THE TERTIARY FLORAS OF ALASKA

BY

ARTHUR HOLLICK

WITH A CHAPTER ON

THE GEOLOGY OF THE TERTIARY DEPOSITS

BY

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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. 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.

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.

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, 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, who mentioned the following forms:

Newropteris acetabulata? (=N. acetabulata Brongniart?), Unga Island (pp. 170, 364).

Abies sp., Kodiak (Kodiak) Island (p. 364) ("Pinus-arten"), p. 1667.


Impressions suggestive of Gramineen, Unga Island (p. 170). Alnus sp., Tshugatska Peninsula (pp. 114, 364).

It may be assumed that it was Grewingk's intention to identify Newropteris acetabulata as the Carboniferous species N. acetabulata 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 Goepert. (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. acetabulata Brongniart, shows a closely similar surficial appearance between the two species.

An abstract of the original paper, by the same author, was issued subsequently, