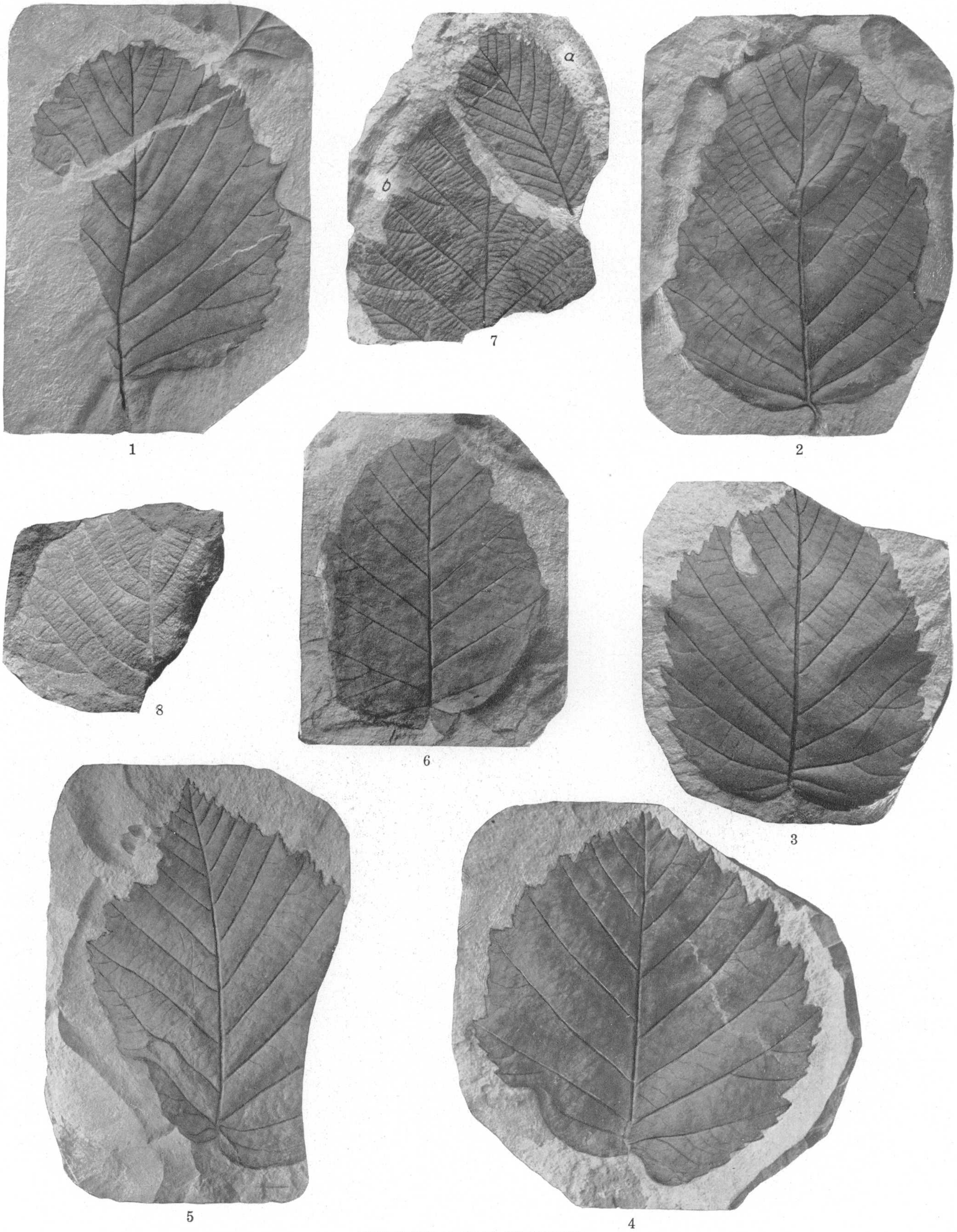
3



6

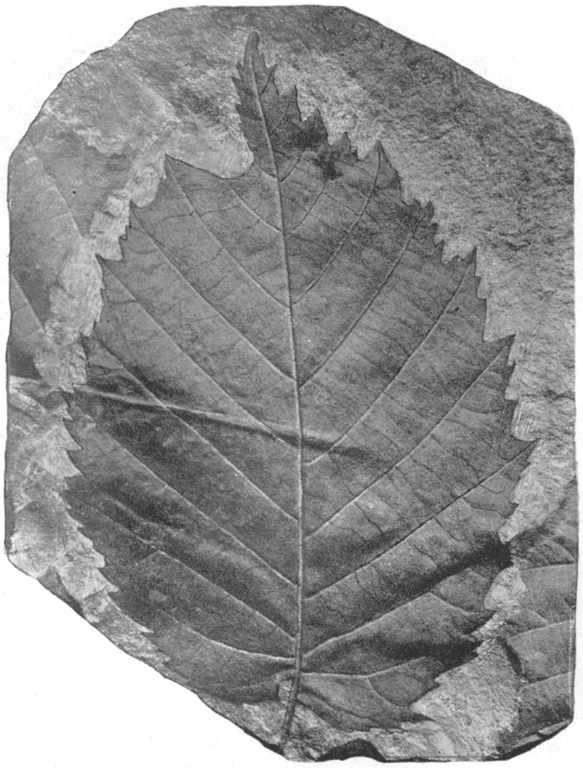
TERTIARY FLORAS OF ALASKA.

1a. *Alnus corylina* Knowlton and Cockerell (U.S.N.M. 38833; pp. 93–94). **1b–5.** *Corylus kenaiana* Hollick, n. sp. (U.S.N.M. 38831; pp. 87–88).
6. *Corylus macquarrii* (Forbes) Heer (introduced for comparison).



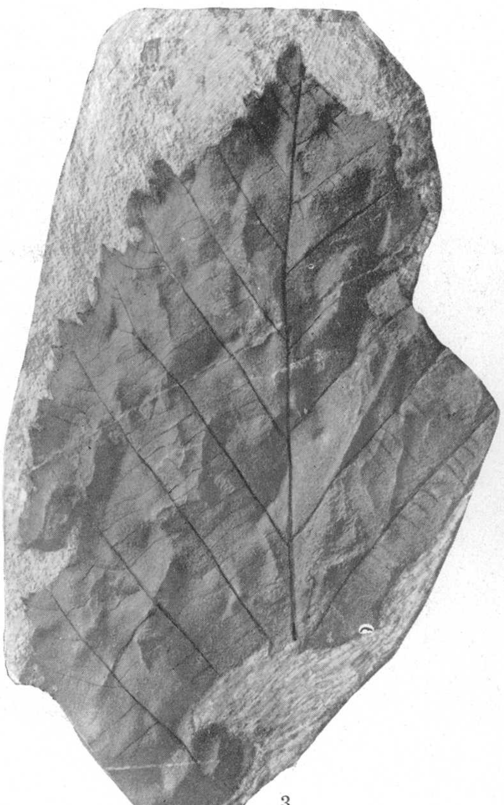
TERTIARY FLORAS OF ALASKA.

1–5. *Corylus kenaiana* Hollick, n. sp. (U.S.N.M. 38831; pp. 87–88).
6. *Corylus adumbrata* Hollick, n. sp. (U.S.N.M. 38834; p. 86).
7a. *Carpinus grandis* Unger (U.S.N.M. 38835; pp. 84–85).
7b, 8. *Alnus alnifolia* (Goeppert) Hollick, n. comb. (U.S.N.M. 38836, 38837; p 93).



1

2

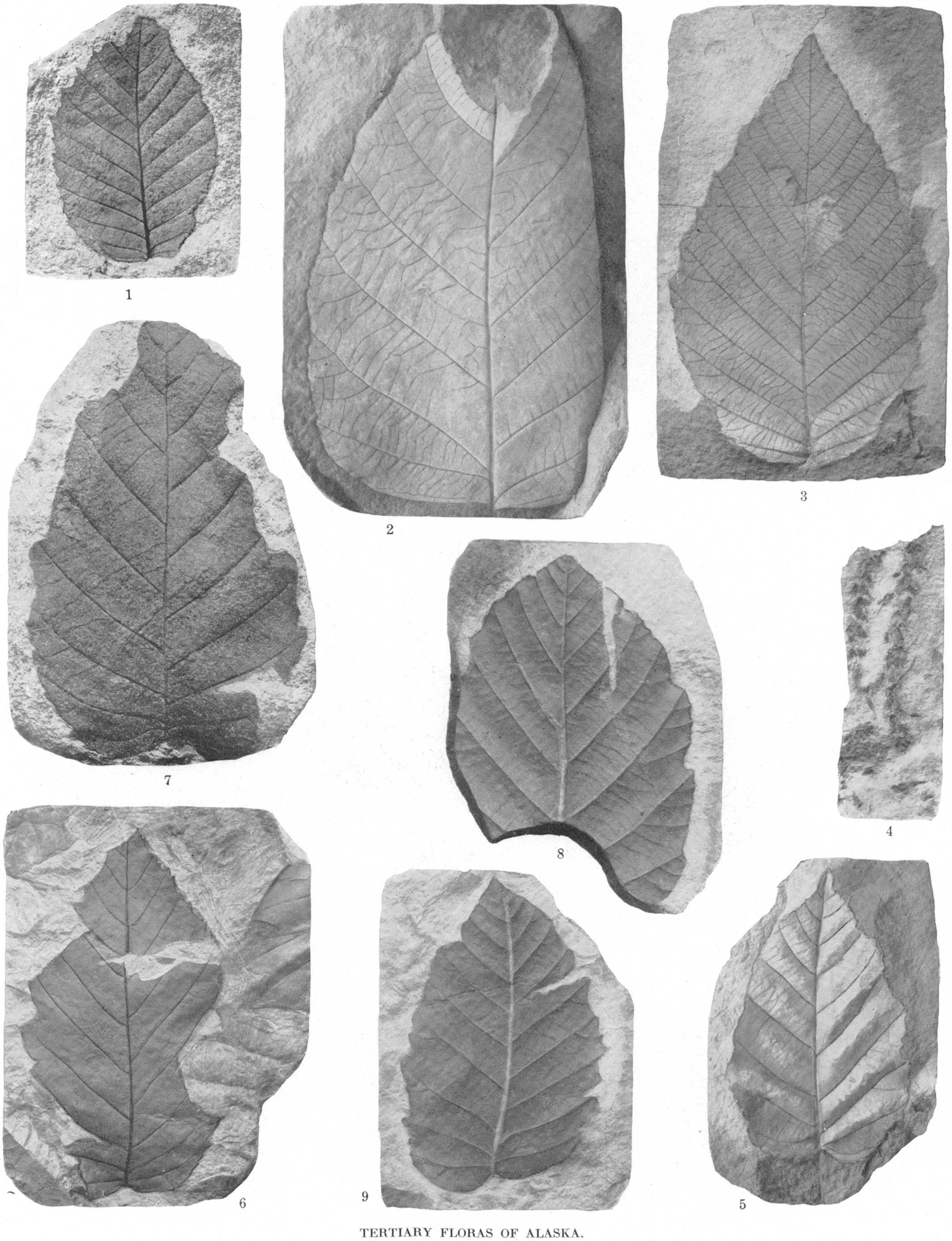


3

4

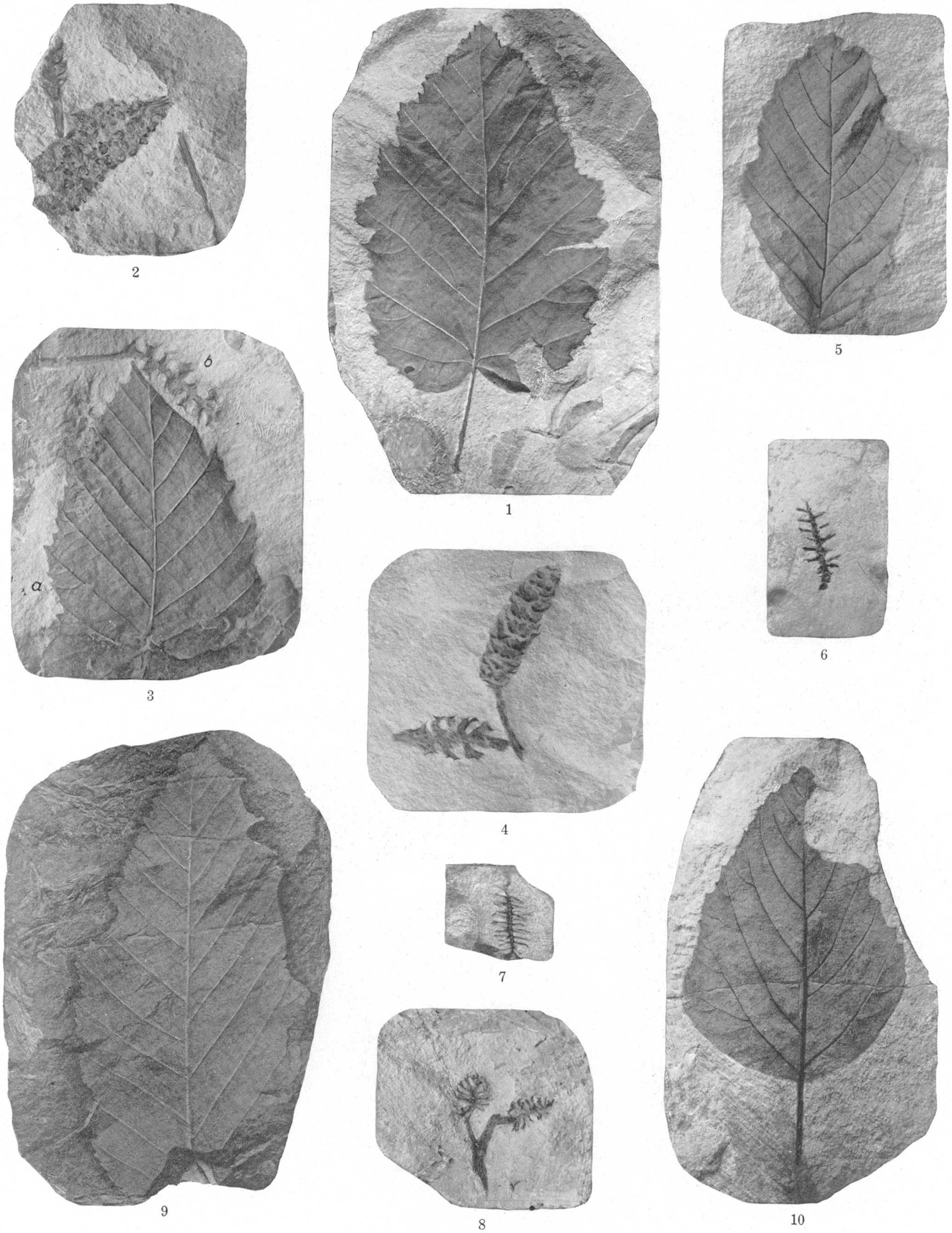
TERTIARY FLORAS OF ALASKA.

1–3. *Corylus americana fossilis* Newberry (U.S.N.M. 38832, 38838; p. 86). **4a.** *Ulmus diptera* Steenstrup? (U.S.N.M. 38839; p. 107).
4b. *Taxites olriki* Heer (U.S.N.M. 38840; p. 44).



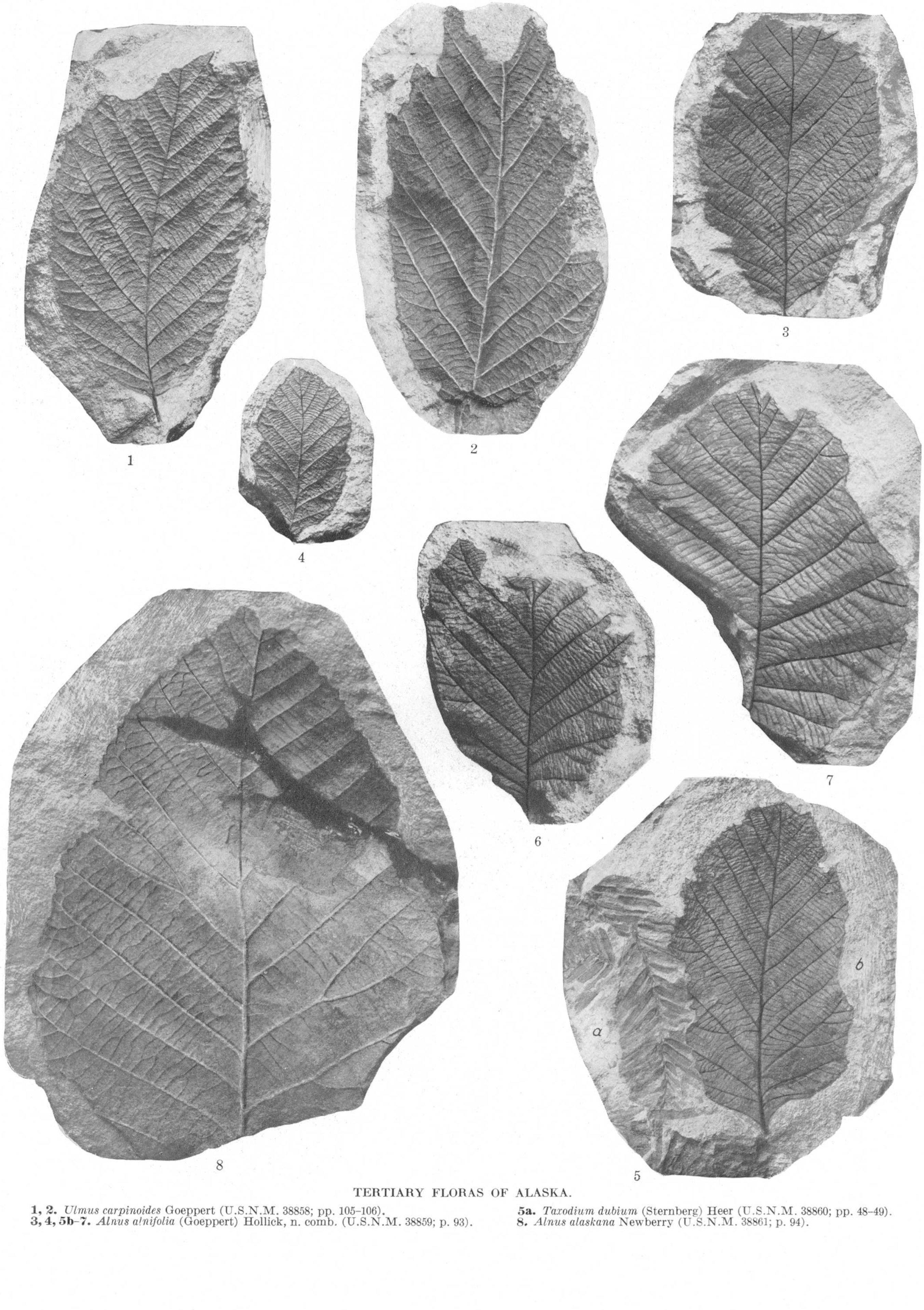
TERTIARY FLORAS OF ALASKA.

1. *Carpinus grandis* Unger (U.S.N.M. 38842; pp. 84–85).
2. *Carpinites truncatus* Hollick, n. sp. (U.S.N.M. 38843; p. 85).
3. *Corylus evidens* Hollick, n. sp. (U.S.N.M. 38844; pp. 86–87).
4. Staminate aments of *Corylus* sp.? (U.S.N.M. 38845; p. 90).
5–7. *Corylus adumbrata* Hollick, n. sp. (U.S.N.M. 38706, 38846; p. 86).
8, 9. *Alnus corylina* Knowlton and Cockerell(U.S.N.M. 38847; pp. 93–94).



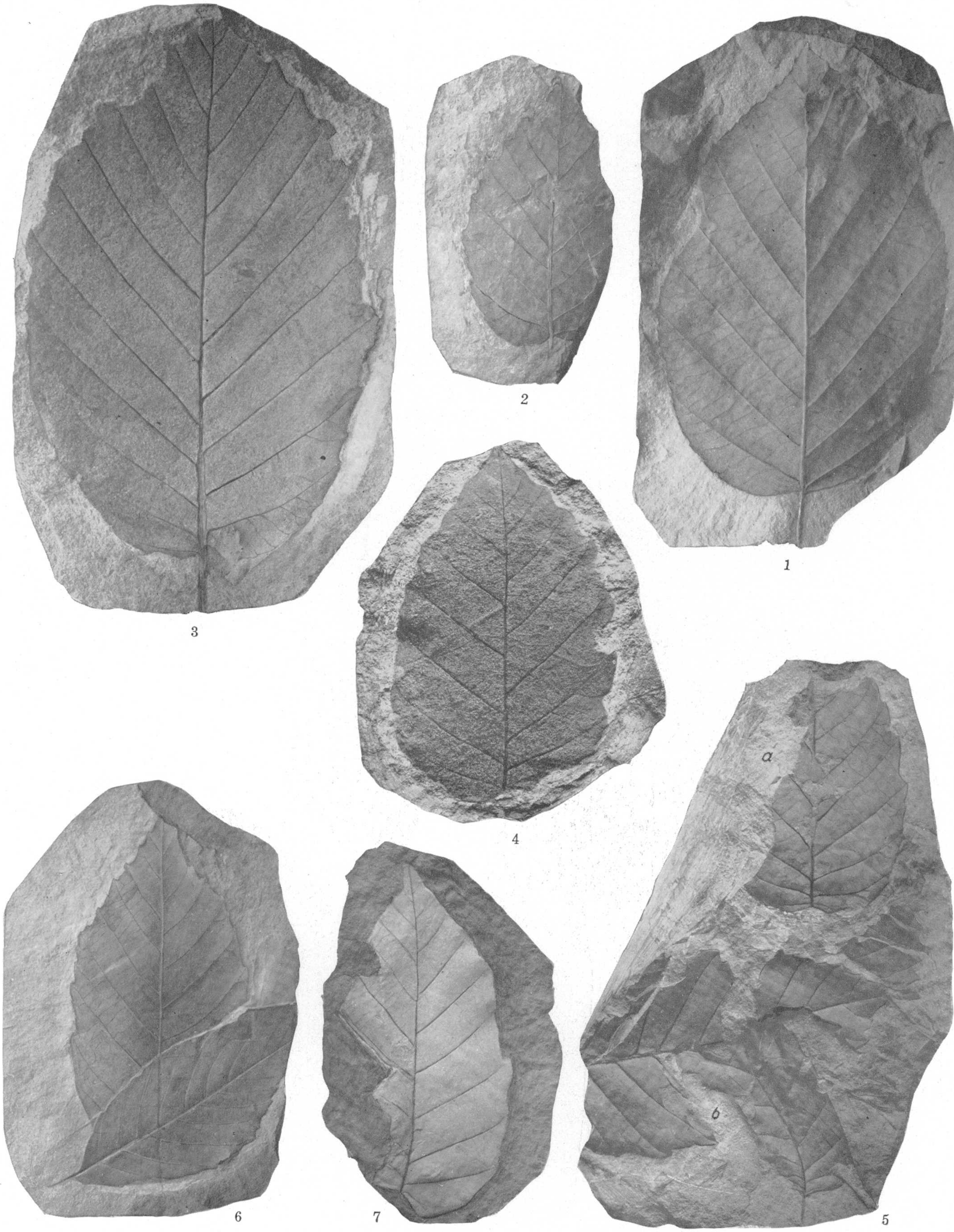
TERTIARY FLORAS OF ALASKA.

1. *Alnus corylina* Knowlton and Cockerell (U.S.N.M. 38847; pp. 93–94).
2. Aments of *Betula* sp.? (U.S.N.M. 38849; p. 92).
3a. *Betula prisca* Ettingshausen (U.S.N.M. 38850; p. 91).
3b, 4. Aments of *Betula* sp.? (U.S.N.M. 38841; pp. 92–93).
5. *Quercus oregoniana* Knowlton? (U.S.N.M. 38851; p. 103).
6, 7. Aments of *Corylus* sp.? (U.S.N.M. 38852, 38853; p. 90).
8. Pistillate aments of *Alnus* sp.? (U.S.N.M. 38854; p. 95).
9. *Carpinus grandis* Unger (U.S.N.M. 38856; pp. 84–85).
10. *Betula populoides* Hollick, n. sp. (U.S.N.M. 38857; pp. 91–92).



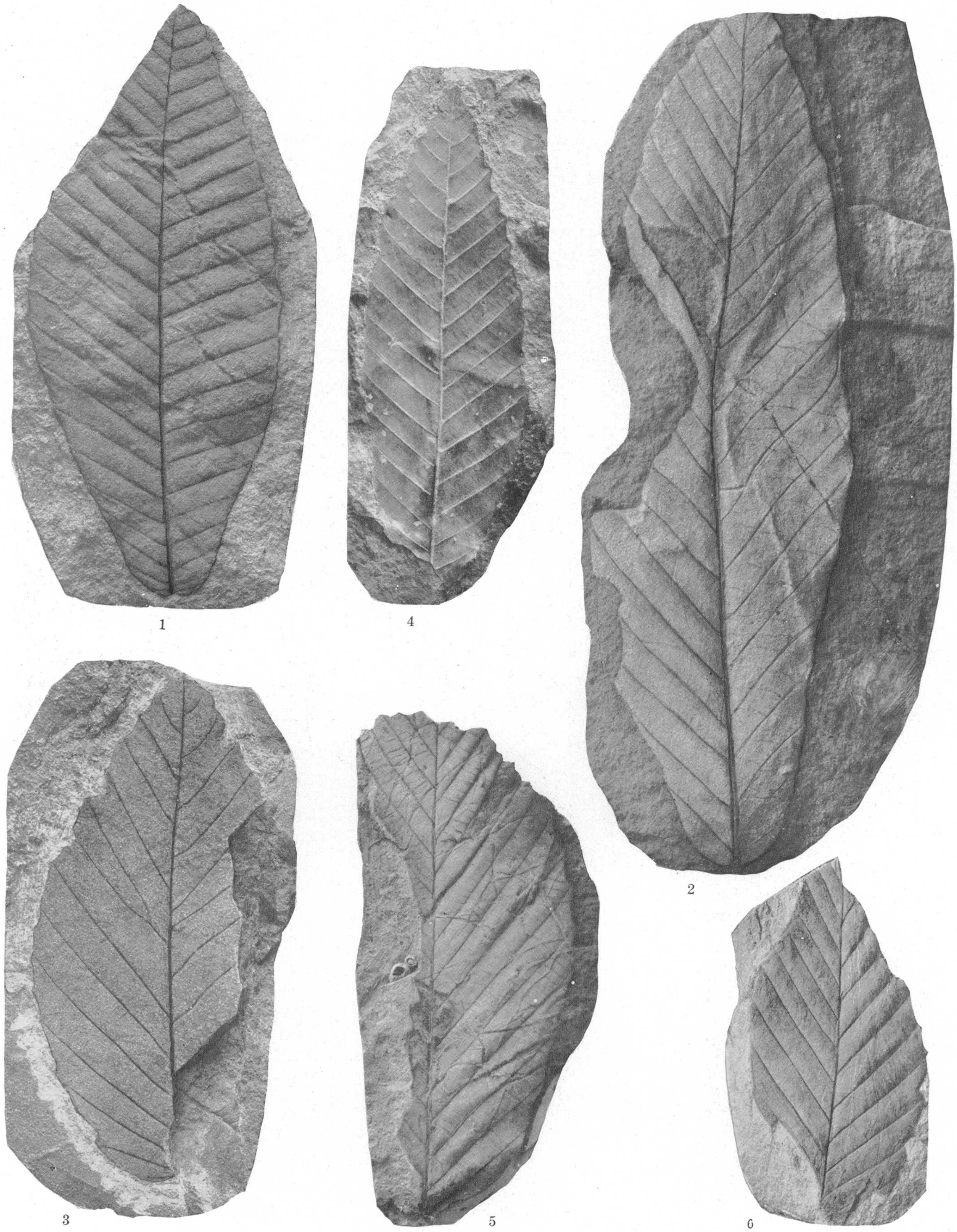
TERTIARY FLORAS OF ALASKA.

1, 2. *Ulmus carpinoides* Goeppert (U.S.N.M. 38858; pp. 105–106).
3, 4, 5b–7. *Alnus alnifolia* (Goeppert) Hollick, n. comb. (U.S.N.M. 38859; p. 93).
5a. *Taxodium dubium* (Sternberg) Heer (U.S.N.M. 38860; pp. 48–49).
8. *Alnus alaskana* Newberry (U.S.N.M. 38861; p. 94).



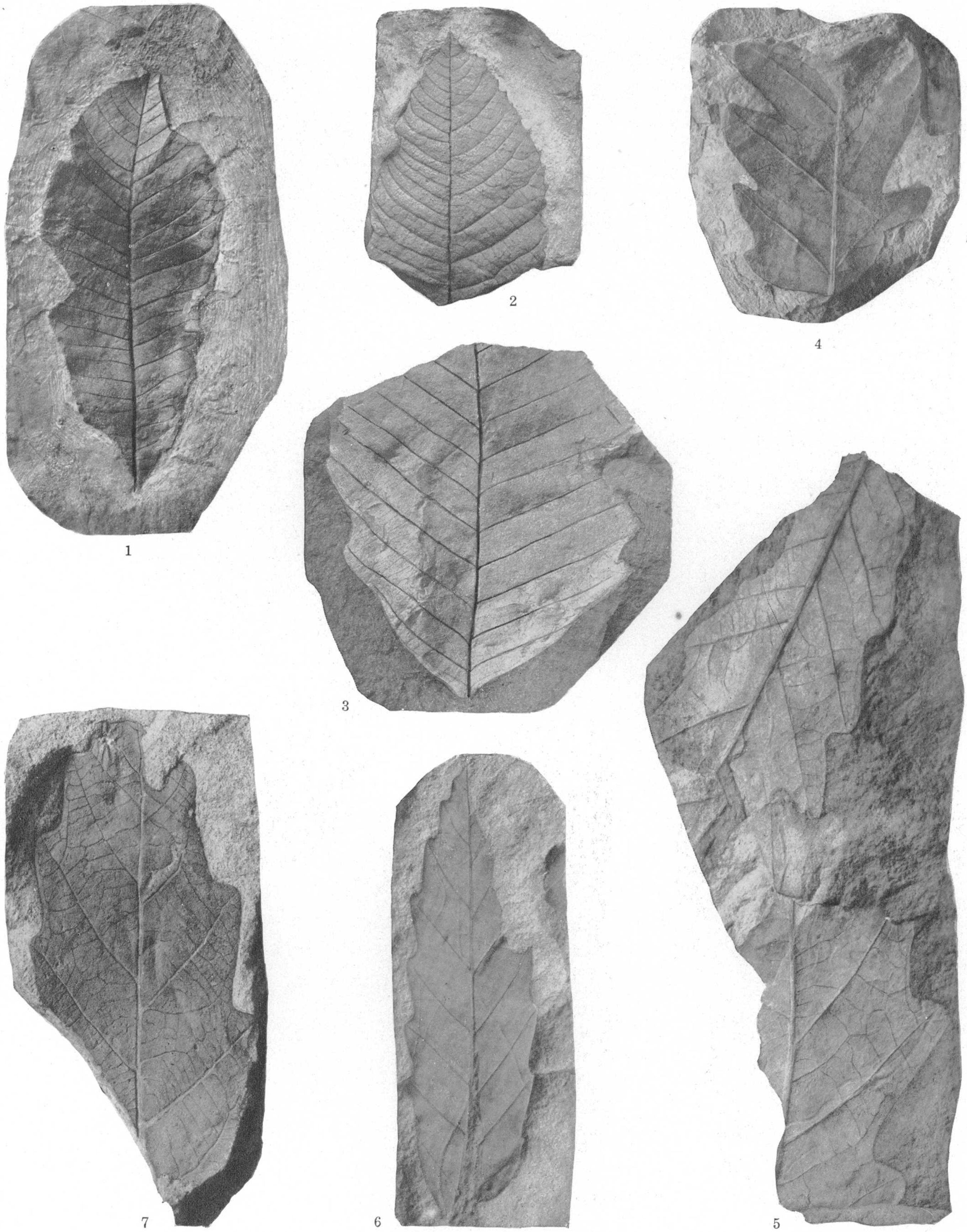
TERTIARY FLORAS OF ALASKA.

1. *Betula confusa lata* Hollick, n. var. (U.S.N.M. 38862; p. 91).
2. *Betula prisca* Ettingshausen (U.S.N.M. 38863; p. 91).
3. *Quercus olafseni* Heer (U.S.N.M. 38864; pp. 99–100).
4. *Quercus dalli* Lesquereux (U.S.N.M. 38865; p. 103).
5a, 7. *Fagus alnitifolia* Hollick, n. sp. (U.S.N.M. 38866; p. 97).
5b, 6. *Quercus steenstrupiana* Heer (U.S.N.M. 38867, 38869; p. 100).



TERTIARY FLORAS OF ALASKA.

1, 2. *Fagus antipofii* Abich (U.S.N.M. 38871; pp. 95–96). **3.** *Fagus deucalionis* Unger (U.S.N.M. 38872; p. 97).
4–6. *Castanea castaneaefolia* (Unger) Knowlton (U.S.N.M. 38873, 38874, 38875; pp. 97–98).

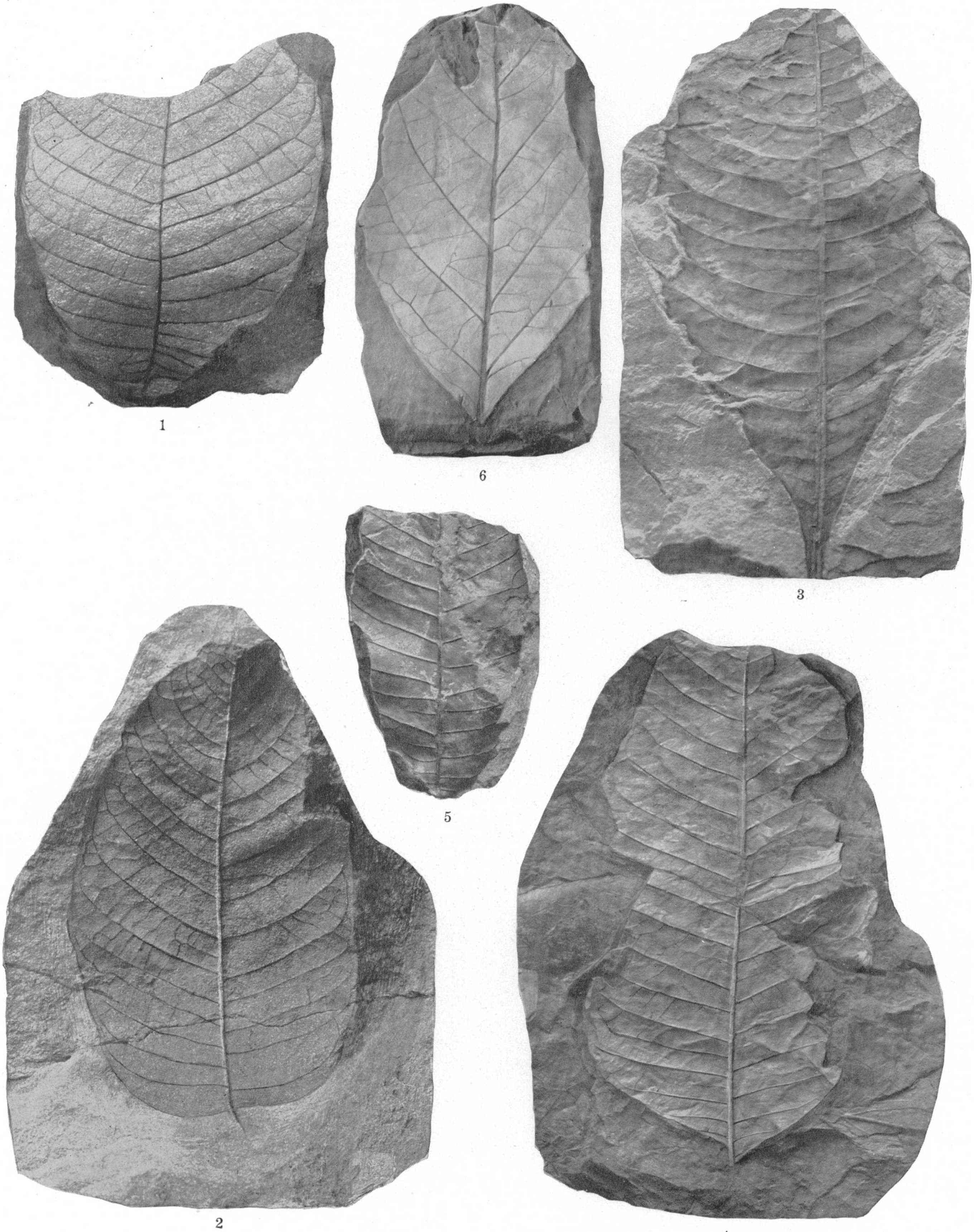


TERTIARY FLORAS OF ALASKA.

1, 2. *Quercus nevadensis* Lesquereux (U.S.N.M. 38876; p. 99).
3. *Quercus grönlandica* Heer (U.S.N.M. 38878; p. 99).
4, 5. *Quercus pseudocastanea* Goeppert (U.S.N.M. 38879, 38880; p. 98).
6, 7. *Quercus etymodrys* Unger (U.S.N.M. 38881; pp. 98-99).

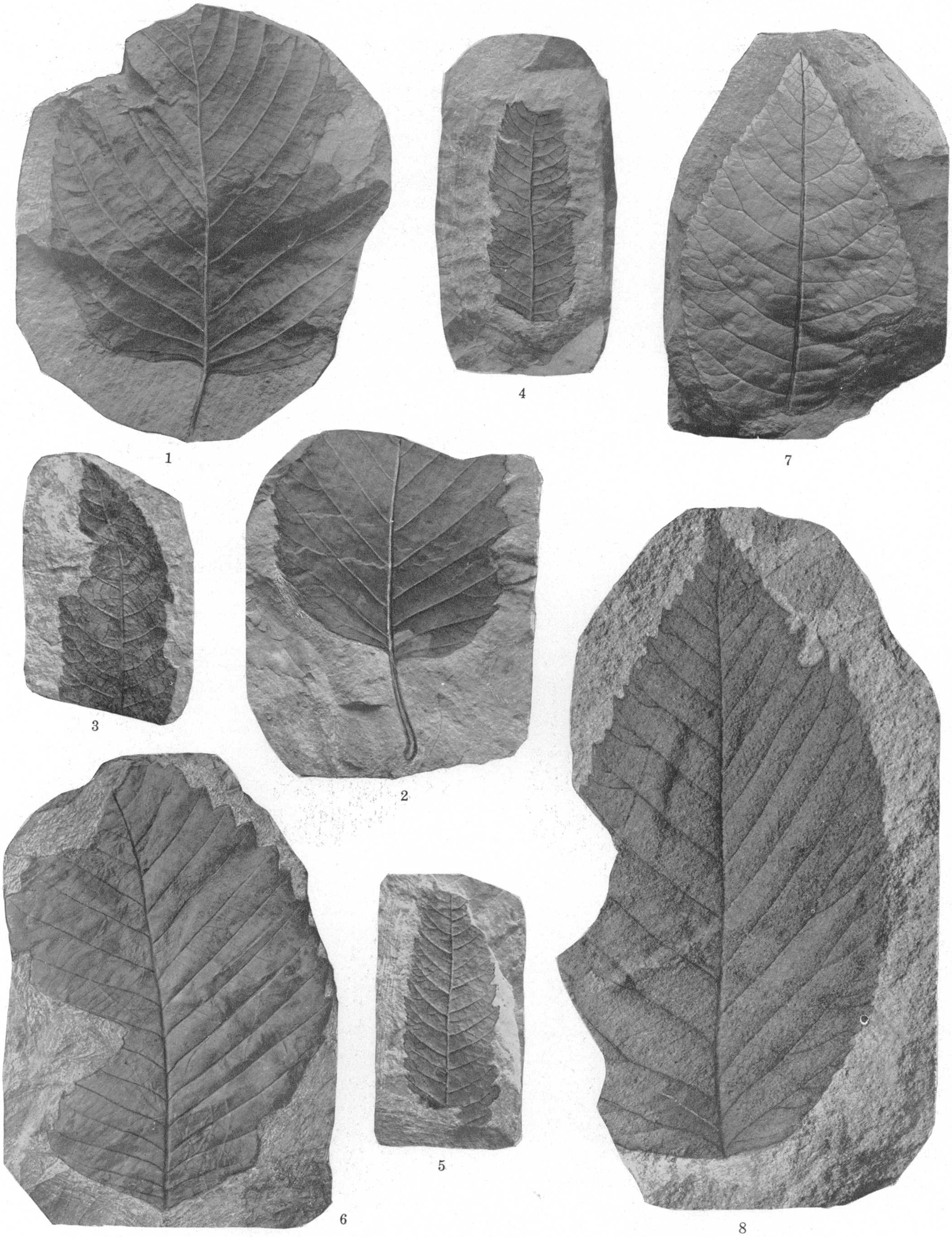
TERTIARY FLORAS OF ALASKA.

Quercus furuhjelmi Heer (U.S.N.M. 38882; p. 98).



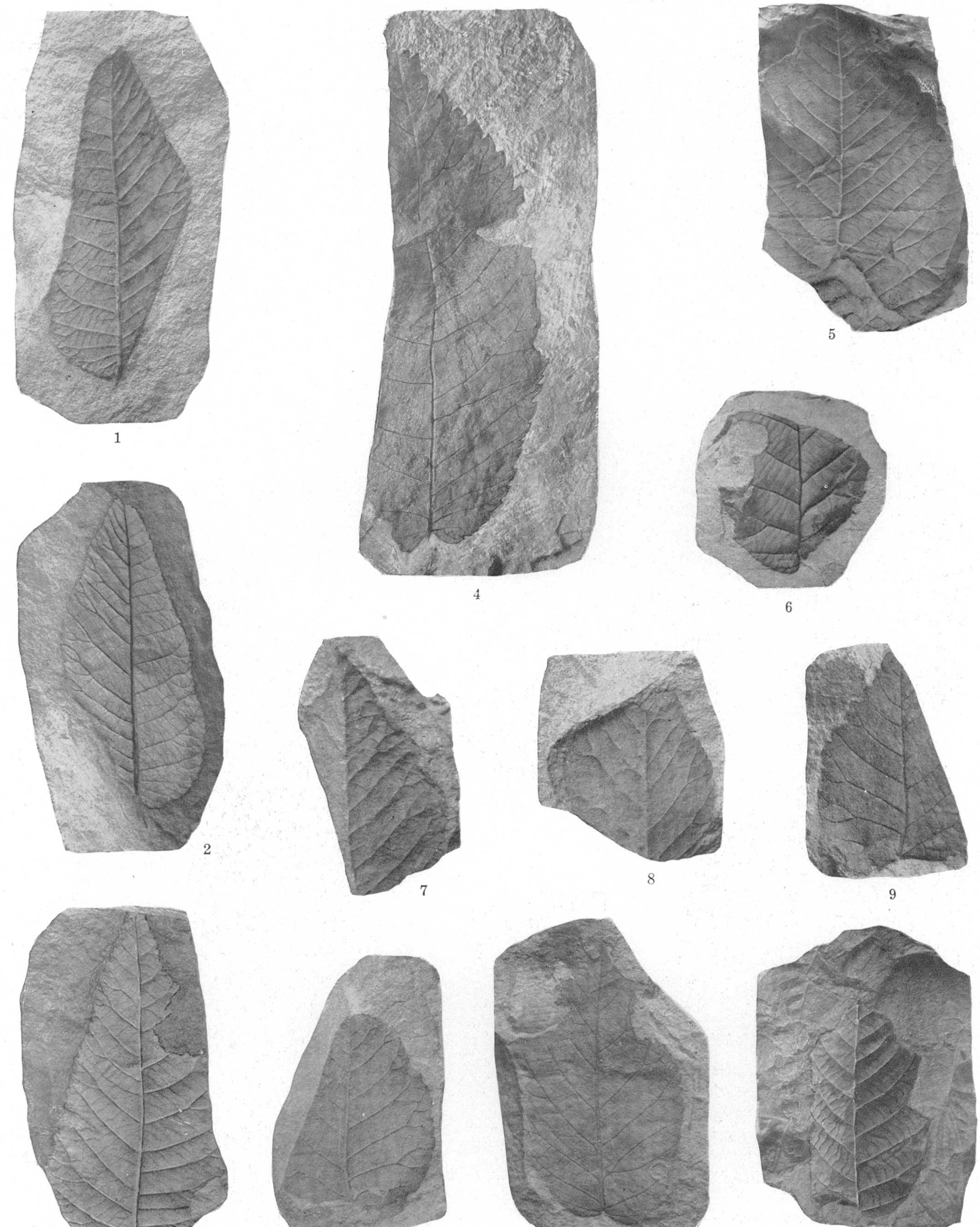
TERTIARY FLORAS OF ALASKA.

1, 2. *Artocarpus ordinarius* Hollick, n. sp. (U.S.N.M. 38883; p. 108). **3–5.** *Dryophyllum stanleyanum* Dawson (U.S.N.M. 38884, 38885, 38886; pp. 103–104).
6. *Quercus artocarpites* Ettingshausen (U.S.N.M. 38887; p. 102).



TERTIARY FLORAS OF ALASKA.

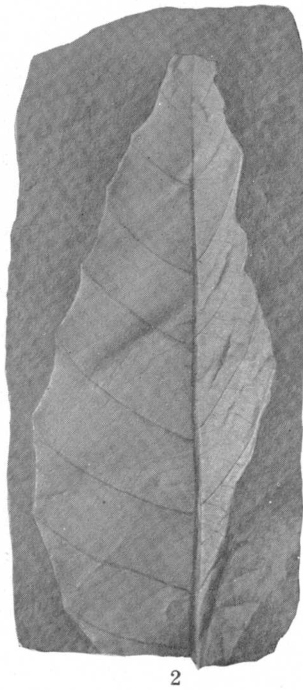
1, 2. *Ulmus borealis* Heer (U.S.N.M. 38848; pp. 106–107).
3–5. *Ulmus sorbifolia* Goeppert (U.S.N.M. 38868, 38888, 38889; p. 106).
6. *Quercus grönlandica* Heer (U.S.N.M. 38892; p. 99).
7. *Planera aquaticiformis* Hollick, n. sp. (U.S.N.M. 38893; p. 107).
8. *Betula brongniartii* Ettingshausen (U.S.N.M. 38894; p. 90).



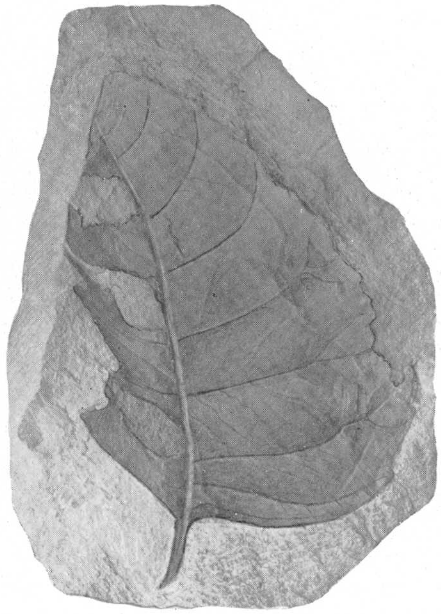
TERTIARY FLORAS OF ALASKA.

1–3. *Ulmus pseudobraunii* Hollick, n. sp. (U.S.N.M. 38895; p. 105).
4. *Ulmus longifolia* Unger (U.S.N.M. 38745; p. 107).
5. *Planera ungeri* Ettingshausen (U.S.N.M. 38896; pp. 107–108).
6–12. *Ulmus braunii* Heer? (U.S.N.M. 38897, 38898; p. 105).

1

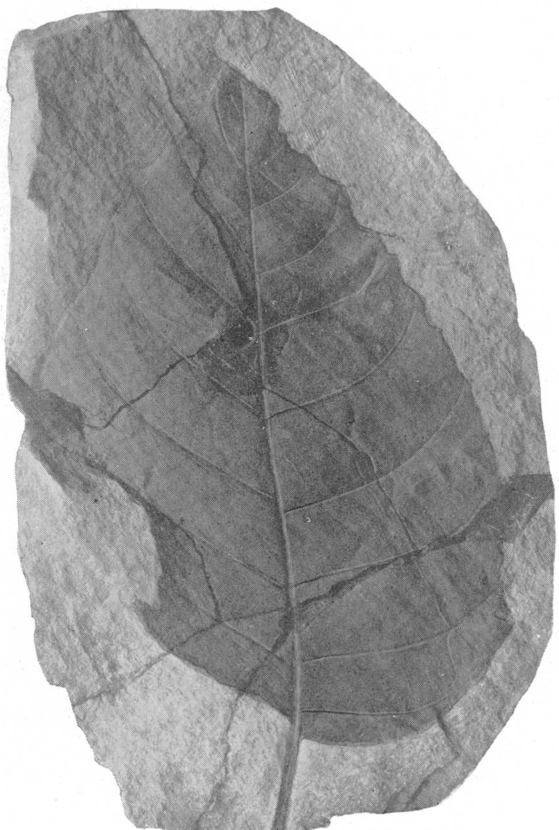


2



3

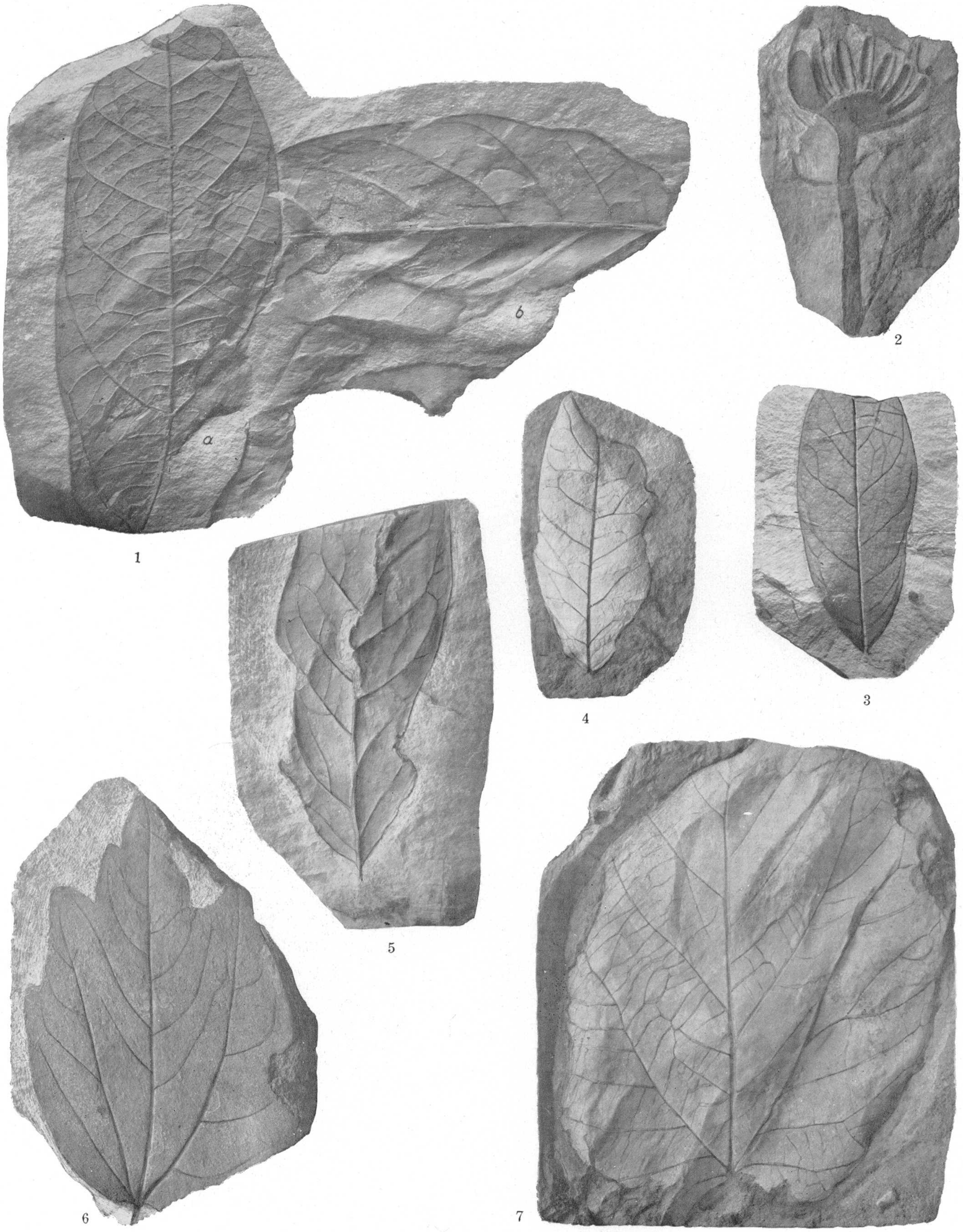
5



4

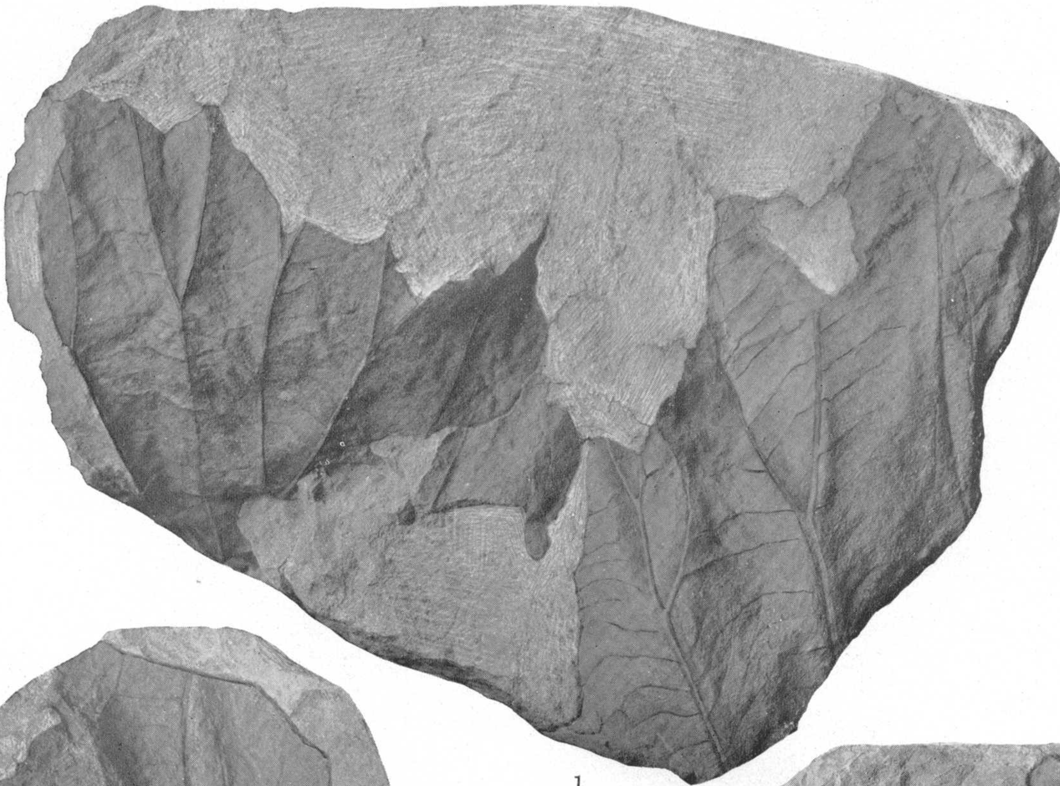
TERTIARY FLORAS OF ALASKA.

Artocarpidium alaskanum Hollick, n. sp. (U.S.N.M. 38899, 38900; pp. 108–109).

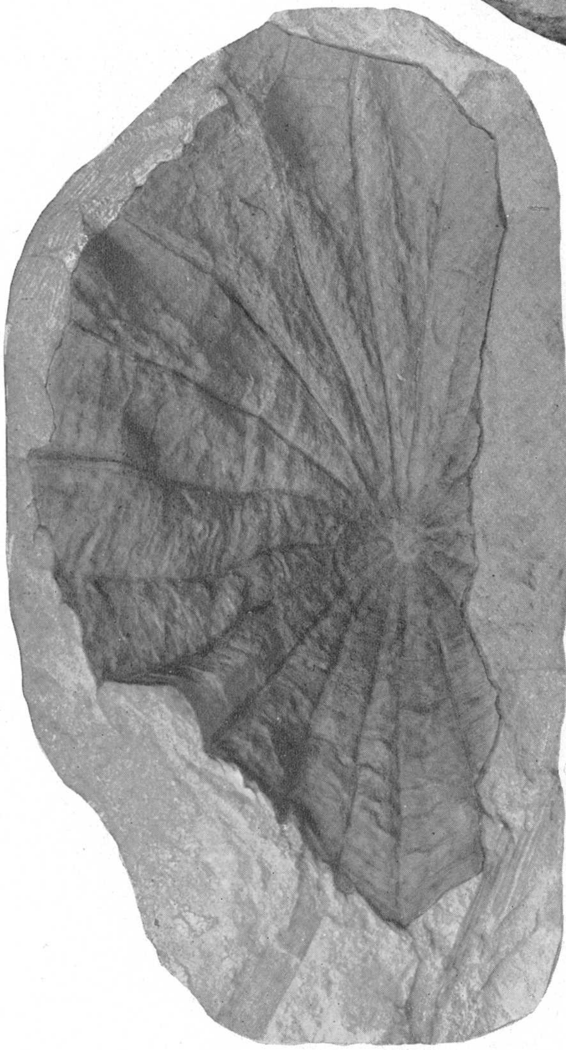


TERTIARY FLORAS OF ALASKA.

1a. *Juglans thermalis* Lesquereux (U.S.N.M. 38901; p. 79).
1b. *Mohrodendron inopinum* Hollick, n. sp. (U.S.N.M. 38902; pp. 162–163).
2. *Palaeanthus prindlei* Hollick, n.sp. (U.S.N.M. 38903; pp. 169–170).
3–5. *Grevillea alaskana* Hollick, n. sp. (U.S.N.M. 38904, 38870; p. 111).
6. *Ficus menzeli* Hollick, n. sp. (U.S.N.M. 38905; pp. 109–110).
7. *Ficus overbecki* Hollick, n. sp. (U.S.N.M. 38906; p. 110).



1



2

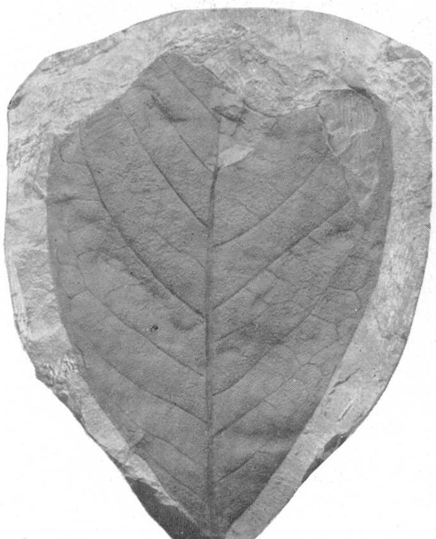
3

TERTIARY FLORAS OF ALASKA.

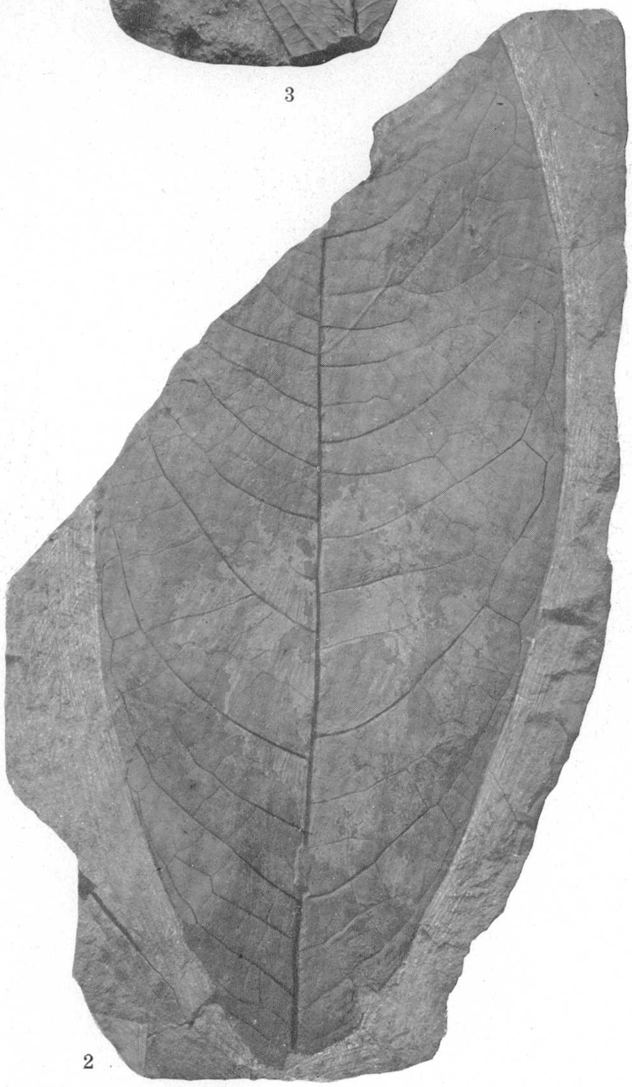
Nelumbo protolutea Berry? (U.S.N.M. 38907; pp. 118-119).

1

3



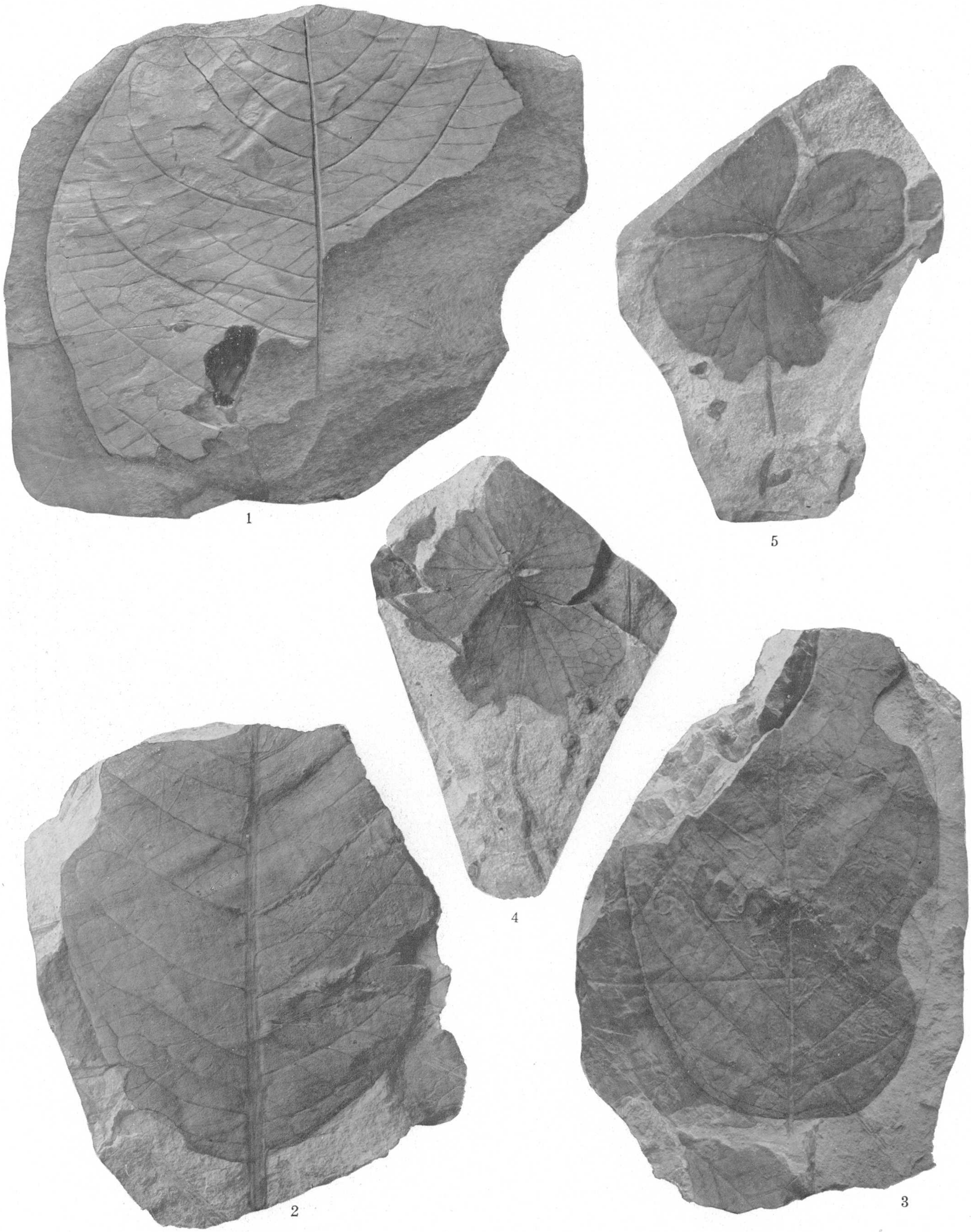
4



2

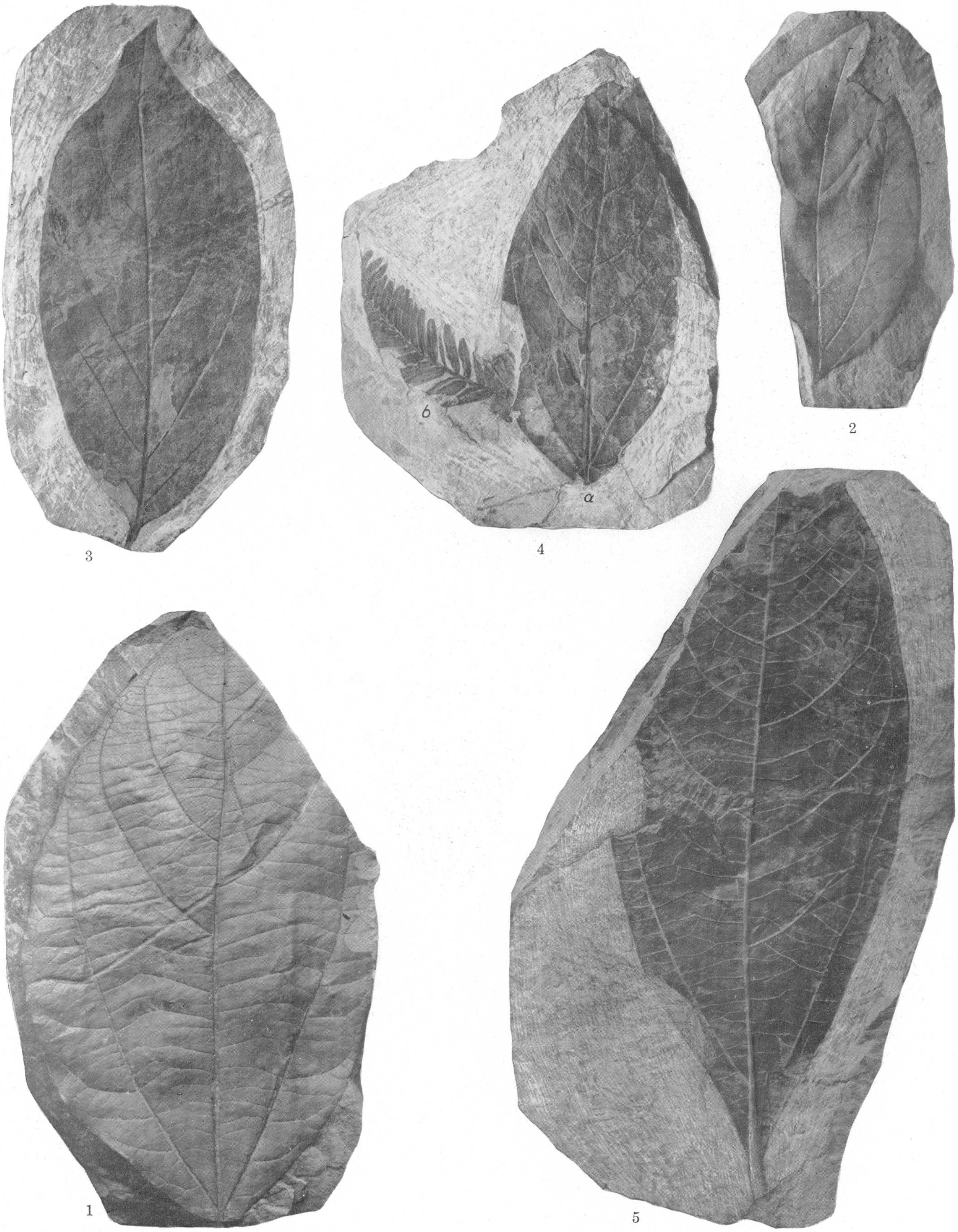
TERTIARY FLORAS OF ALASKA.

Magnolia inglefieldi Heer (U.S.N.M. 38769, 38908–38910; p. 114).



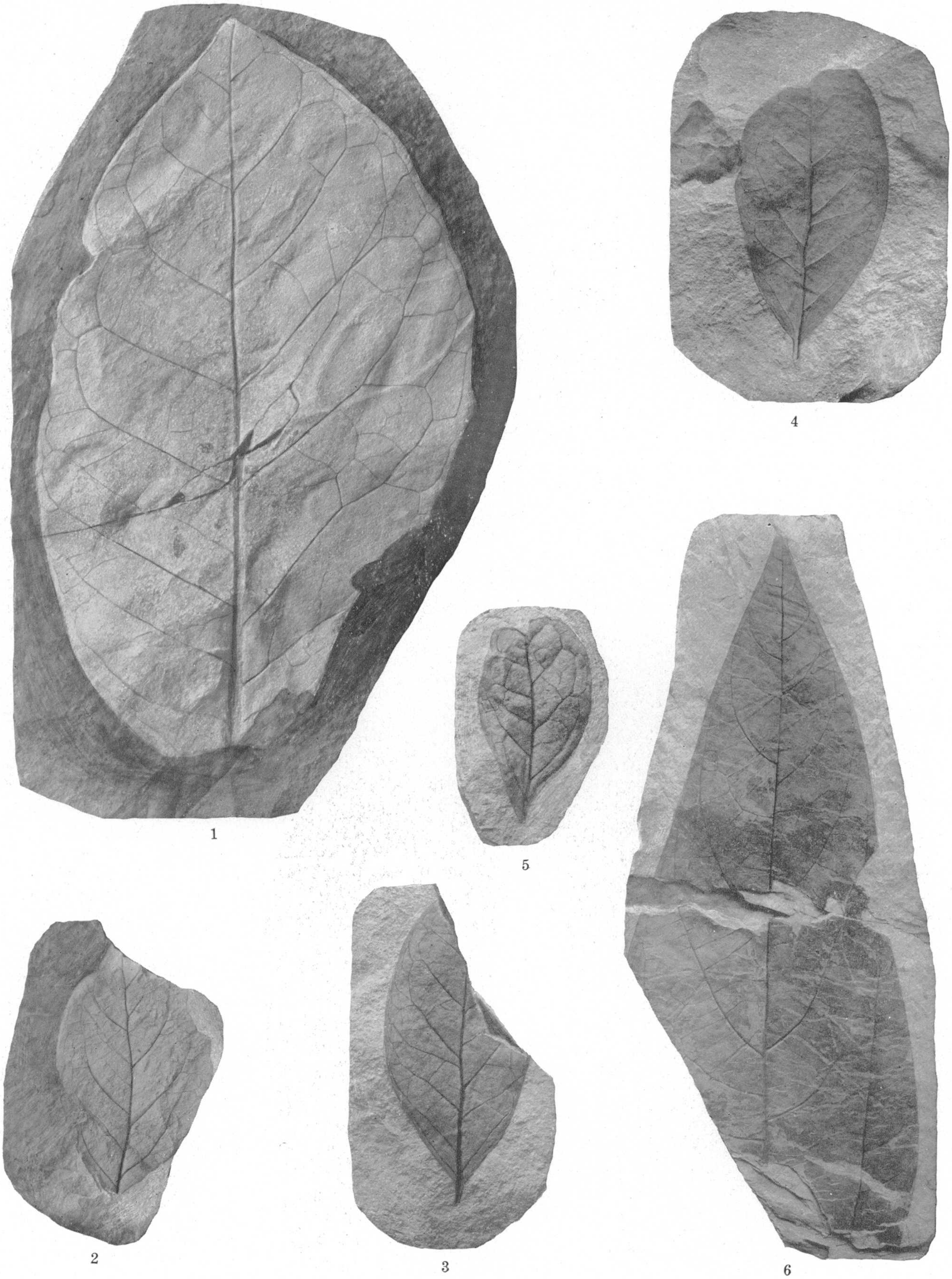
TERTIARY FLORAS OF ALASKA.

1, 2. *Magnolia ovalis* Lesquereux (U.S.N.M. 38667; pp. 114–115). **3.** *Magnolia wormskioldi* Heer (U.S.N.M. 38911; p. 115).
4, 5. *Hydrangea alaskana* Hollick (U.S.N.M. 38912; p. 122).



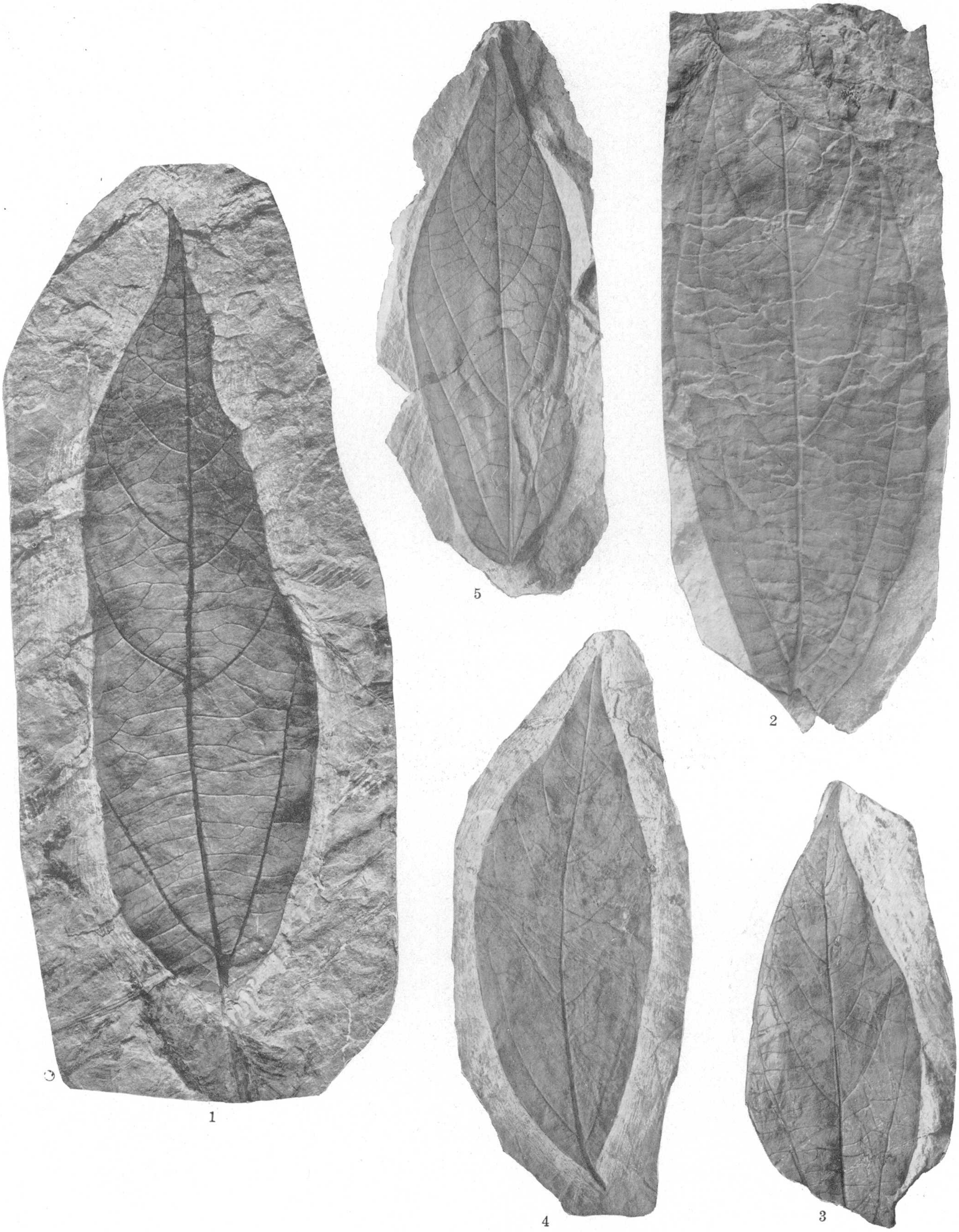
TERTIARY FLORAS OF ALASKA.

1. *Cinnamomum ficoides* Hollick, n. sp. (U.S.N.M. 38913; p. 116).
2. *Cinnamomum cinnamomeum* (Rossmaessler) Hollick, n. comb. (U.S.N.M. 38914; pp. 115–116).
3. *Laurus hamiltonensis* Hollick, n. sp. (U.S.N.M. 38916; p. 120).
4a. *Laurus californica* Lesquereux (U.S.N.M. 38917; p. 119).
4b. *Taxodium crassum* Hollick, n. sp. (U.S.N.M. 38918; p. 48).
5. *Sassafras alaskanum* Hollick, n. sp. (U.S.N.M. 38919; pp. 117–118).



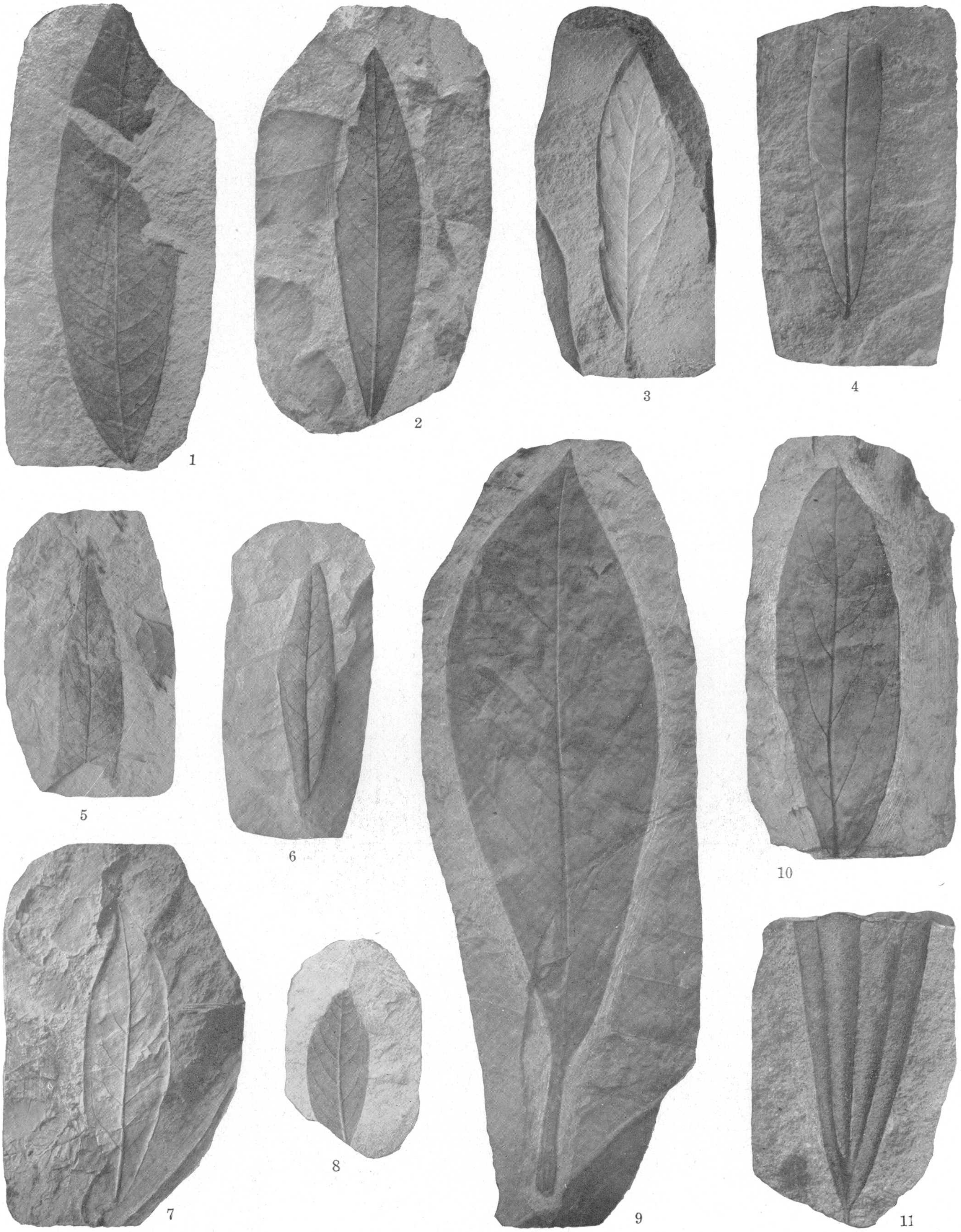
TERTIARY FLORAS OF ALASKA.

1. *Persea spatiosa* Hollick, n. sp. (U.S.N.M. 38920; pp. 116–117). **2–5.** *Benzoin antiquum* Heer (U.S.N.M. 38922; p. 119).
6. *Malapoenna carbonensis* (Ward) Knowlton? (U.S.N.M. 38923; p. 119).



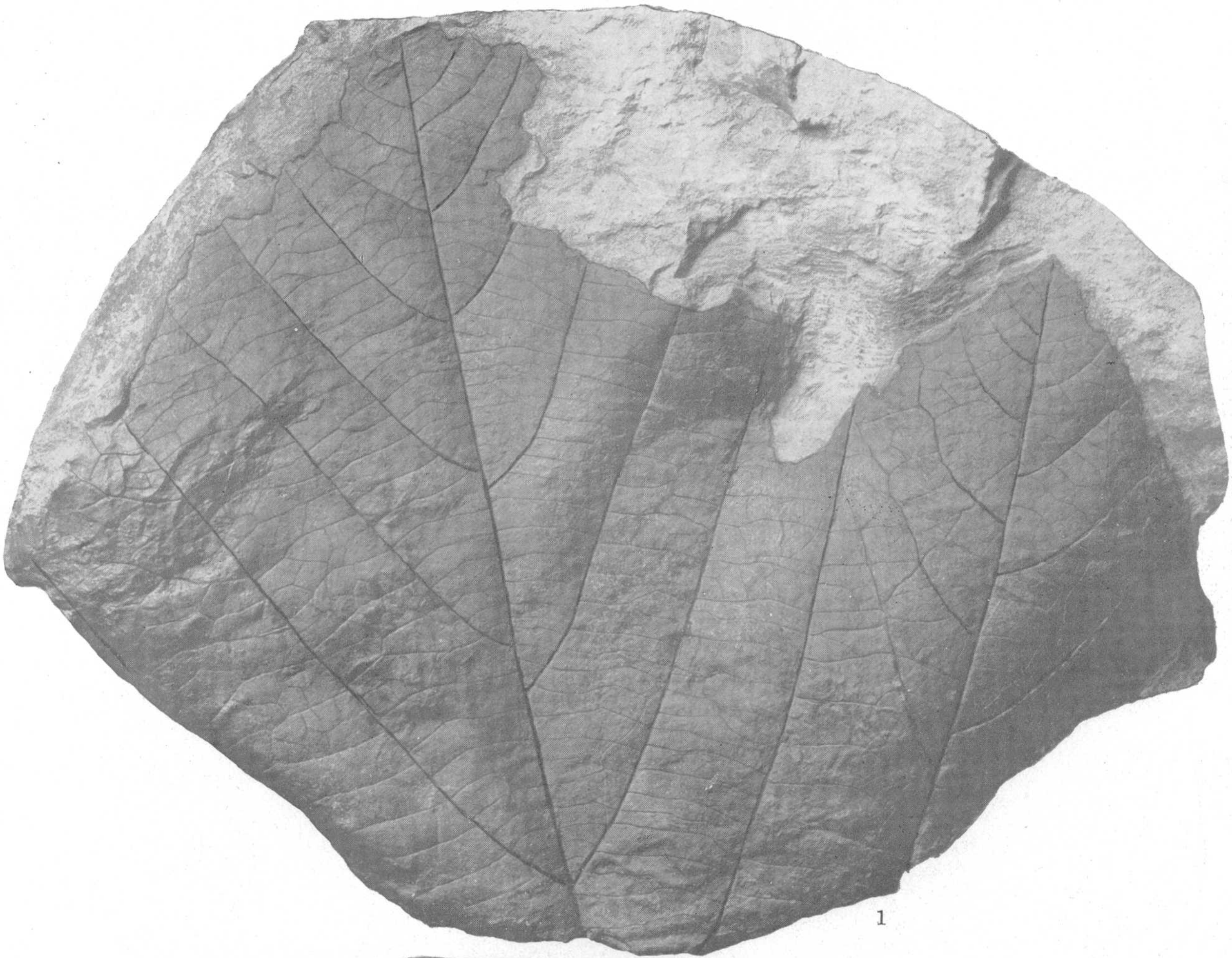
TERTIARY FLORAS OF ALASKA.

Malapoenna magnifica (Saporta) Hollick, n. comb. (U.S.N.M. 38670, 38924, 38925, 38926; pp. 118–119).



TERTIARY FLORAS OF ALASKA.

1. *Laurus princeps* Heer (U.S.N.M. 38927; pp. 120–121).
2–8. *Laurus saliciformis* Knowlton and Cockerell (U.S.N.M. 38778, 38928, 38929, 38930; p. 121).
9. *Laurus fürstenbergii* Alex. Braun (U.S.N.M. 38931; pp. 119–120).
10. *Laurus ocotaefolia* Ettingshausen (U.S.N.M. 38932; p. 120).
11. *Daphnogene kanii* Heer (U.S.N.M. 38933; pp. 121–122).



1

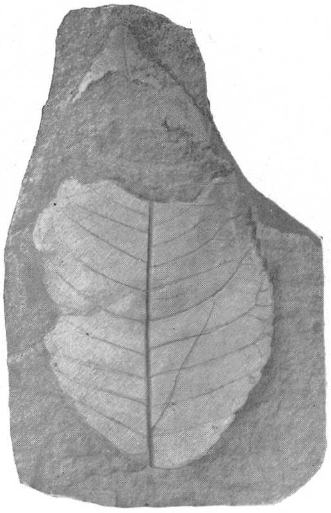
2

TERTIARY FLORAS OF ALASKA.

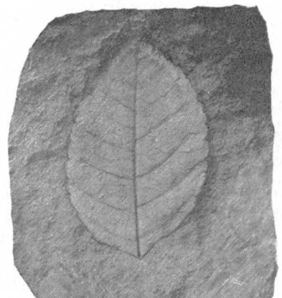
Platanus aceroides latifolia Knowlton (U.S.N.M. 38934; p. 123).

TERTIARY FLORAS OF ALASKA.

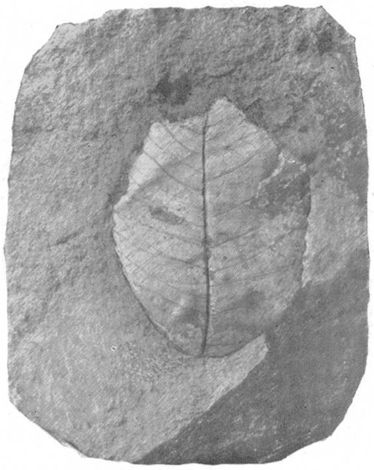
Platanus rectinervis Hollick, n. sp. (U.S.N.M. 38935; pp. 123-124).



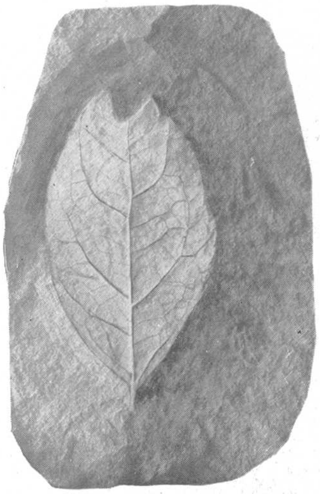
1



2

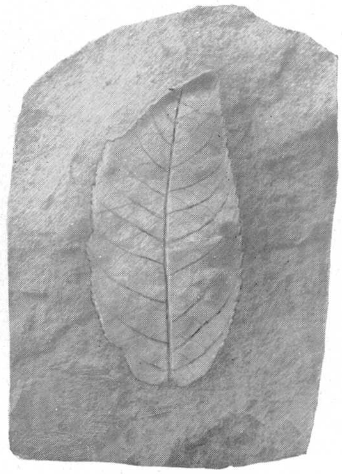


3



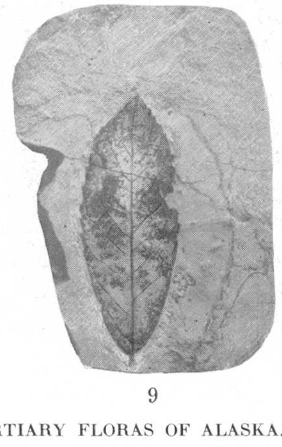
7

4

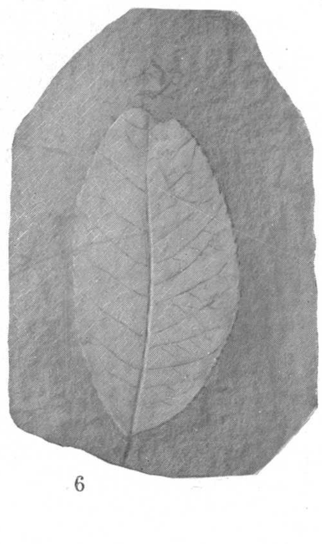


5

8



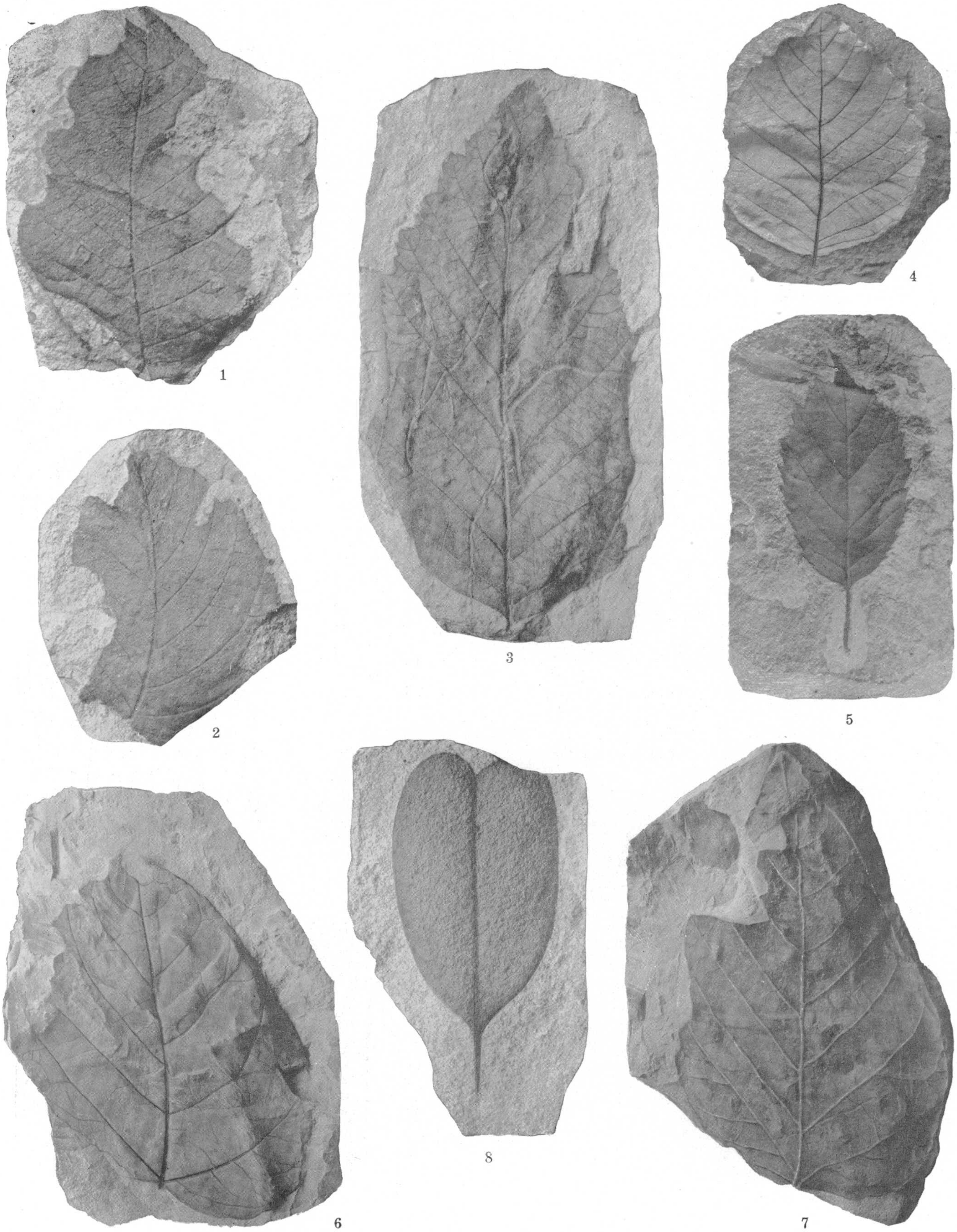
9



6

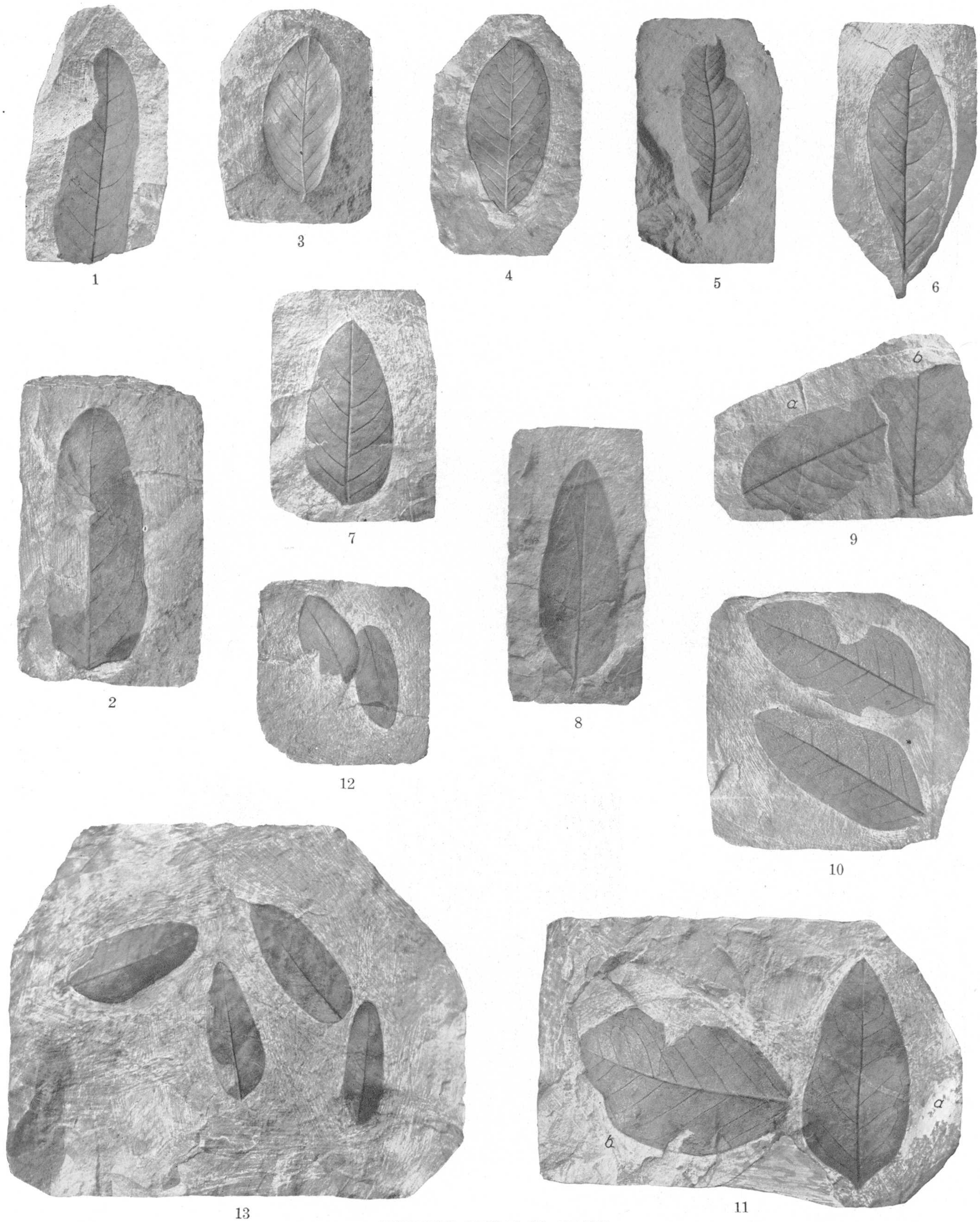
TERTIARY FLORAS OF ALASKA.

1-3. *Prunus hartungi aequalis* Hollick, n. var. (U.S.N.M. 38936; pp. 126-127).
4. *Prunus scottii* Heer (U.S.N.M. 38937; p. 126).
5, 6. *Prunus olympica* Ettingshausen (U.S.N.M. 38938; p. 127).
7. *Spiraea weaveri* Hollick, n. sp. (U.S.N.M. 38939; pp. 124-125).
8. *Rosa cetera* Hollick, n. sp. (U.S.N.M. 38940; p. 125).
9. *Rosa confirmata* Hollick, n. sp. (U.S.N.M. 38941; p. 125).



TERTIARY FLORAS OF ALASKA.

1, 2. *Prunus variabilis* Newberry? (U.S.N.M. 38942; p. 127).
3. *Crataegus cappsii* Hollick, n. sp. (U.S.N.M. 38943; p. 126).
4. *Crataegus yukonensis* Hollick, n. sp. (U.S.N.M. 38944; p. 126).
5. *Crataegus alaskensis* Hollick, n. sp. (U.S.N.M. 38945; pp. 125–126).
6, 7. *Dolichos convexus* Hollick, n. sp. (U.S.N.M. 38767; p. 130).
8. *Canavalia eocenica* Berry (U.S.N.M. 38946; pp. 129–130).

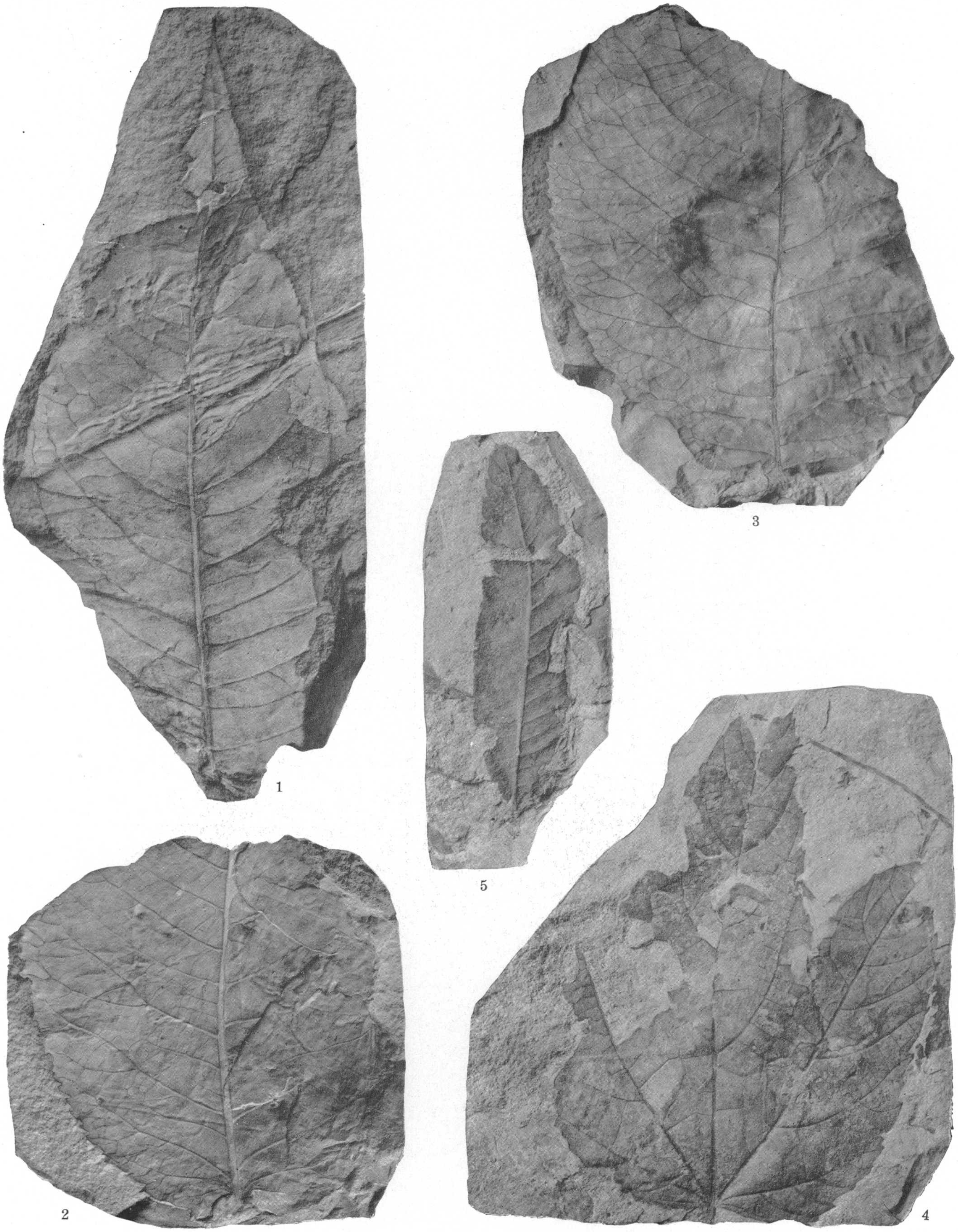


TERTIARY FLORAS OF ALASKA.

1, 2, 7, 8, 9a, 10, 11a, 12, 13. *Sophora multiformis* Hollick, n. sp. (U.S.N.M. 38947; p. 129).
3, 4. *Cassia glenni* Berry? (U.S.N.M. 38830, 38948; p. 128).
5, 6. *Cassia phaseolites* Unger? (U.S.N.M. 38949; p. 129).
9b, 11b. *Pithecolobium ceterum* Hollick, n. sp. (U.S.N.M. 38950; p. 127).

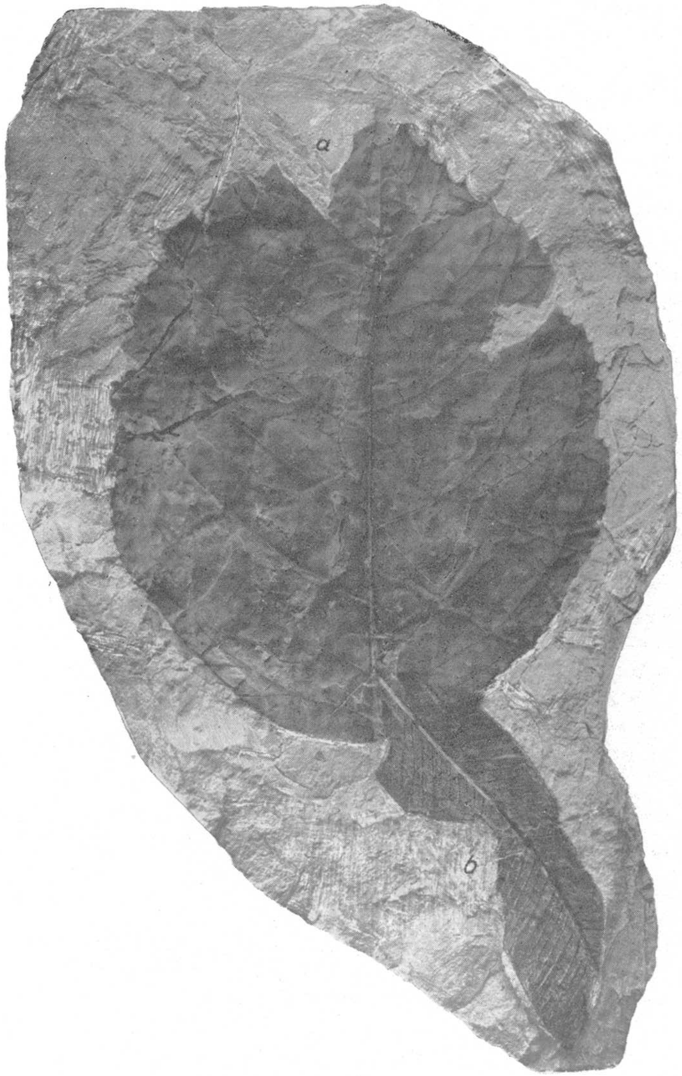
TERTIARY FLORAS OF ALASKA.

Ilex insignis Heer (U.S.N.M. 38951; pp. 131–132).

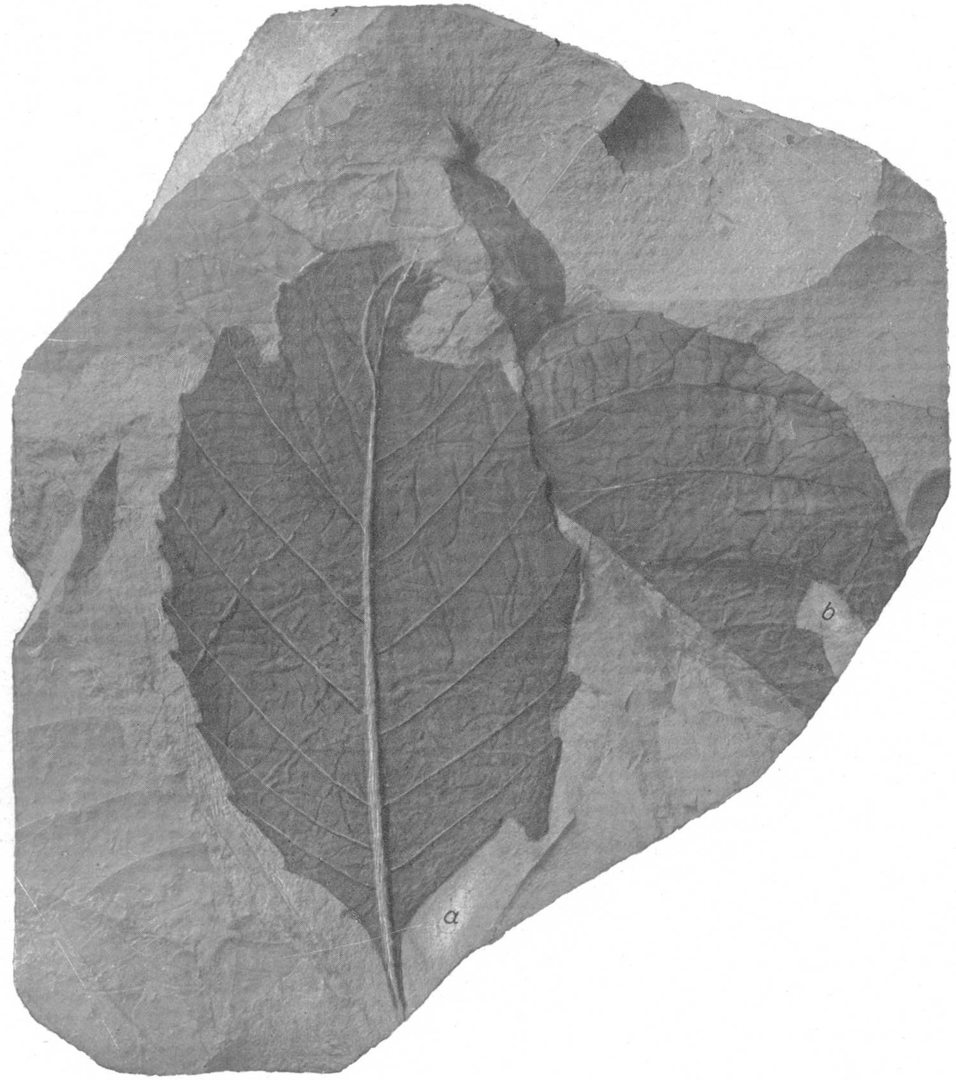


TERTIARY FLORAS OF ALASKA.

1. *Ilex insignis* Heer (U.S.N.M. 38952; pp. 131–132).
2, 3. *Celastrus borealis* Heer (U.S.N.M. 38953; pp. 132–133).
4. *Acer disputabilis* Hollick, n. sp. (U.S.N.M. 38954; p. 134).
5. *Cupania comparabilis* Hollick, n. sp. (U.S.N.M. 38955; p. 136).



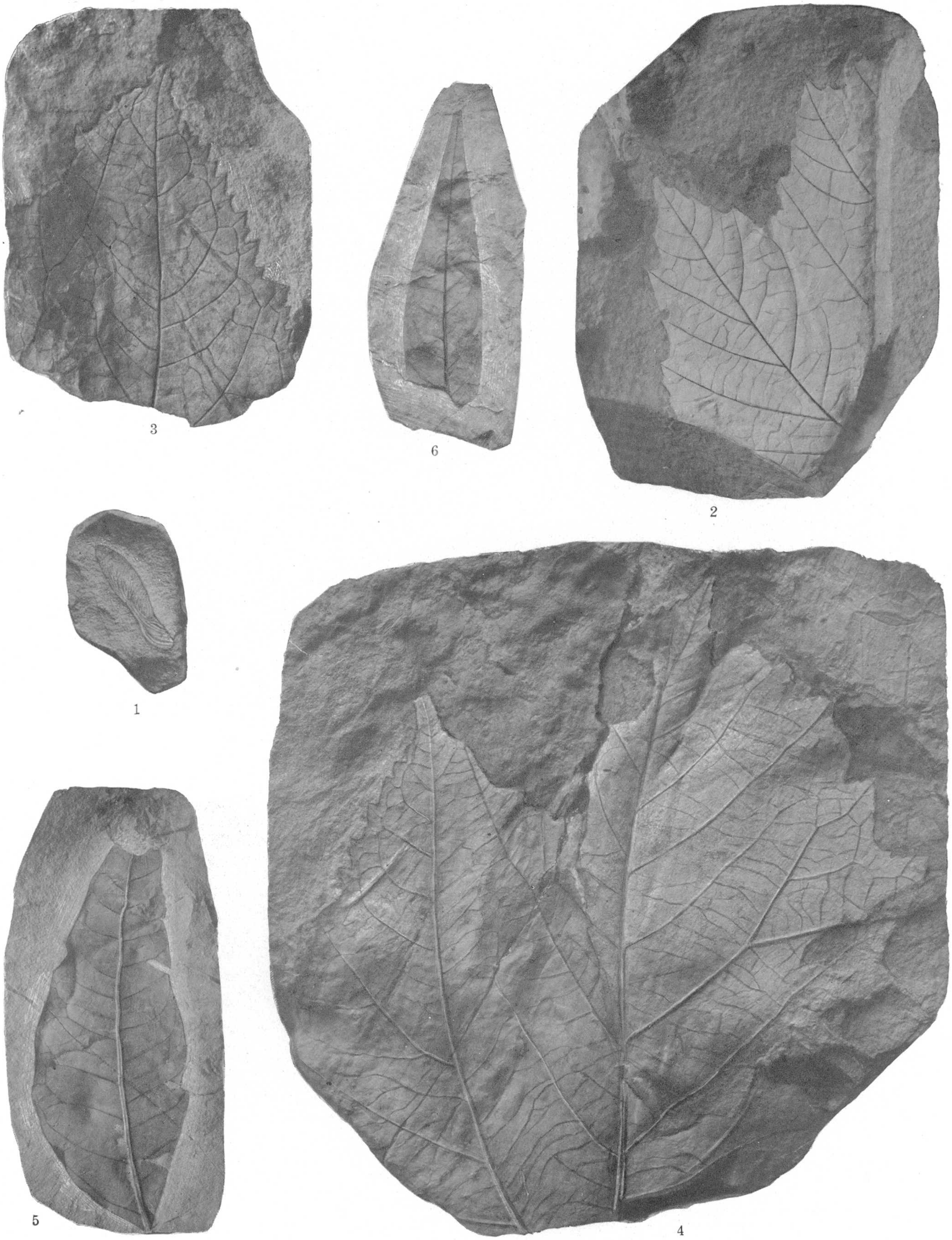
1



2

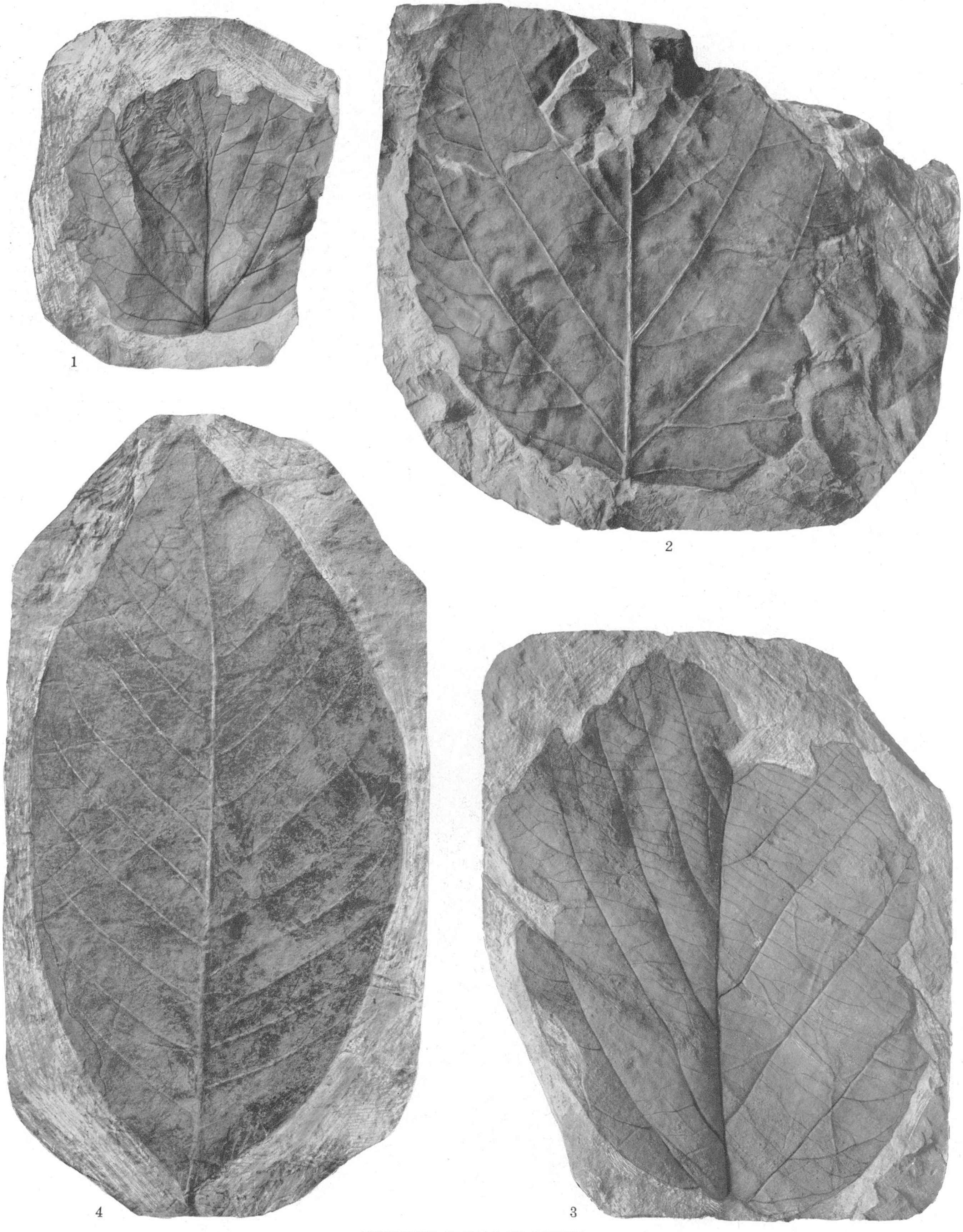
TERTIARY FLORAS OF ALASKA.

1a. *Celastrus comparabilis* Hollick, n. sp. (U.S.N.M. 38956; p. 132).
1b. *Pteris pseudopennaeformis* Lesquereux (U.S.N.M. 38957; p. 39).
2a. *Paullinia alaskana* Hollick, n. sp. (U.S.N.M. 38958; pp. 136–137).
2b. *Celastrus comparabilis* Hollick, n. sp. (U.S.N.M. 38959; p. 132).



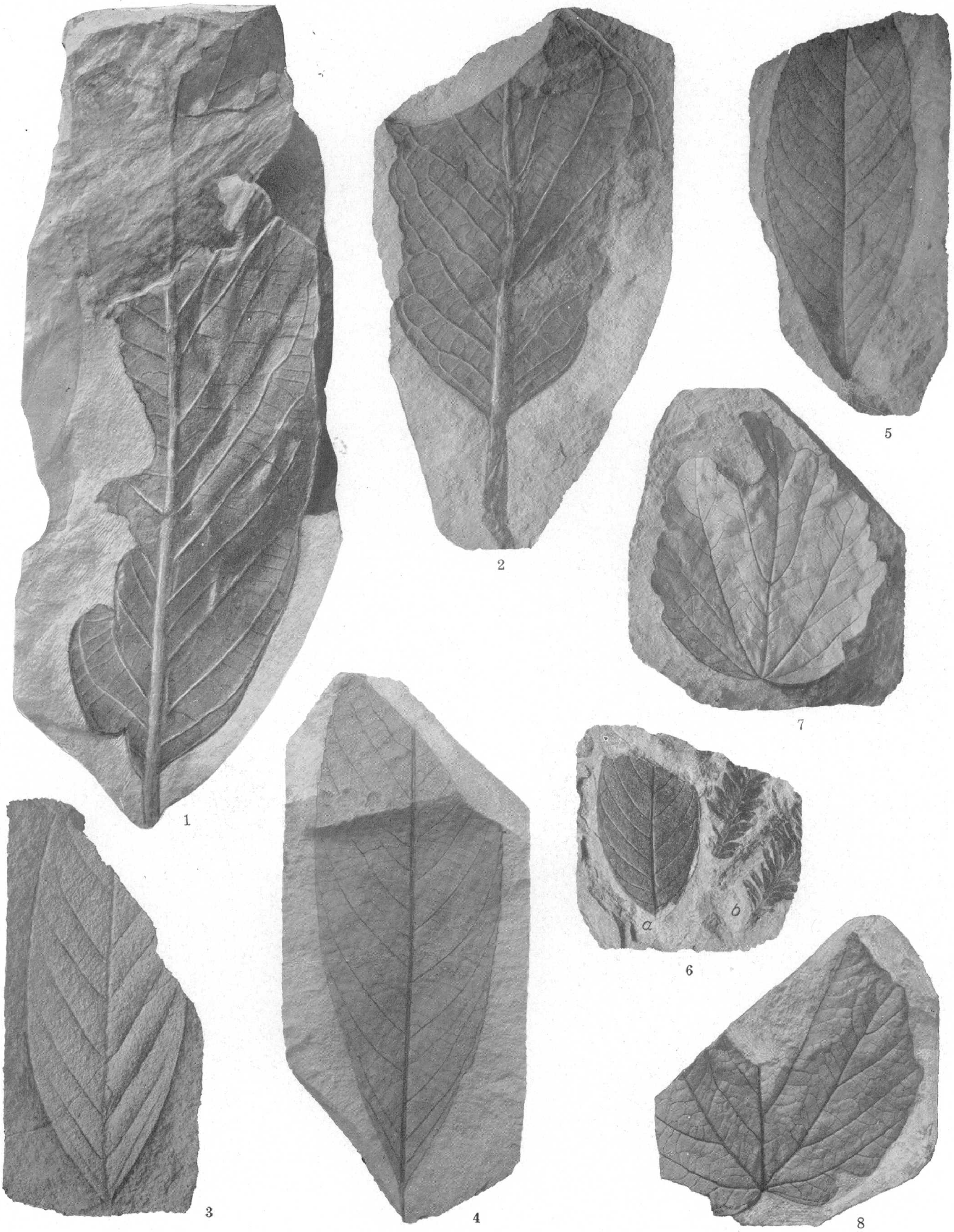
TERTIARY FLORAS OF ALASKA.

1. Fruit of *Acer* sp.? (U.S.N.M. 38960; p. 136).
2. *Acer trilobatum productum* (Alex. Braun) Heer (U.S.N.M. 38961; p. 135).
3, 4. *Acer visibilis* Hollick, n. sp. (U.S.N.M. 38962; pp. 135–136).
5. *Sapindus affinis* Newberry? (U.S.N.M. 38963; p. 137).
6. *Sapindus angustifolius* Lesquereux? (U.S.N.M. 38964; p. 137).



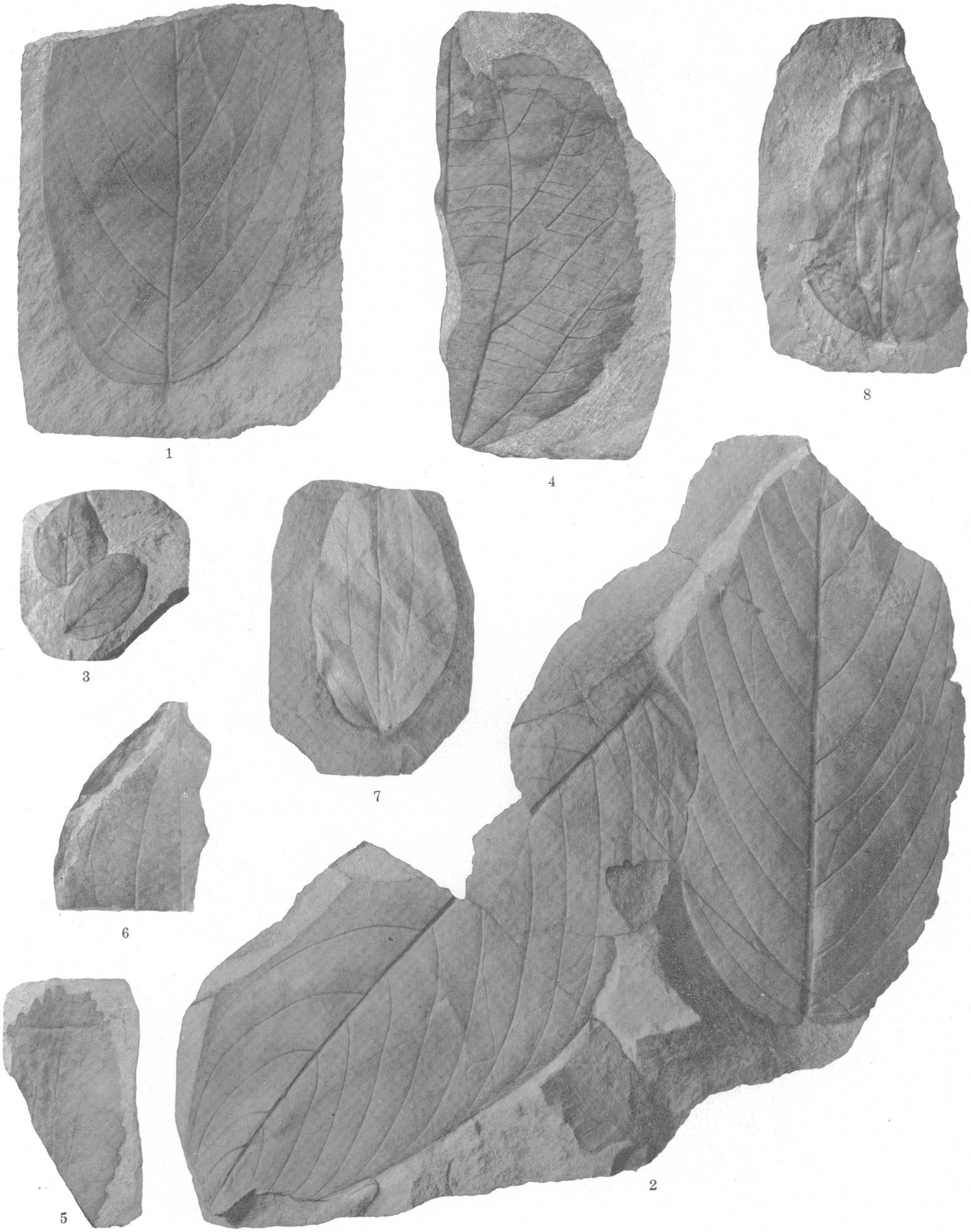
TERTIARY FLORAS OF ALASKA.

1. *Acer arcticum* Heer (U.S.N.M. 38966; pp. 133–134). **2, 3.** *Acer inaequale* Heer? (U.S.N.M. 38968, 38969; p. 135).
4. *Sapindus basilicus* (Unger) Unger (U.S.N.M. 38970; p. 137).



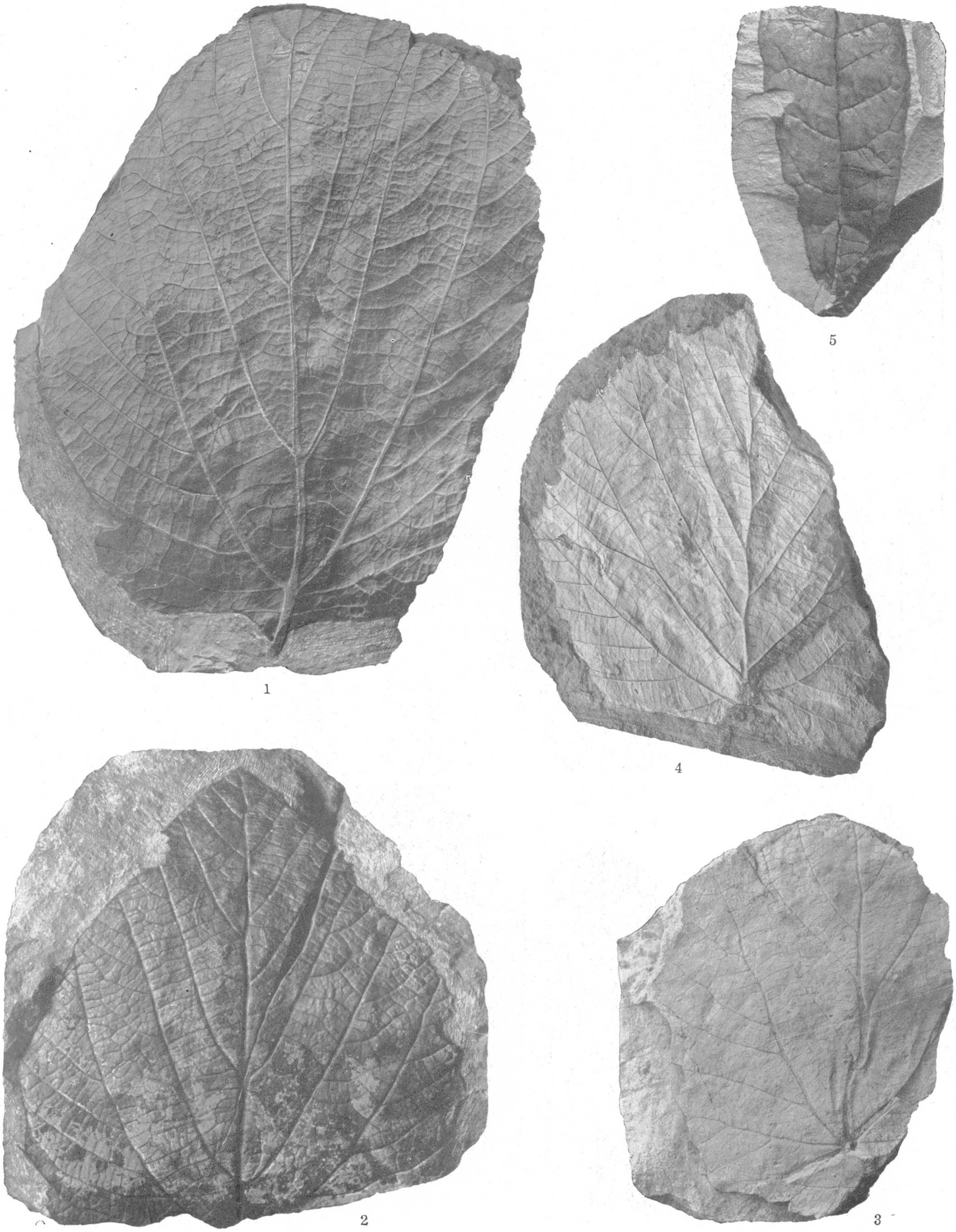
TERTIARY FLORAS OF ALASKA.

1, 2. *Rhamnus marginatus* Lesquereux (U.S.N.M. 38915; p. 140).
3. *Rhamnus decheni* Weber (U.S.N.M. 38971; pp. 138–139).
4, 5. *Rhamnus gaudini* Heer (U.S.N.M. 38972, 38973; p. 139).
6a. *Rhamnus rossmaessleri* Unger (U.S.N.M. 38974; p. 138).
6b. *Sequoia brevifolia* Heer (U.S.N.M. 38975; pp. 46–47).
7, 8. *Acer arcticum* Heer (U.S.N.M. 38976, 38977; pp. 133–134).



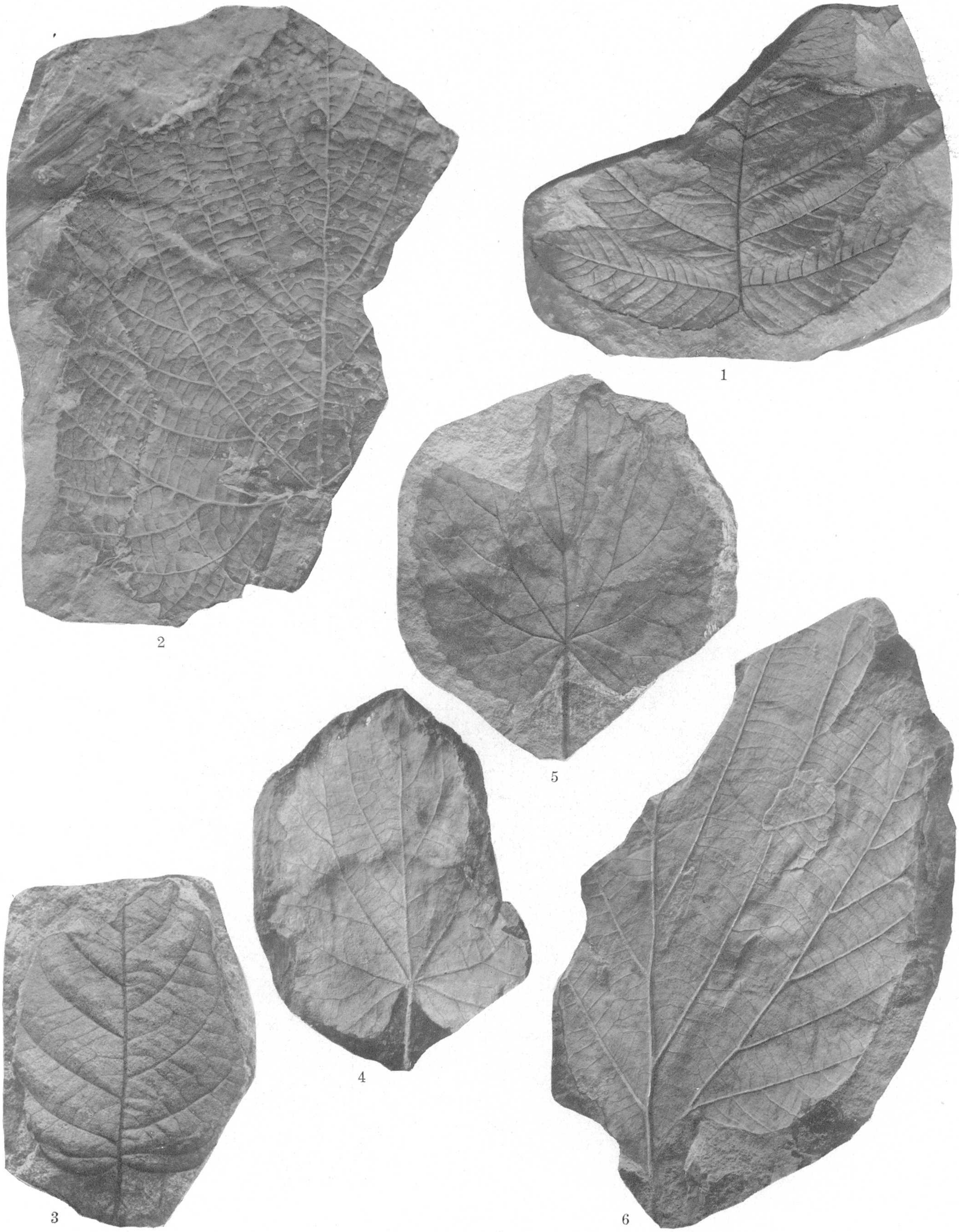
TERTIARY FLORAS OF ALASKA.

1, 2. *Rhamnus pseudogoldianus* Hollick, n. sp. (U.S.N.M. 38978; pp. 139–140).
3. *Rhamnus brevifolius* Alex. Braun (U.S.N.M. 38855; p. 138).
4. *Zizyphus meigsii* (Lesquereux) Berry? (U.S.N.M. 38979; p. 140).
5, 6. *Zizyphus hyperboreus* Heer? (U.S.N.M. 38980, 38981; p. 140).
7, 8. *Paliurus ceterus* Hollick, n. sp. (U.S.N.M. 38982; pp. 141–142).



TERTIARY FLORAS OF ALASKA.

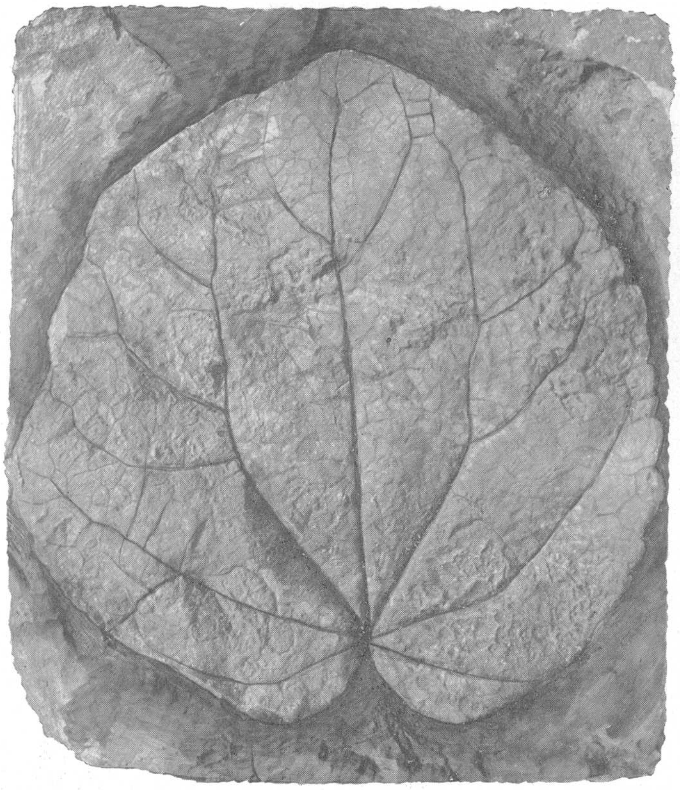
1. *Cissus pterospermoides* Hollick, n. sp. (U.S.N.M. 38983; p. 143).
2. *Cissus cissoides* (Saporta) Hollick, n. comb. (U.S.N.M. 38984; p. 143).
3. *Vitis heeriana* Knowlton and Cockerell? (U.S.N.M. 38985; p. 142).
4. *Vitis atwoodi* Hollick, n. sp. (U.S.N.M. 38986; p. 142).
5. *Elaeocarpus alaskensis* Hollick, n. sp. (U.S.N.M. 38988; pp. 143–144).



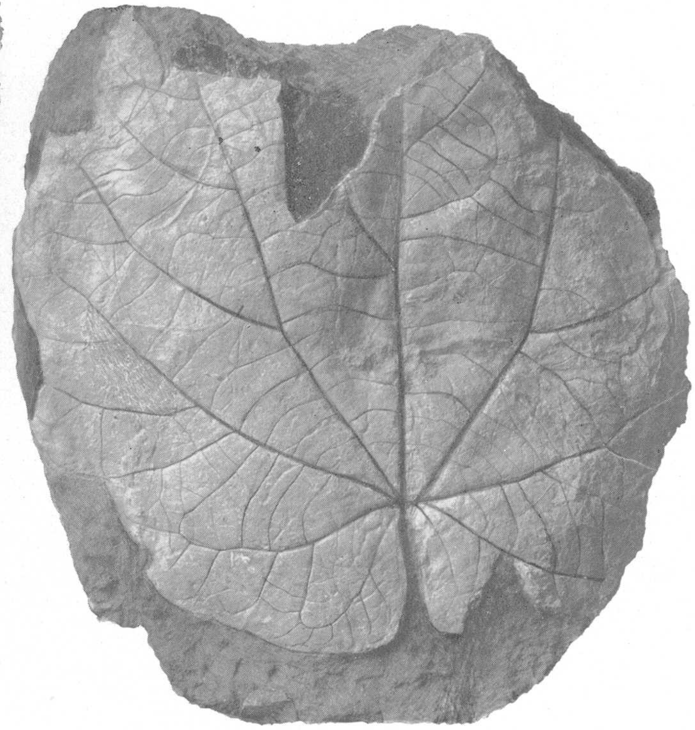
TERTIARY FLORAS OF ALASKA.

1. *Koelreuteria eakini* Hollick, n. sp. (U.S.N.M. 38989; pp. 137–138).
2. *Vitis olriki* Heer (U.S.N.M. 38990; p. 142).
3. *Apeibopsis? discolor* (Lesquereux) Lesquereux (U.S.N.M. 38991; p. 149).
4, 5. *Tilia grewioides* Hollick, n. sp. (U.S.N.M. 38992; pp. 144–145).
6. *Tilia* sp.? Hollick (U.S.N.M. 38993; p. 145).

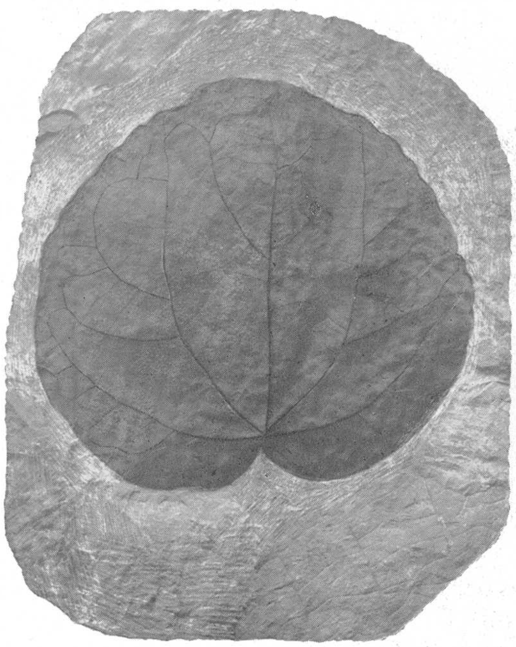
TERTIARY FLORAS OF ALASKA.
Tilia notabilis Hollick, n. sp. (U.S.N.M. 38994; p. 145).



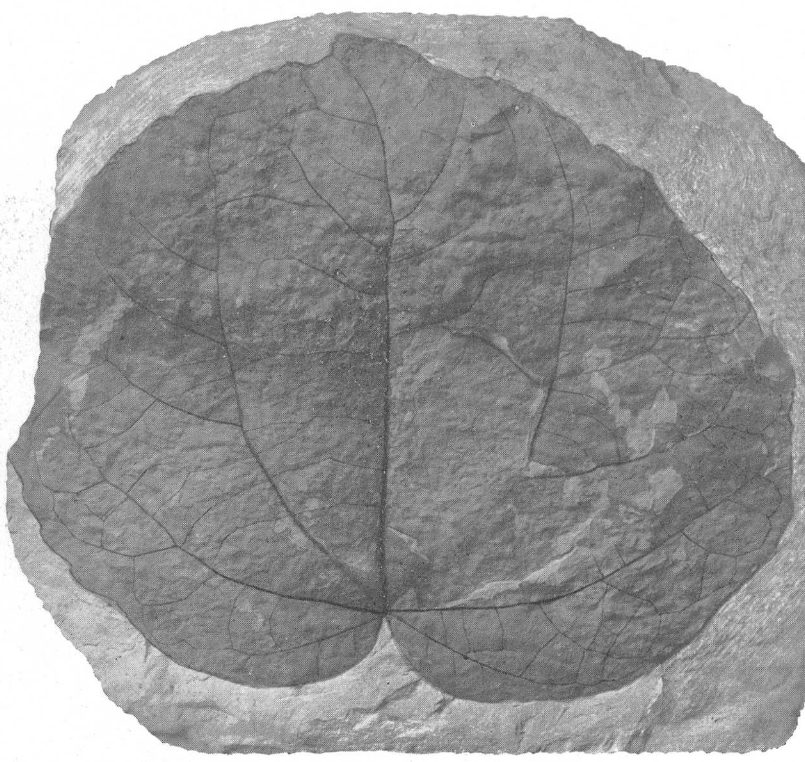
1



2



3

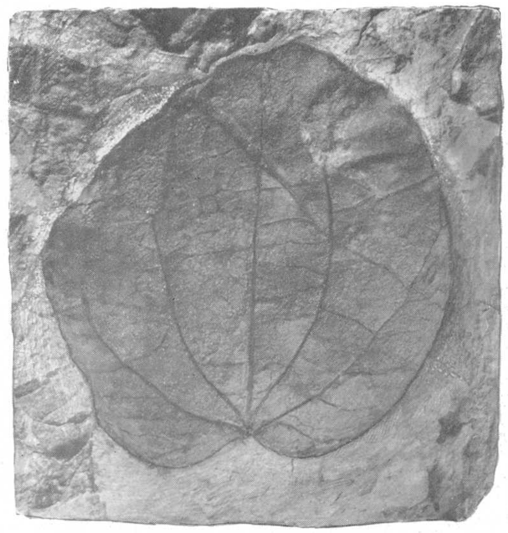


4

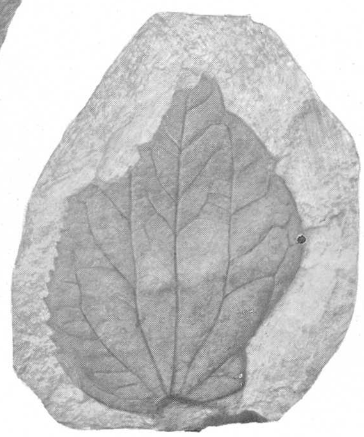
TERTIARY FLORAS OF ALASKA.

Grewia orbiculata Hollick, n. sp. (U.S.N.M. 38877; pp. 146–147).

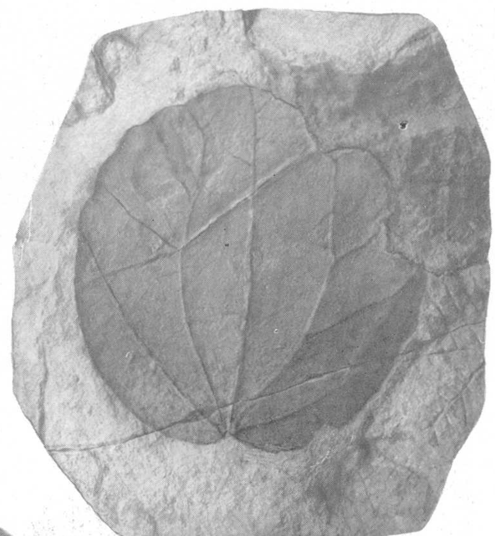
1



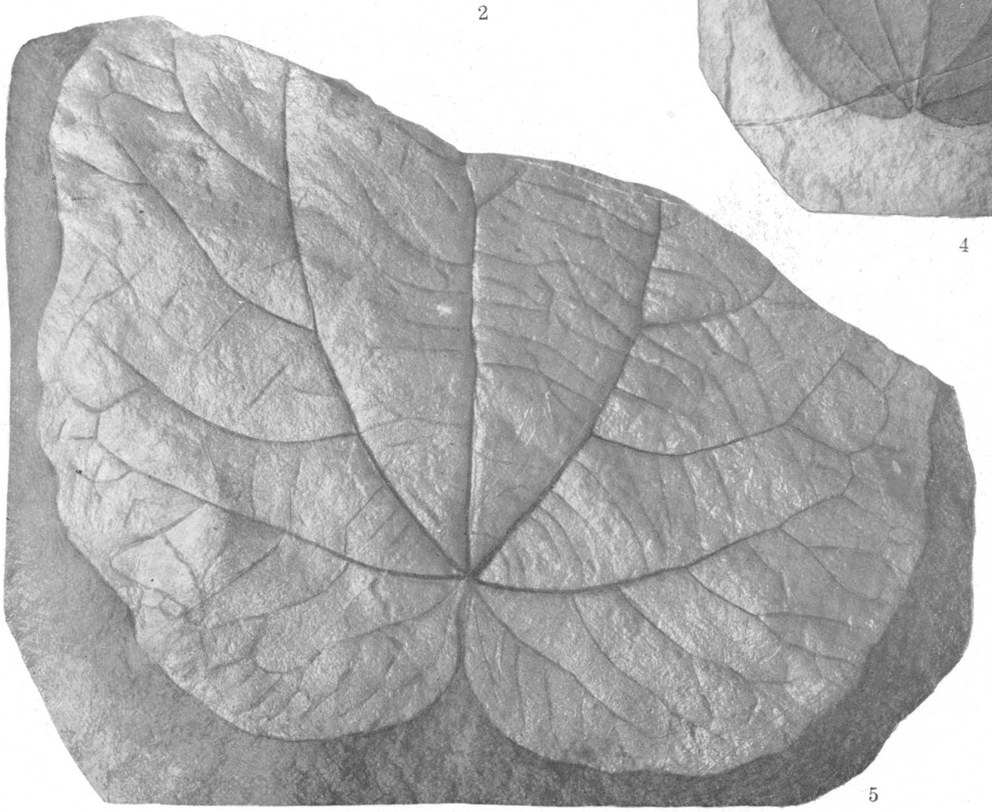
3



2



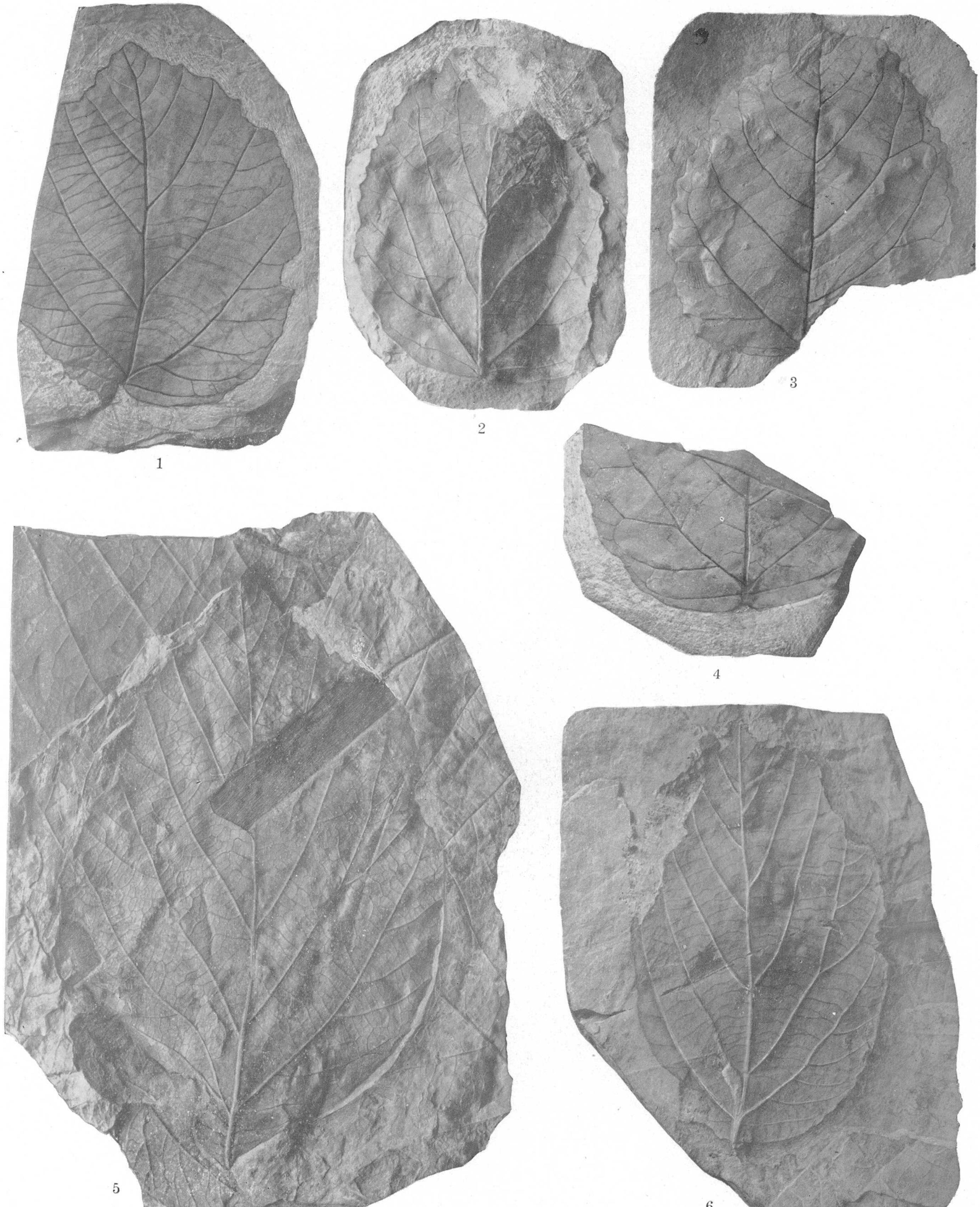
4



5

TERTIARY FLORAS OF ALASKA.

1. *Grewia crenata* (Unger) Heer (U.S.N.M. 38995; pp. 145–146). **2.** *Grewia zizyphoides* Hollick, n. sp. (U.S.N.M. 38766; p. 147).
3–5. *Grewia orbiculata* Hollick, n. sp. (U.S.N.M. 38877, 38996; pp. 146–147).



TERTIARY FLORAS OF ALASKA.

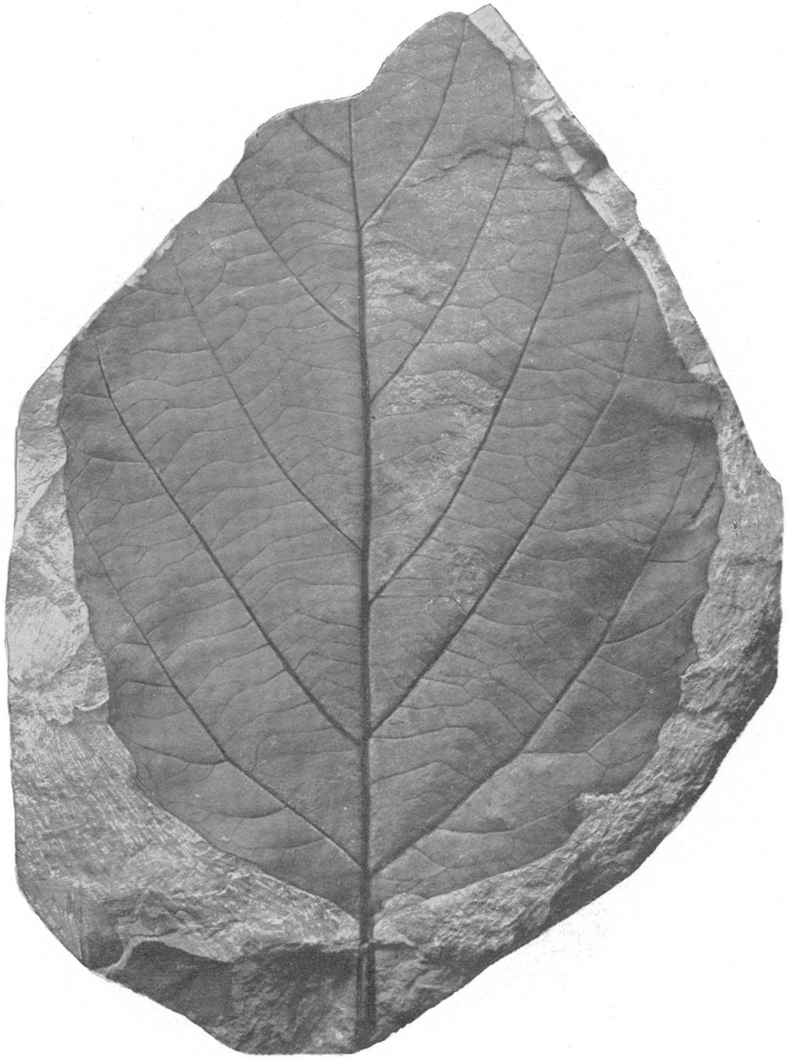
1-4. *Grewiopsis alaskana* Hollick, n. sp. (U.S.N.M. 38997, 38998; p. 149). **5, 6.** *Grewiopsis congerminalis* Hollick, n. sp. (U.S.N.M. 38999, 39000; pp. 148–149).

1

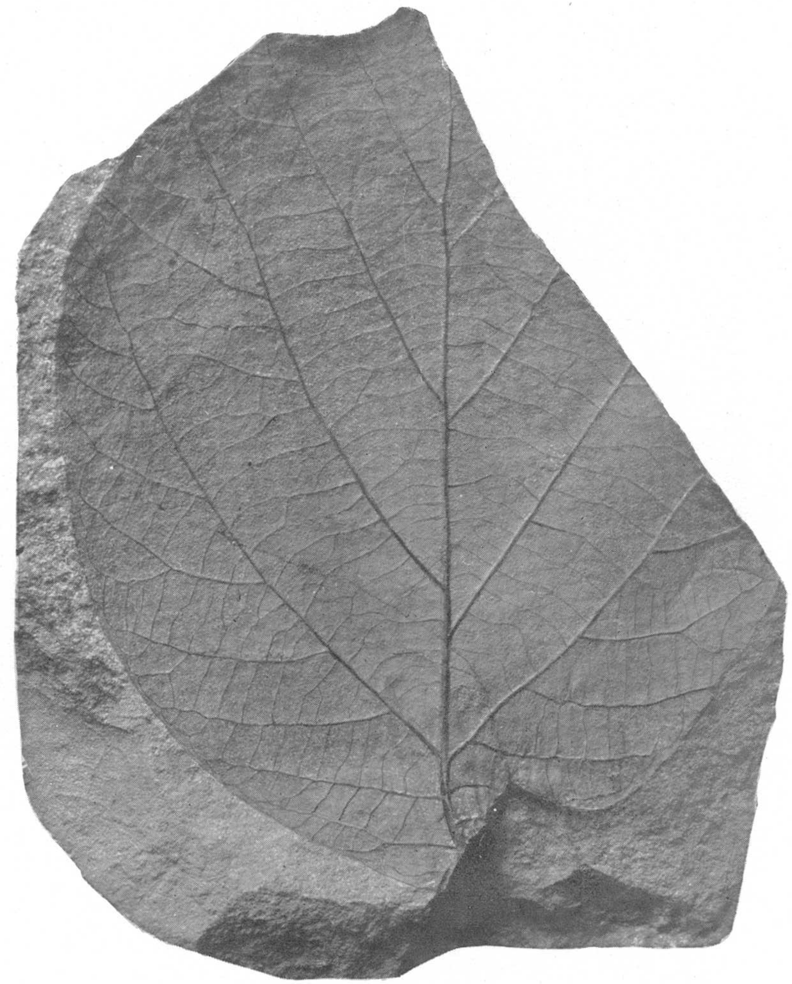
2

TERTIARY FLORAS OF ALASKA.

1. *Grewiopsis frustratorius* Hollick, n. sp. (U.S.N.M. 39001; p. 148). **2a.** *Grewiopsis defectivus* Hollick, n. sp. (U.S.N.M. 39002; p. 148).
2b. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 39003; pp. 47, 48).



1



2

TERTIARY FLORAS OF ALASKA.

1. *Grewiopsis grandiculus* Hollick, n. sp. (U.S.N.M. 39004; pp. 147-148).

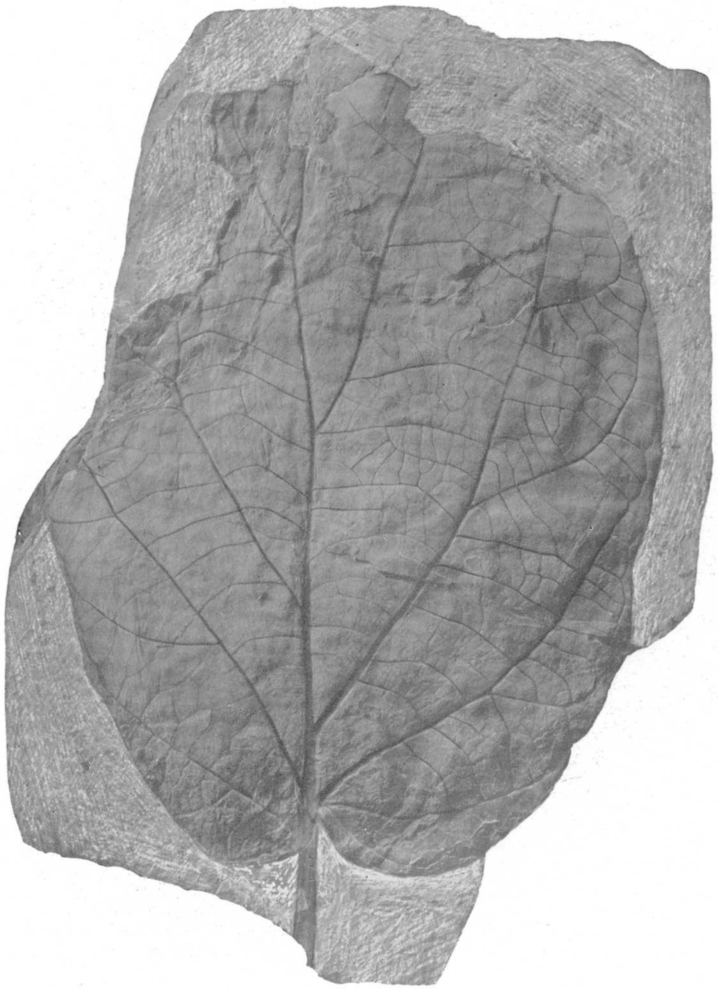
2. *Pterospermites spectabilis* Heer (U.S.M.N. 39005; pp. 150-151).

1

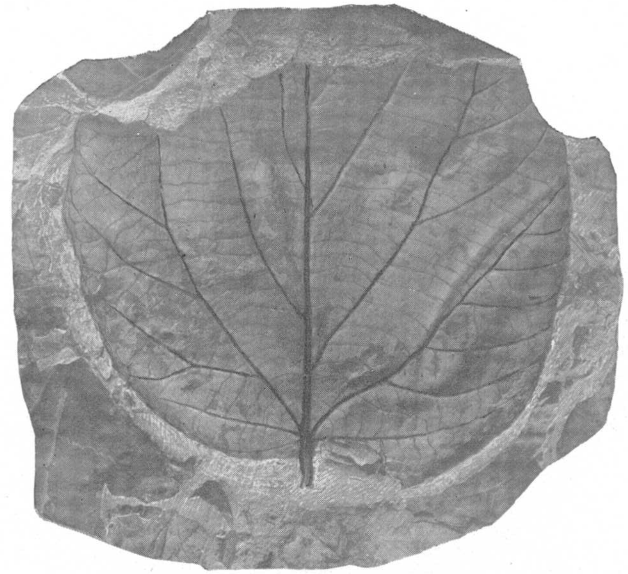
2

TERTIARY FLORAS OF ALASKA.

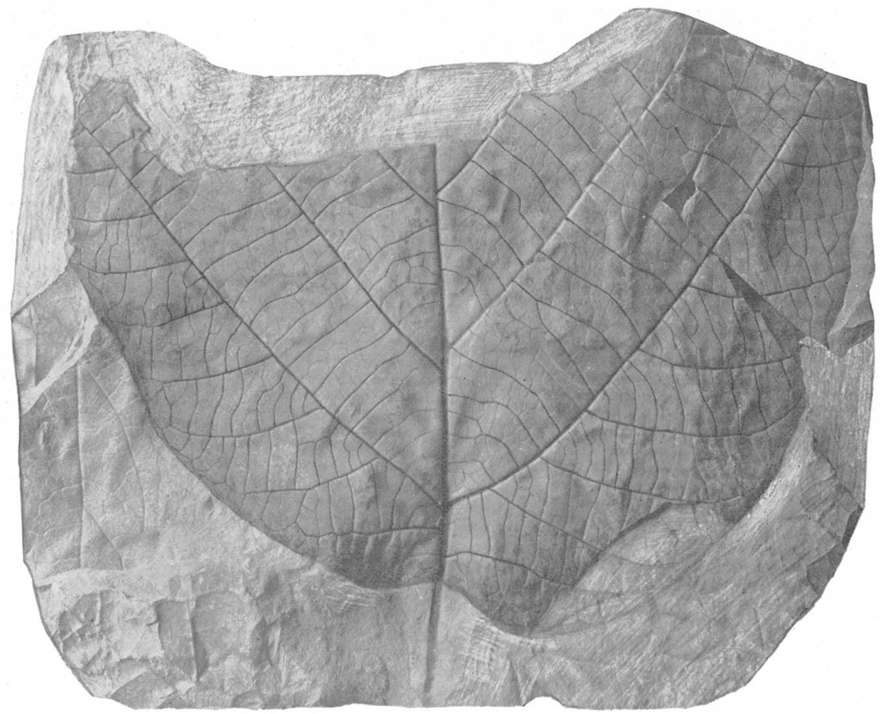
1. *Pterospermites alternans* Heer (U.S.N.M. 39006; p. 151). 2. *Pterospermites spectabilis* Heer (U.S.N.M. 39007; pp. 150–151).



1



2



3

TERTIARY FLORAS OF ALASKA.

1. *Pterospermites imparilis* Hollick, n. sp. (U.S.N.M. 39008; p. 151).

2, 3. *Pterospermites spectabilis* Heer (U.S.N.M. 38740, 39009; pp. 150–151).

1

2

TERTIARY FLORAS OF ALASKA.

1. *Pterospermites imparilis* Hollick, n. sp. (U.S.N.M. 39010; p. 151).

2. *Pterospermites conjunctivus* Hollick, n. sp. (U.S.N.M. 39011; pp. 152–153)

2

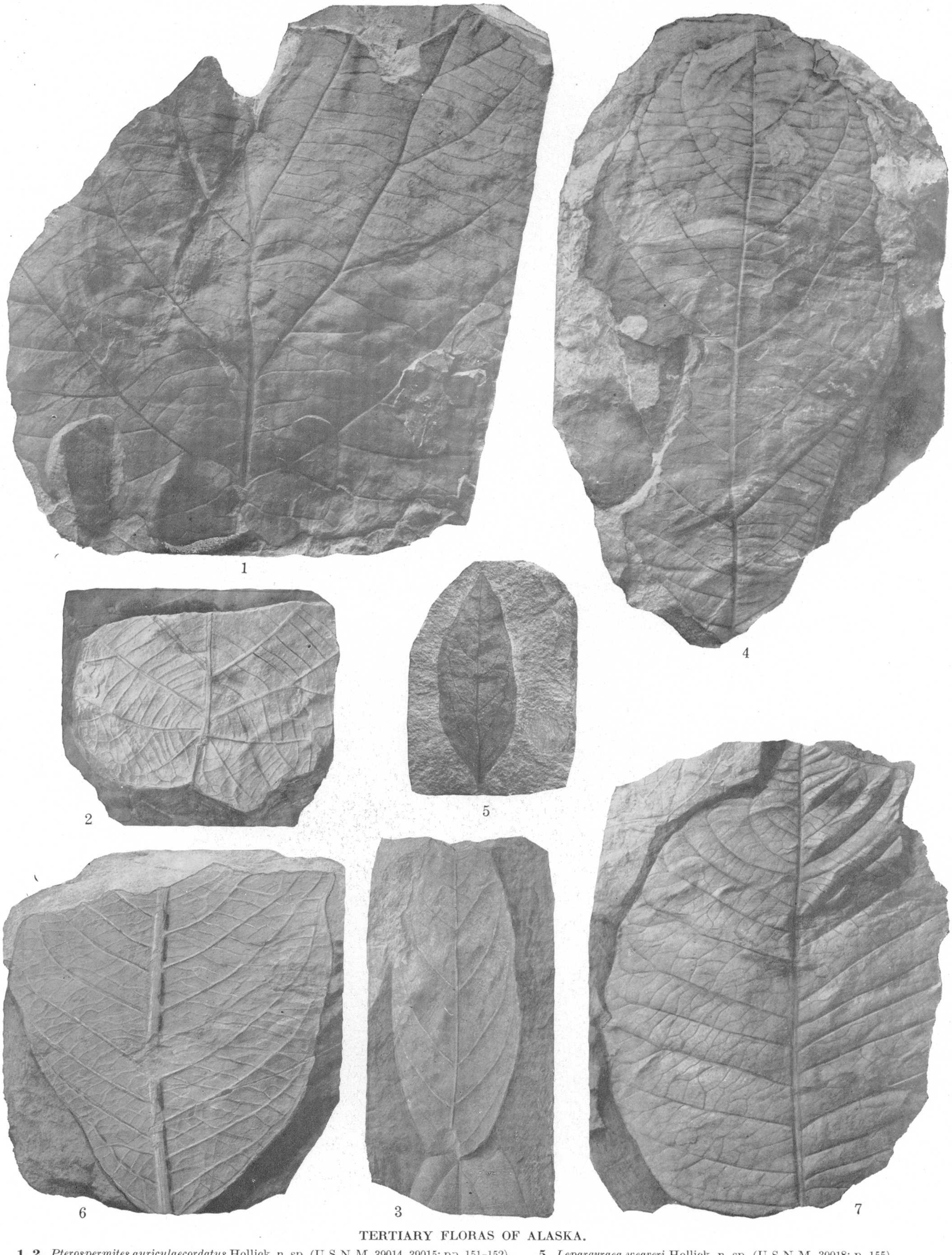
1

TERTIARY FLORAS OF ALASKA.

Pterospermites conjunctivus Hollick, n. sp. (U.S.N.M. 38804, 39012; pp. 152-153).

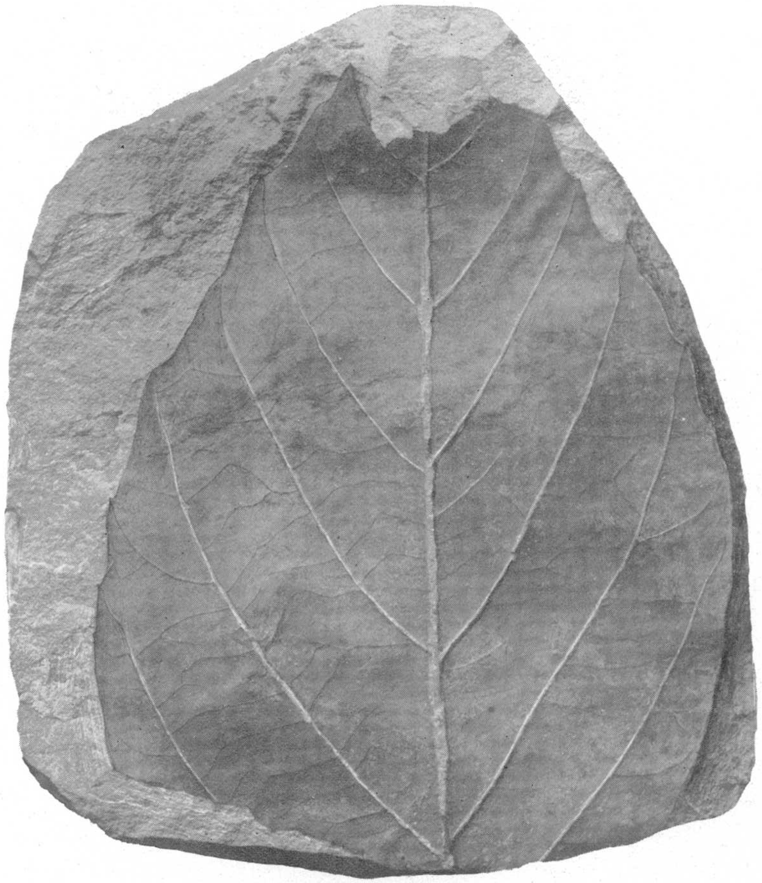
TERTIARY FLORAS OF ALASKA.

Pterospermites auriculaecordatus Hollick, n. sp. (U.S.N.M. 39013; pp. 151–152).

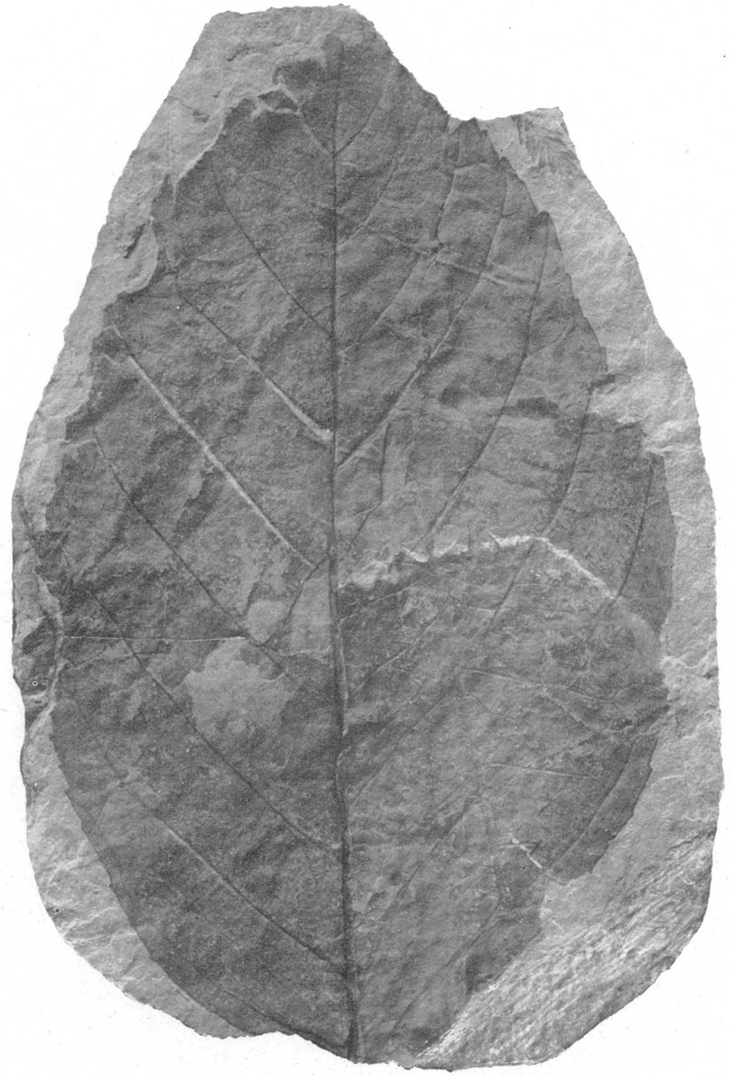


TERTIARY FLORAS OF ALASKA.

1, 2. *Pterospermites auriculaecordatus* Hollick, n. sp. (U.S.N.M. 39014, 39015; pp. 151–152).
3. *Tetrapterys harpyiarum* Unger (U.S.N.M. 39016; p. 130).
4. *Saurauja alaskana* Hollick, n. sp. (U.S.N.M. 39017; p. 155).
5. *Lepargyraea weaveri* Hollick, n. sp. (U.S.N.M. 39018; p. 155).
6. *Terminalia* sp.? (U.S.N.M. 39019; pp. 155–156).
7. *Semecarpus alaskana* Hollick, n. sp. (U.S.N.M. 39020; pp. 130–131).



1



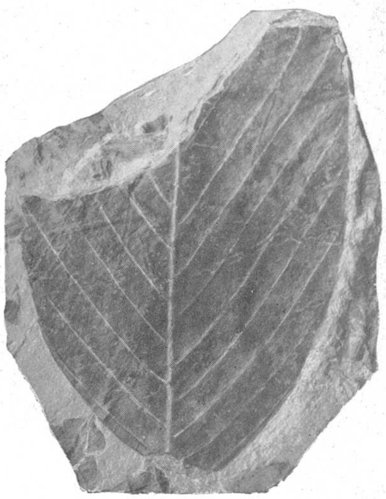
2

TERTIARY FLORAS OF ALASKA.

Dillenia alaskana Hollick, n. sp. (U.S.N.M. 39021, 39022; p. 153).

2

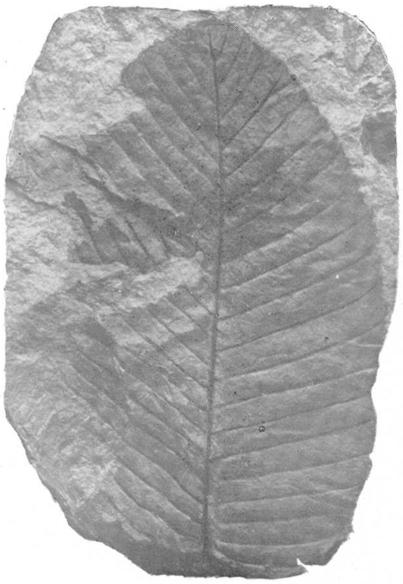
1



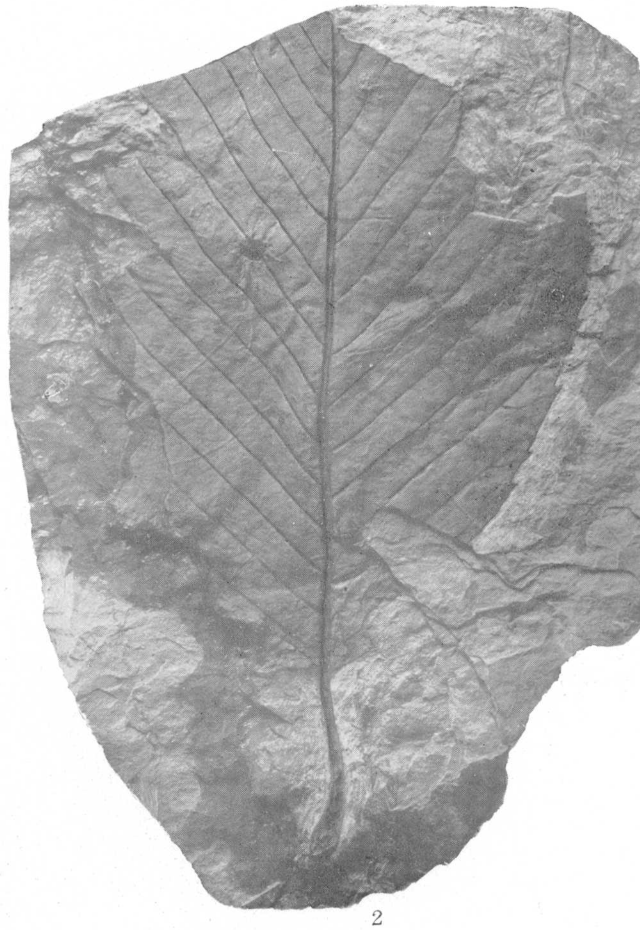
3

TERTIARY FLORAS OF ALASKA.

Dillenites ellipticus Hollick, n. sp. (U.S.N.M. 38735, 39023; p. 154).



1



2

3

4

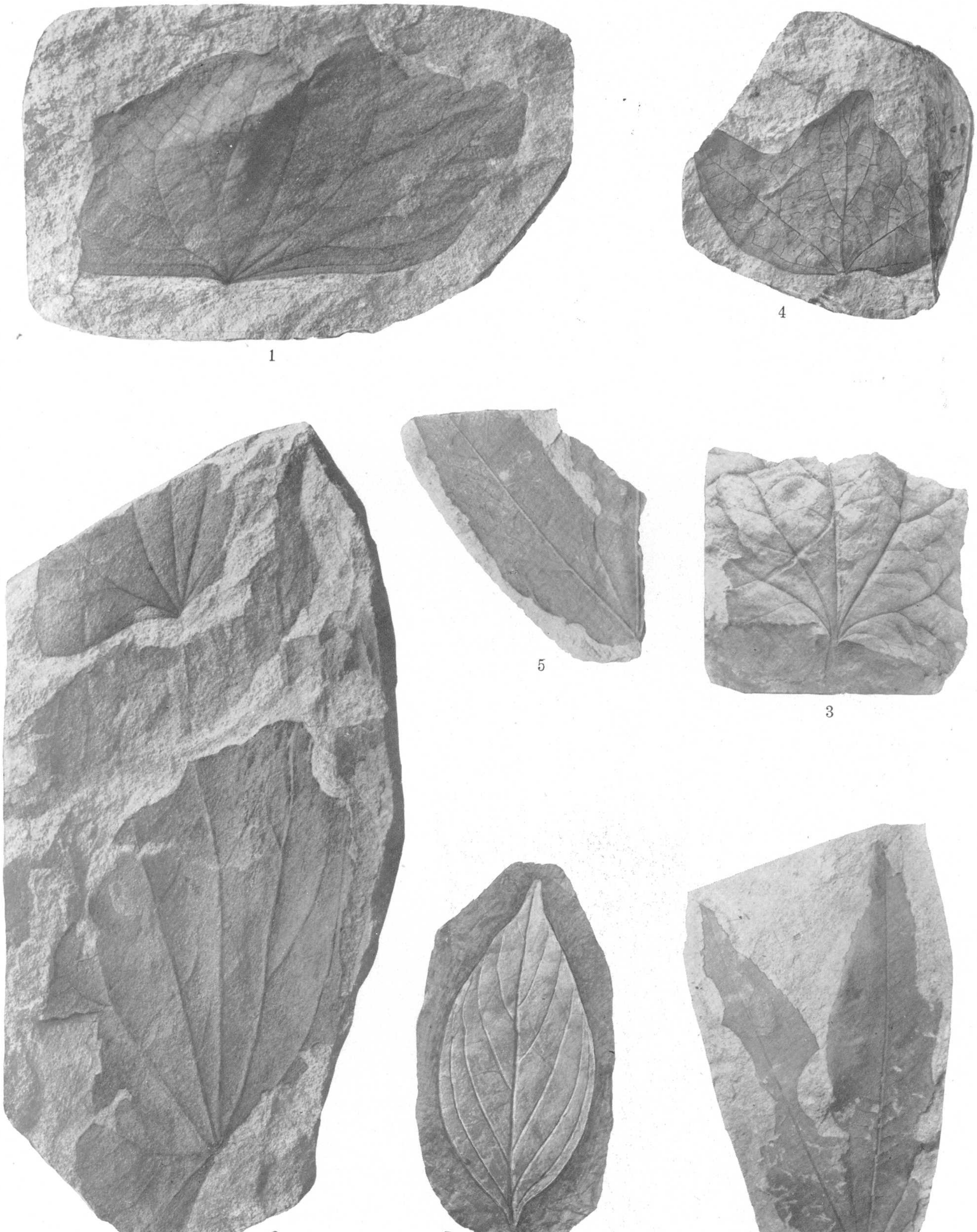
TERTIARY FLORAS OF ALASKA.

1. *Dillenites ceterus* Hollick, n. sp. (U.S.N.M. 39024; p. 154).

2–4. *Dillenites ellipticus ulmifolius* Hollick, n. var. (U.S.N.M. 38806, 38890; p. 154).

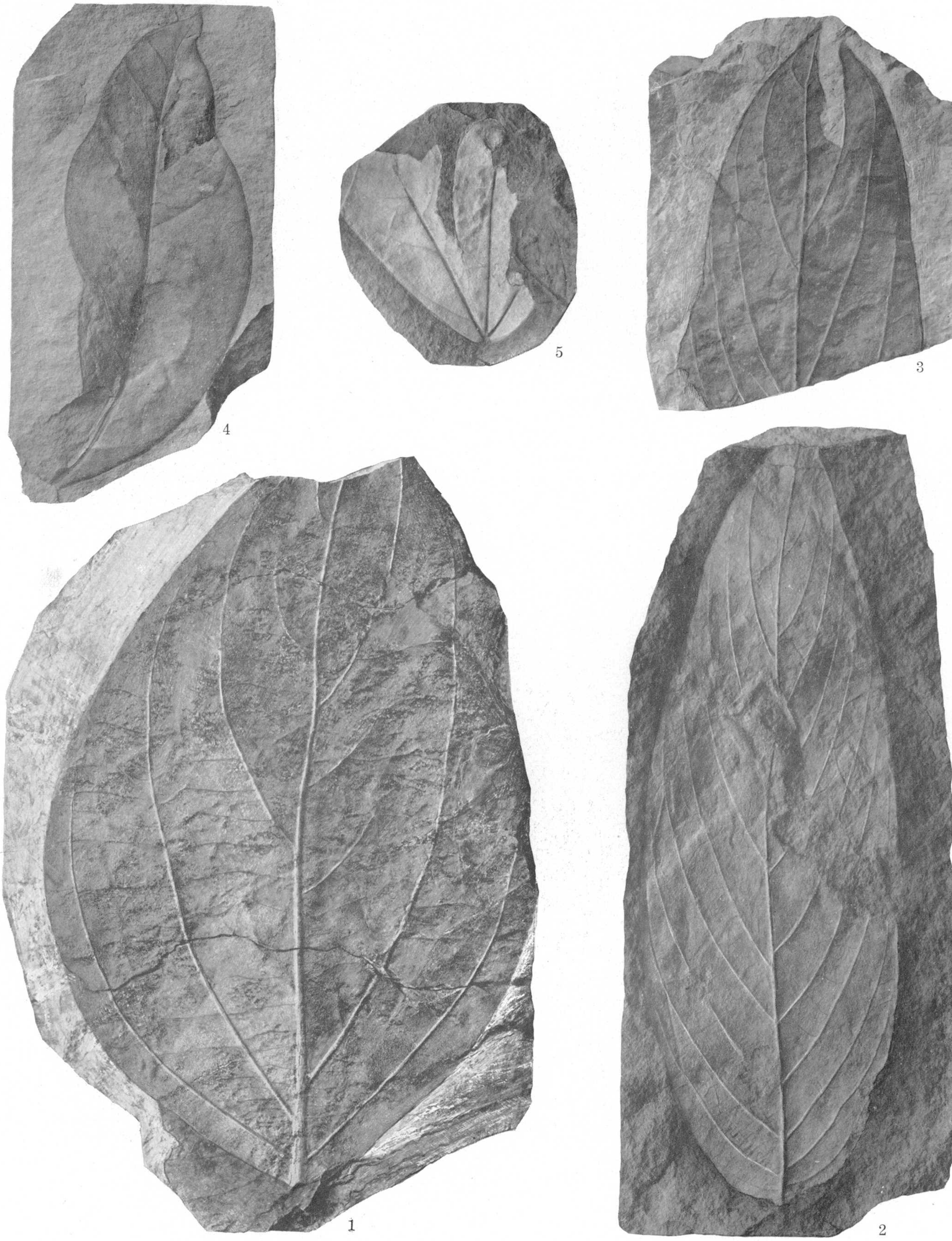
TERTIARY FLORAS OF ALASKA.

1. *Dillenites ellipticus* Hollick, n. sp. (U.S.N.M. 39025; p. 154). **2, 3.** *Dillenites ellipticus ulmifolius* Hollick, n. var. (U.S.N.M. 39026; p. 154).
4. *Dillenites microdentatus* (Hollick) Berry (U.S.N.M. 39027; p. 153).



TERTIARY FLORAS OF ALASKA.

1–3. *Hedera macclurii* Heer (U.S.N.M. 39028, 39029; pp. 156–157).
4. *Aralia delicatula* Hollick, n. sp. (U.S.N.M. 39030; p. 157).
5, 6. *Aralia?* sp. Hollick (U.S.N.M. 39031; p. 157).
7. *Cornus büchi* Heer (U.S.N.M. 39032; pp. 157–158).



TERTIARY FLORAS OF ALASKA.

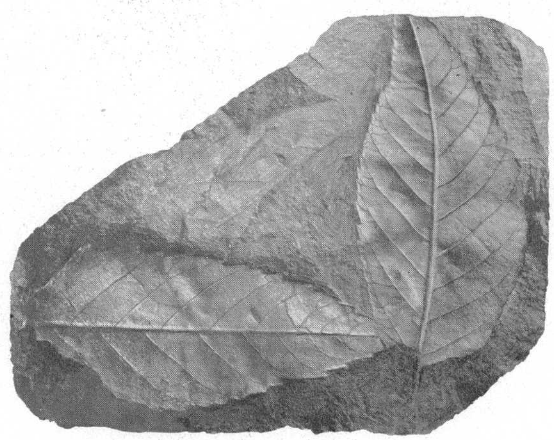
1. *Cornus irregularis* Hollick, n. sp. (U.S.N.M. 39033; p. 158).
2, 3. *Cornus hyperborea* Heer? (U.S.N.M. 39034, 39035; pp. 158–159).
4. *Rhododendron crassum* Hollick, n. sp. (U.S.N.M. 39036; p. 160).
5. *Aralia?* sp. (U.S.N.M. 39037; p. 157).

1

2

3

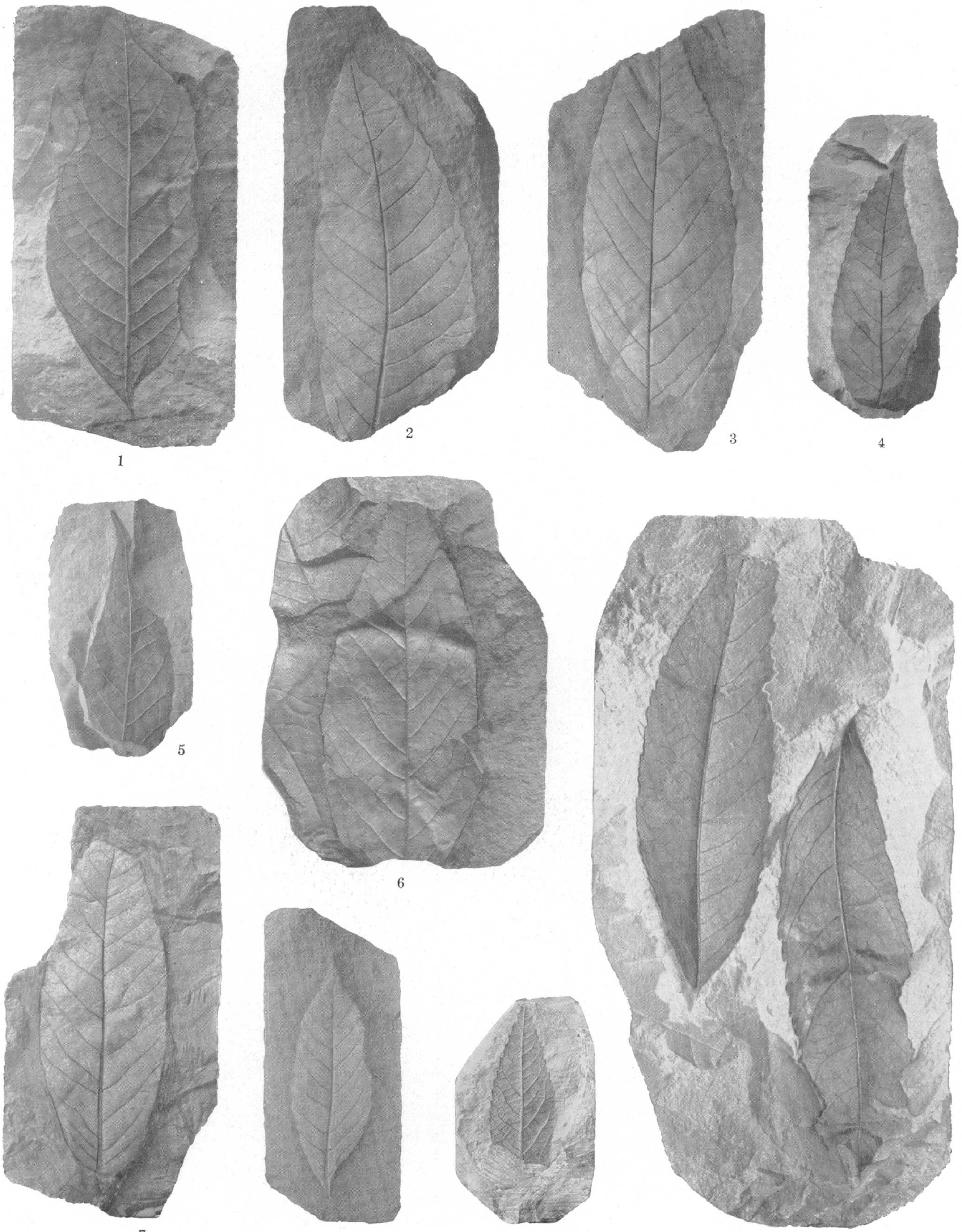
5



4

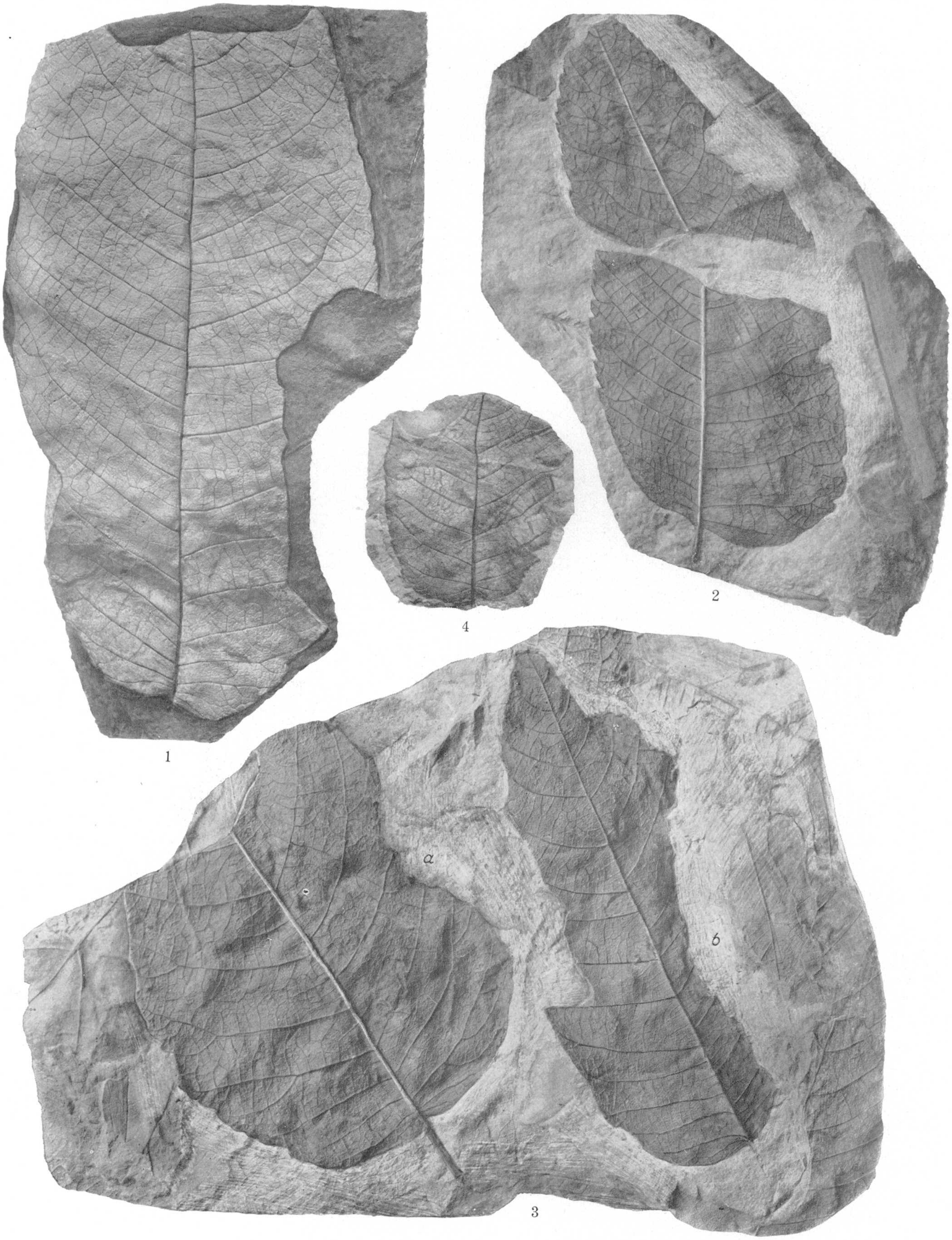
TERTIARY FLORAS OF ALASKA.

1–3. *Fraxirus juglandina* Saporta (U.S.N.M. 39038, 39039; p. 163). **4.** *Fraxinus inordinata* Hollick, n. sp. (U.S.N.M. 39040; pp. 163–164). **5.** *Juglans egregia* Lesquereux (U.S.N.M. 39041; pp. 79–80).



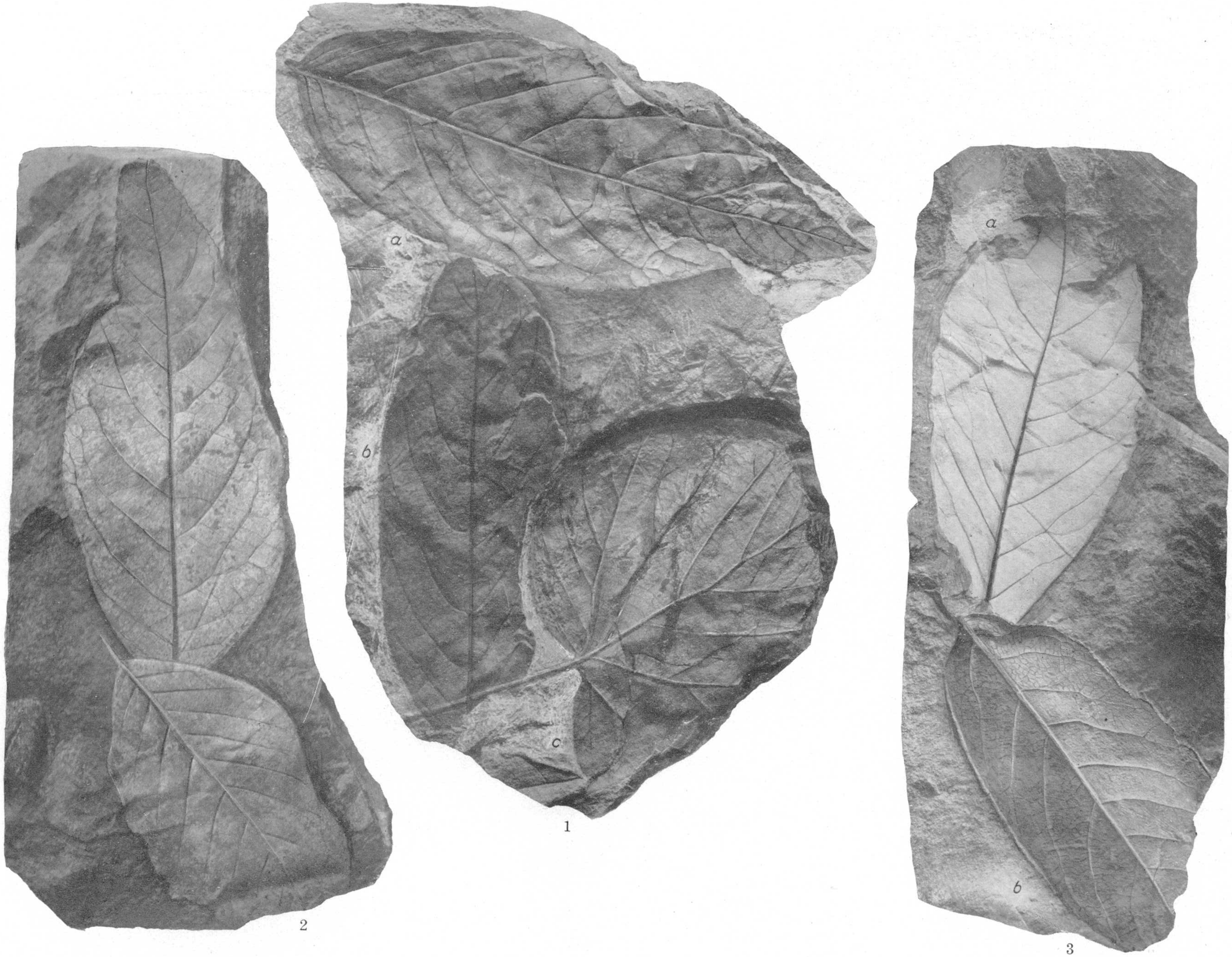
TERTIARY FLORAS OF ALASKA.

1–7. *Fraxinus inordinata* Hollick, n. sp. (U.S.N.M. 38815; pp. 163–164). **8–10.** *Fraxinus juglandina* Saporta (U.S.N.M. 38779, 39042; p. 163)



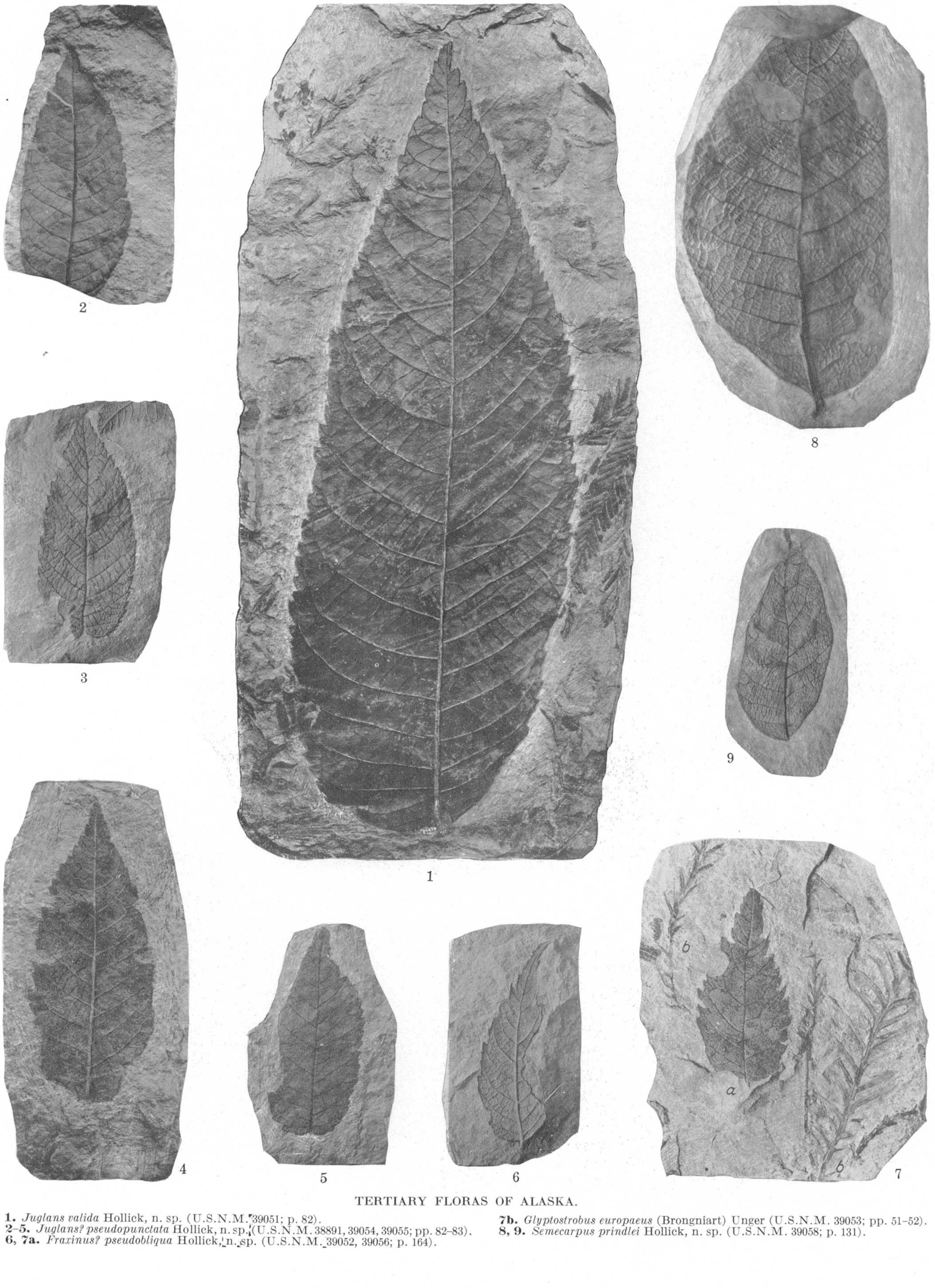
TERTIARY FLORAS OF ALASKA.

Fraxinus yukonensis Hollick, n. sp. (U.S.N.M. 39043, 39044; p. 164).



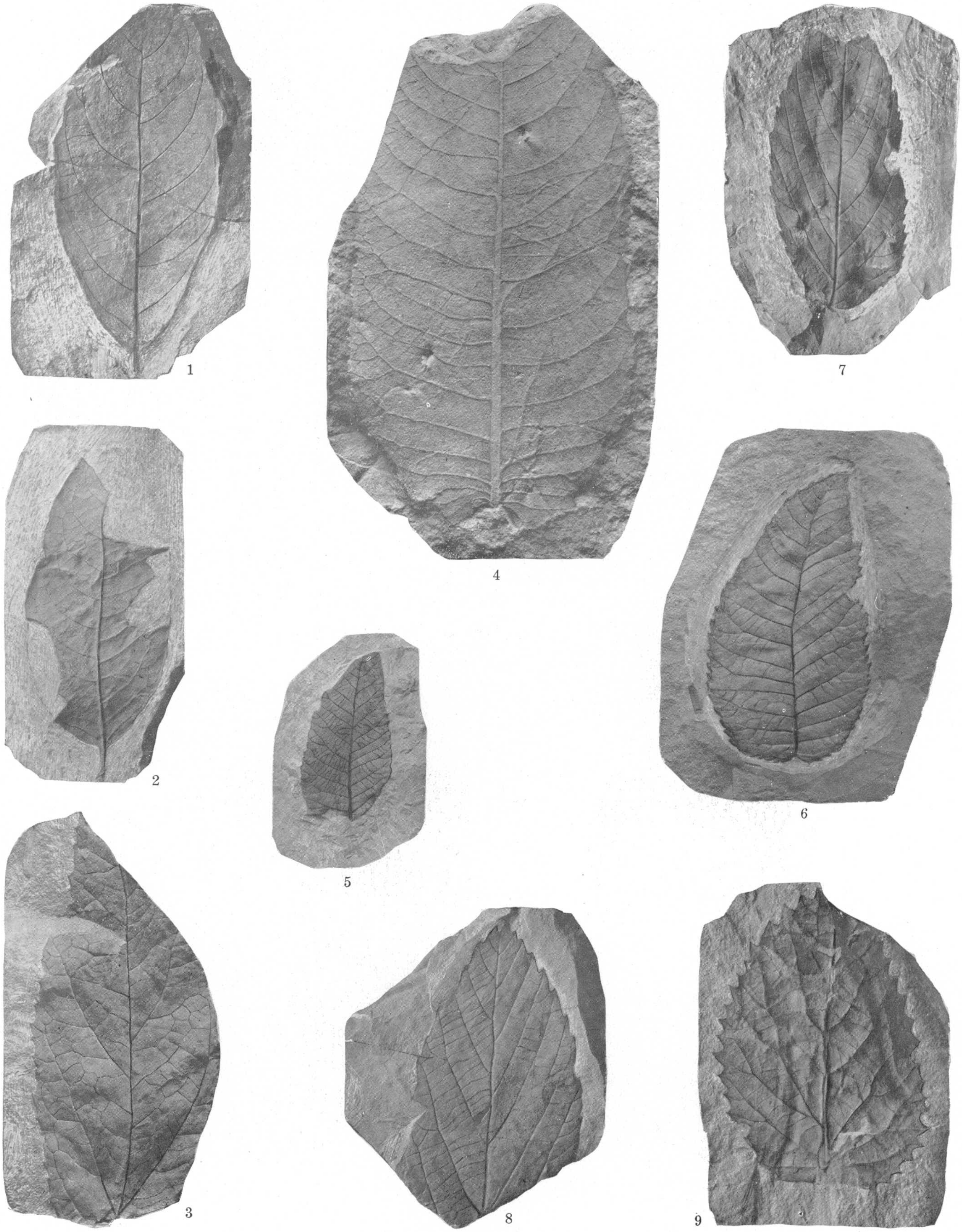
TERTIARY FLORAS OF ALASKA.

1a. *Mohrodendron inopinum* Hollick, n. sp. (U.S.N.M. 39045; pp. 162–163).
1b. *Juglans strozziana* Gaudin? (U.S.N.M. 39046; pp. 78–79).
1c. *Tilia malmgreni* Heer (U.S.N.M. 39047; p. 144).
2. *Mohrodendron inopinum* Hollick, n. sp. (U.S.N.M. 39048; pp. 162–163).
3a. *Juglans crossii* Knowlton (U.S.N.M. 39049; p. 80).
3b. *Ilex? reticulata* Heer (U.S.N.M. 39050; p. 132).



TERTIARY FLORAS OF ALASKA.

1. *Juglans valida* Hollick, n. sp. (U.S.N.M. 39051; p. 82).
2–5. *Juglans? pseudopunctata* Hollick, n. sp. (U.S.N.M. 38891, 39054, 39055; pp. 82–83).
6, 7a. *Fraxinus? pseudobliqua* Hollick, n. sp. (U.S.N.M. 39052, 39056; p. 164).
7b. *Glyptostrobus europaeus* (Brongniart) Unger (U.S.N.M. 39053; pp. 51–52).
8, 9. *Semecarpus prindlei* Hollick, n. sp. (U.S.N.M. 39058; p. 131).

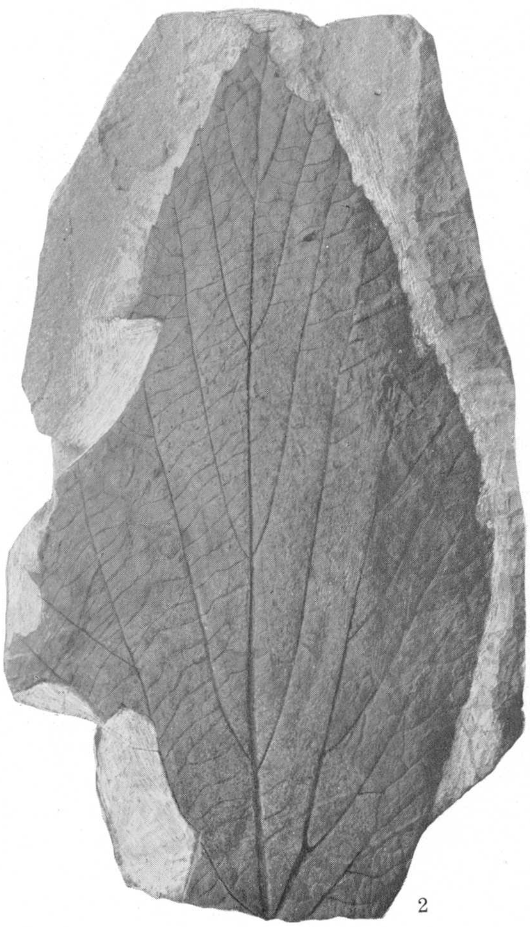


TERTIARY FLORAS OF ALASKA.

1. *Diospyros brachysepala* Alex. Braun (U.S.N.M. 39059; p. 161).
2. *Diospyros anceps* Heer (U.S.N.M. 39057; p. 161).
3. *Fraxinus johnstrupi* Heer (U.S.N.M. 39060; pp. 164–165).
4. *Fraxinus yukonensis* Hollick, n. sp. (U.S.N.M. 39061; p. 164).
5, 6. *Fraxinus lateralis* Hollick, n. sp. (U.S.N.M. 38921, 39063; p. 164).
7, 8. *Viburnum obliquum* Hollick, n. sp. (U.S.N.M. 38967; p. 165).
9. *Viburnum duriusculum* Hollick, n. sp. (U.S.N.M. 39062; p. 168).

1

3

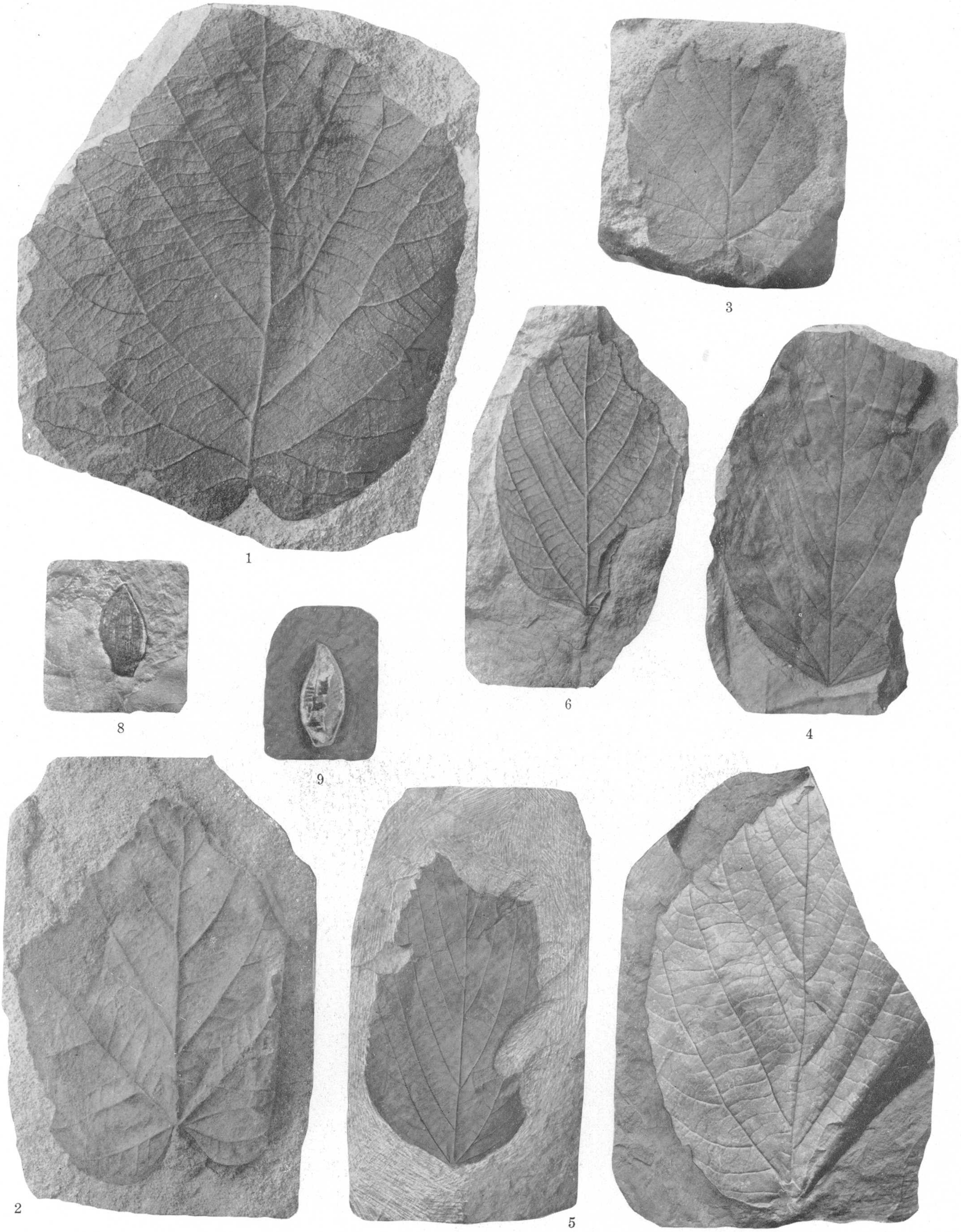


2

4

TERTIARY FLORAS OF ALASKA.

1. *Viburnum contortum* Lesquereux (U.S.N.M. 39064; pp. 165–166).
2. *Viburnum newberryanum* Ward (U.S.N.M. 39065; p. 165).
3. *Viburnum antiquum* (Newberry) Hollick (U.S.N.M. 39066; p. 166).
4. *Viburnum schmidtianum* Heer? (U.S.N.M. 39067; p. 167).



TERTIARY FLORAS OF ALASKA.

1-3. *Viburnum nordenskiöldi* Heer (U.S.N.M. 39068, 39069; p. 167). **4, 5, 6?, 7?.** *Viburnum whymperi* Heer (U.S.N.M. 39070, 39071; pp. 167-168). **8, 9.** Fruit of *Viburnum* sp.? (U.S.N.M. 39072; pp. 168-169).

1

2

TERTIARY FLORAS OF ALASKA.

1. *Chondrites heeri* Eichwald? (U.S.N.M. 39073; pp. 34-35).

2. *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 39074; pp. 47-48).

TERTIARY FLORAS OF ALASKA.

1–6. *Dryopteris meyeri* (Heer) Hollick, n. comb. (U.S.N.M. 39075–39078; p. 36).
7. *Osmunda doroschkiana* Goeppert (U.S.N.M. 39079; p. 40).
8a. *Pteris sitkensis* Heer (U.S.N.M. 39080; pp. 39–40).
8b. *Laurus californica* Lesquereux (U.S.N.M. 39081; p. 119).
9, 10. *Taxodium occidentale* Newberry (U.S.N.M. 39082, 39083; p. 50).
11. *Glyptostrobus europaeus* (Brongniart) Unger (U.S.N.M. 39084; pp. 51–52).
12. *Phragmites alaskana* Heer? (U.S.N.M. 39085; p. 55).
13. *Myrica* (*Dryandroides*) *lignitum* (Unger) Saporta (U.S.N.M. 39086; pp. 76–77).
14–16. *Myrica banksiaefolia curta* Hollick, n. var. (U.S.N.M. 39087; pp. 75–76).

TERTIARY FLORAS OF ALASKA.

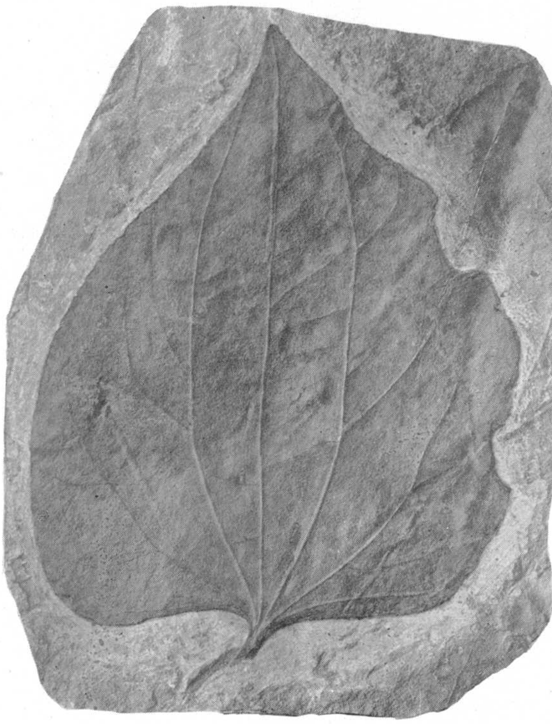
a. *Dioön praespinulosum* Hollick (U.S.N.M. 39088; p. 43). **b.** *Sequoia langsdorfii* (Brongniart) Heer (U.S.N.M. 39089; pp. 47–48).

TERTIARY FLORAS OF ALASKA.

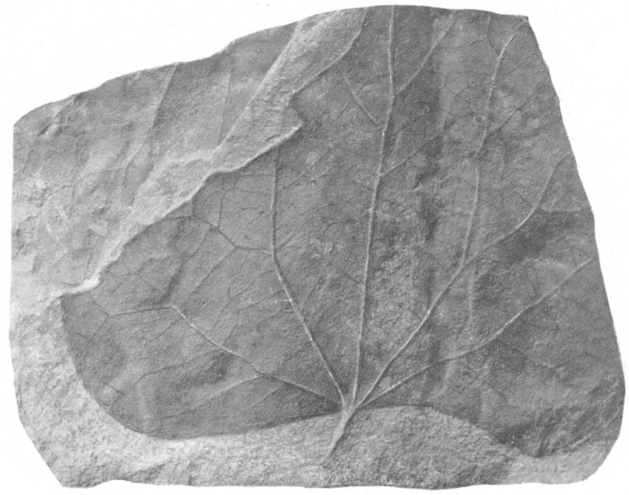
Flabellaria alaskana Hollick, n. sp. (U.S.N.M. 39090; pp. 57–58).

TERTIARY FLORAS OF ALASKA.

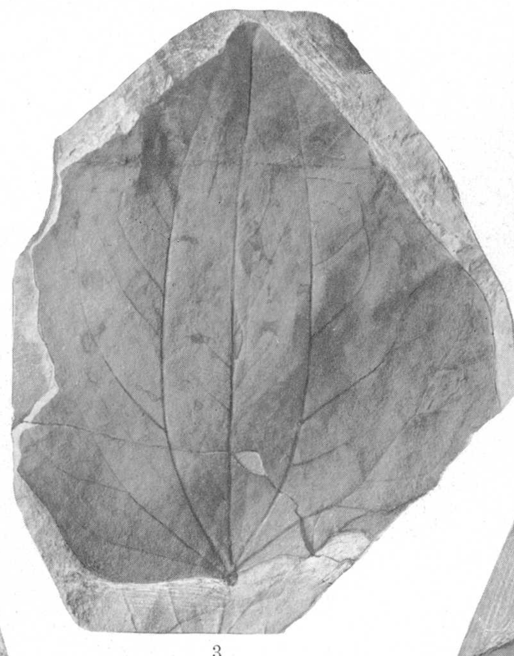
Flabellaria alaskana Hollick, n. sp. (U.S.N.M. 39090; pp. 57-58).



1



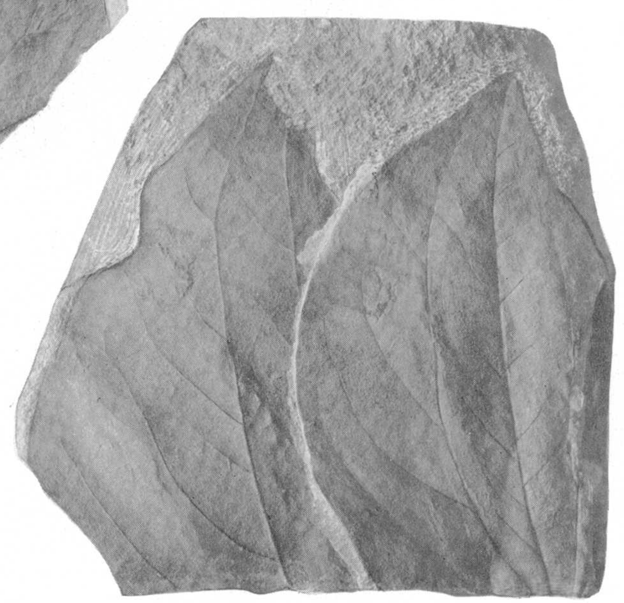
2



3

4

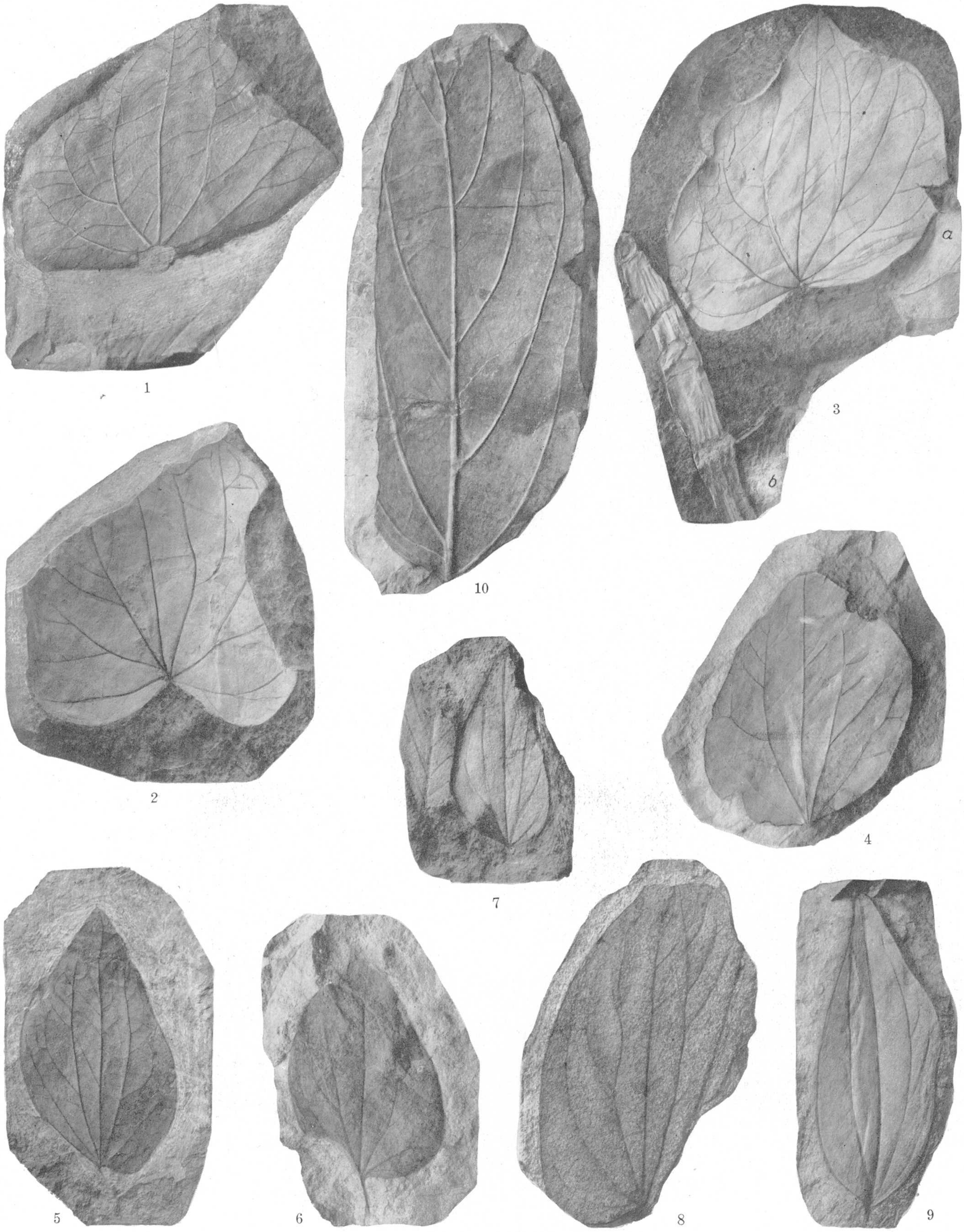
5



6

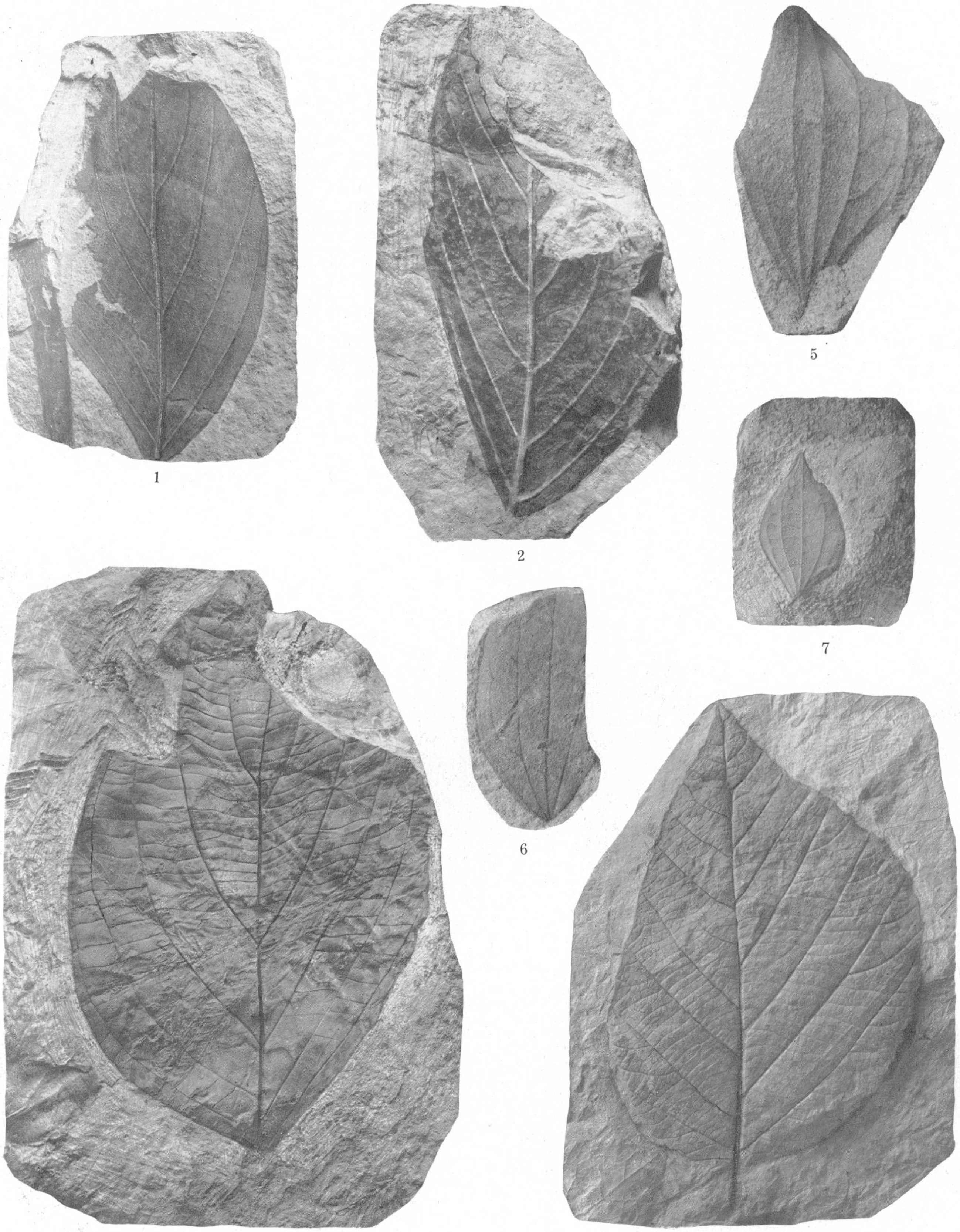
TERTIARY FLORAS OF ALASKA.

Piper septentrionalis Hollick, n. sp. (U.S.N.M. 39091, 39092; pp. 58–59).



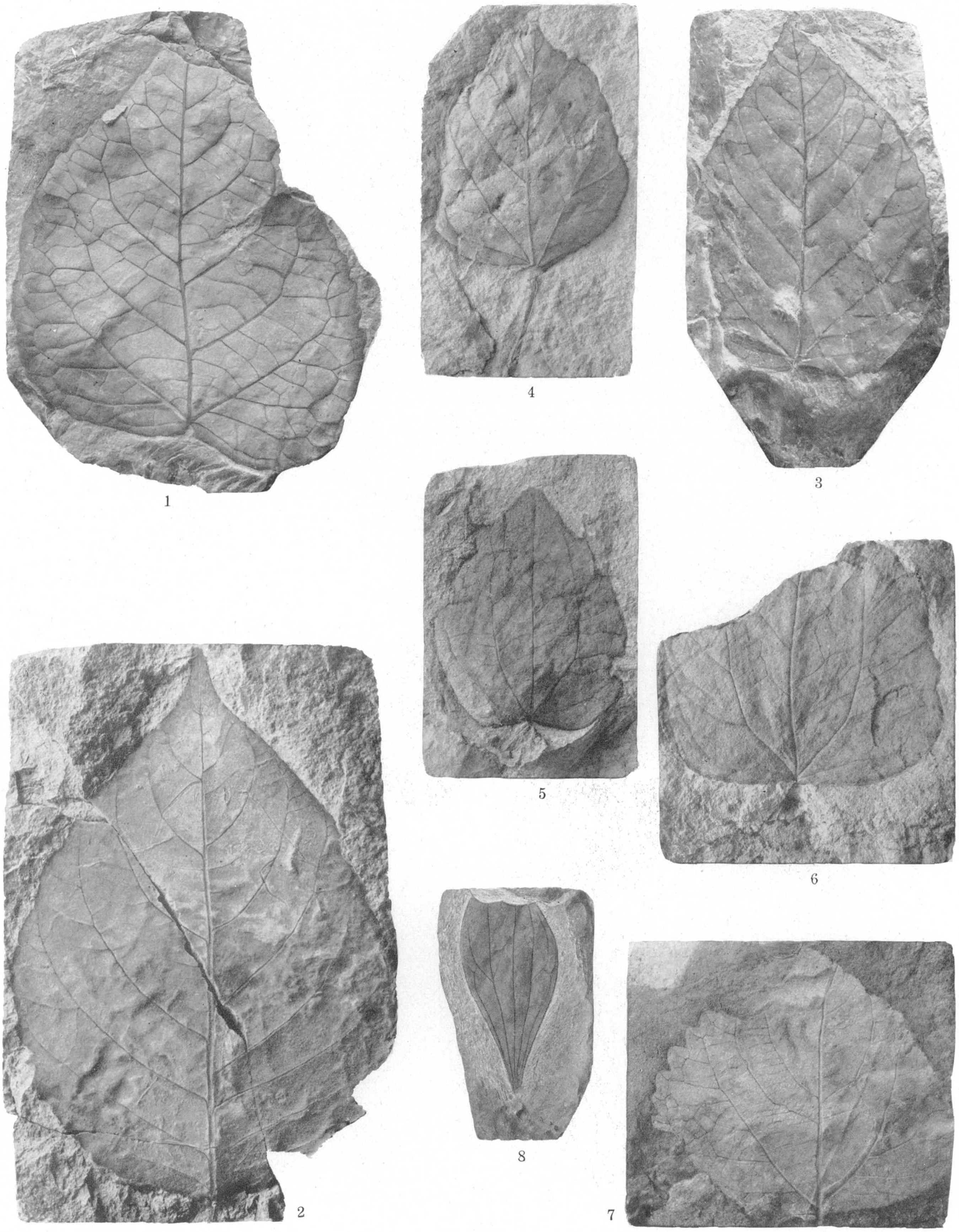
TERTIARY FLORAS OF ALASKA.

1. *Piper septentrionalis* Hollick, n. sp. (U.S.N.M. 39093; pp. 58–59).
2, 3a, 4–9. *Piper controvertabilis* Hollick, n. sp. (U.S.N.M. 38678, 39094, 39095, 39096; p. 59).
3b. *Equisetum arcticum* Heer (U.S.N.M. 39097; pp. 41–42).
10. *Piper disputabilis* Hollick, n. sp. (U.S.N.M. 39098; pp. 59–60).



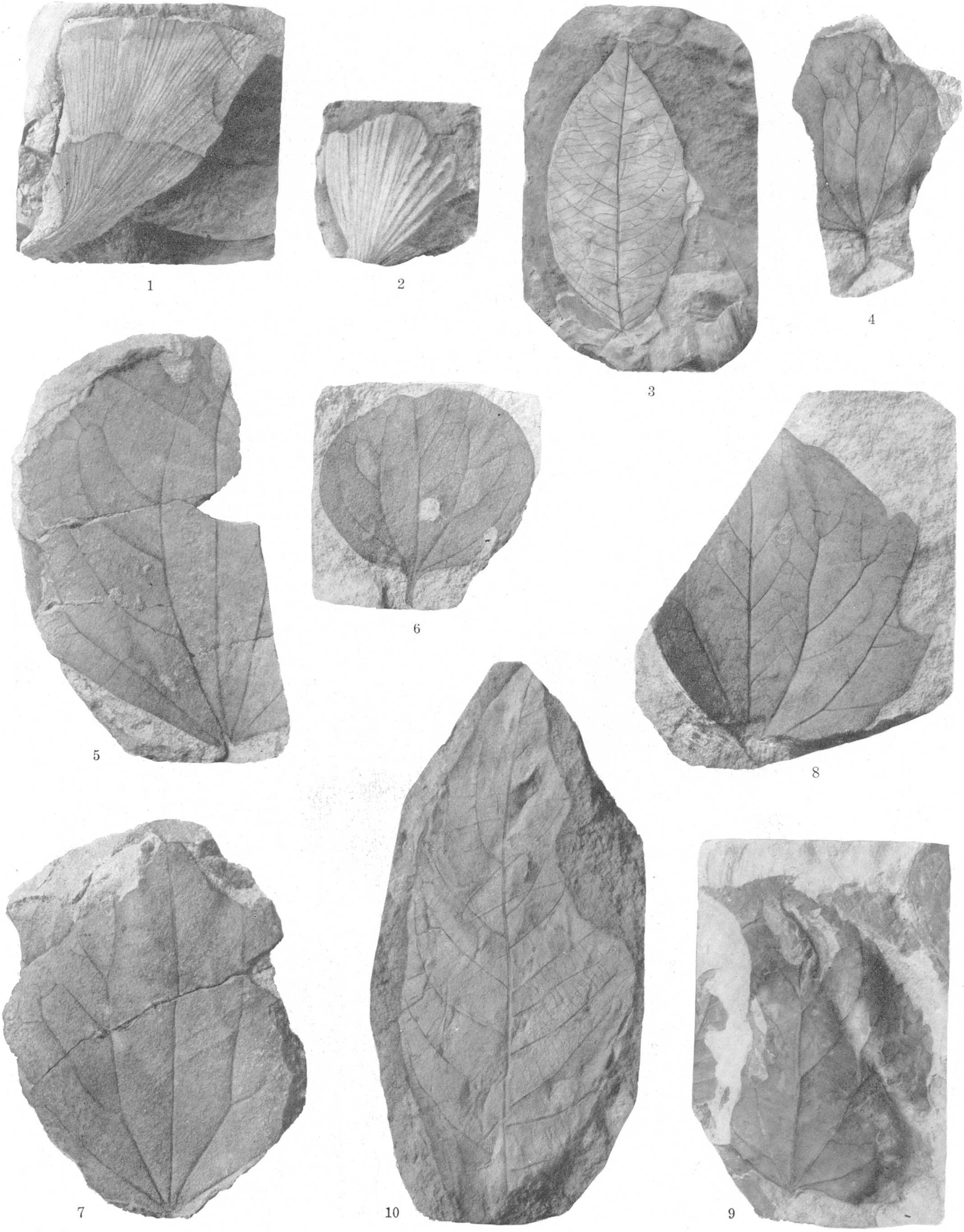
TERTIARY FLORAS OF ALASKA.

1, 2. *Piper concavum* Hollick, n. sp. (U.S.N.M. 39099, 39100; p. 59).
3. *Piper chapini* Hollick, n. sp. (U.S.N.M. 39101; p. 60).
4. *Hamamelis clarus* Hollick, n. sp. (U.S.N.M. 39102; pp. 122–123).
5–7. *Paliurus colombi* Heer (U.S.N.M. 39103, 39104; p. 141).



TERTIARY FLORAS OF ALASKA.

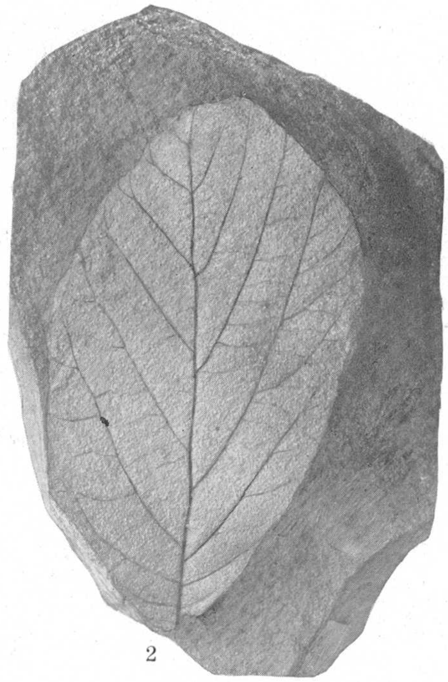
1. *Populus glandulifera* Heer (U.S.N.M. 39105; p. 65).
2. *Populus congerminalis* Hollick, n. sp. (U.S.N.M. 39106; pp. 67-68).
3, 4. *Populus balsamoides* Goeppert (U.S.N.M. 39107, 39108; pp. 65-67).
5, 6. *Populus zaddachi* Heer? (U.S.N.M. 39109, 39110; p. 69).
7. *Populus amblyrhyncha* Ward (U.S.N.M. 39111; p. 63).
8. *Hakea alaskana* Hollick, n. sp. (U.S.N.M. 38965; pp. 111-112).



TERTIARY FLORAS OF ALASKA.

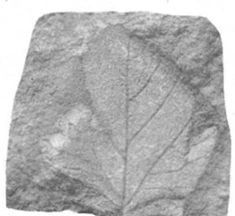
1, 2. *Ginkgo adiantoides* (Unger) Heer (U.S.N.M. 39112; pp. 43, 44).
3. *Salix raeana* Heer (U.S.N.M. 39113; pp. 72-73).
4-8. *Populus arctica* Heer (U.S.N.M. 38764, 39114; pp. 60-61).
9. *Populus flexuosa* Hollick, n. sp. (U.S.N.M. 39115; p. 63).
10. *Juglans acuminata* Alex. Braun (U.S.N.M. 39116; pp. 77-78).

1

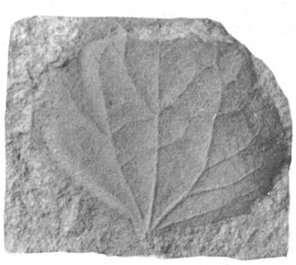


2

3



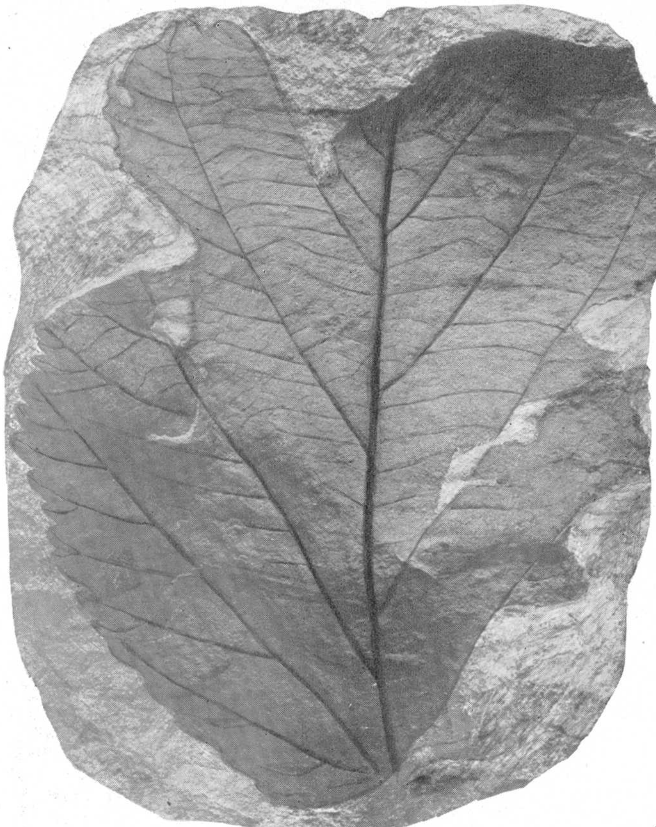
4



5

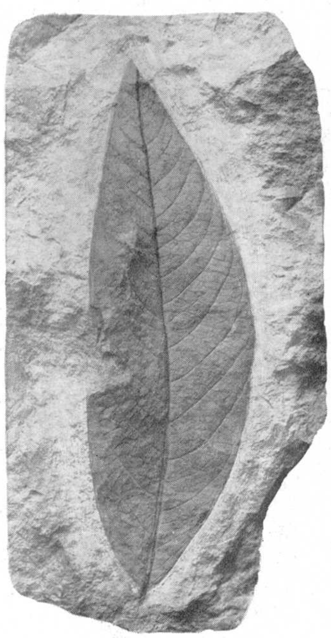
TERTIARY FLORAS OF ALASKA.

1. *Hampea conditionalis* Hollick, n. sp. (U.S.N.M. 39117; p. 150).
2. *Protoficus inaequalis* Newberry? (U.S.N.M. 39118; p. 111).
3. *Abutilon eakini* Hollick, n. sp. (U.S.N.M. 39119; pp. 149–150).
4. *Populus* sp.? (U.S.N.M. 39120; p. 69).
5. *Populus arctica* Heer (U.S.N.M. 39121; pp. 60–61).



1

2



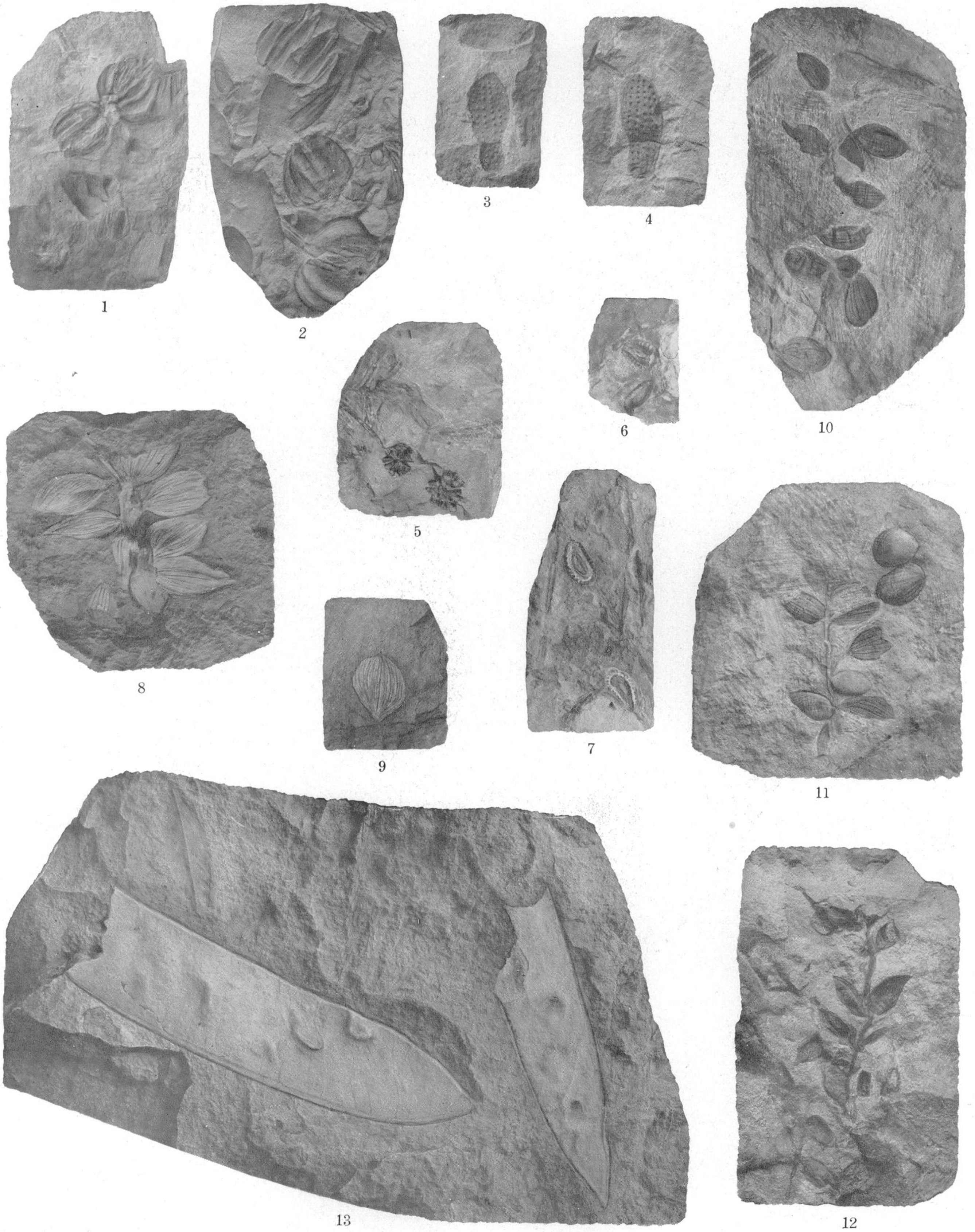
3

4

5

TERTIARY FLORAS OF ALASKA.

1. *Viburnum aequale* Hollick, n. sp. (U.S.N.M. 39122; pp. 166–167).
2. *Viburnum evexum* Hollick, n. sp. (U.S.N.M. 39123; p. 166).
3. *Engelhardtia ettingshauseni* Berry (U.S.N.M. 39124; p. 84).
4. *Ficus stantoni* Hollick, n. sp. (U.S.N.M. 39125; p. 110).
5. *Rhamnus pseudogoldianus* Hollick, n. sp. (U.S.N.M. 38987; pp. 139–140).



TERTIARY FLORAS OF ALASKA.

1, 2. *Nordenskiöldia borealis* Heer (U.S.N.M. 39126; p. 169).
3, 4. *Carpolithes elytraeformis* Hollick, n. sp. (U.S.N.M. 39127; p. 171).
5. *Antholithes castaneoides* Hollick, n. sp. (U.S.N.M. 39128; p. 169).
6, 7. *Carpolithes auriformis* Hollick, n. sp. (U.S.N.M. 39129; pp. 170–171).
8–12. *Nyssidium ekmani* Heer (U.S.N.M. 39130, 39131, 39132; pp. 159–160).
13. *Acacia aquilonia* Hollick, n. sp. (U.S.N.M. 39133; pp. 127–128).

TERTIARY FLORAS OF ALASKA.

Coccolobis chapini Hollick, n. sp. (U.S.N.M. 39134; pp. 112–113).

TERTIARY FLORAS OF ALASKA.

Coccolobis chapini Hollick, n. sp (U.S.N.M. 39134; pp. 112–113).

INDEX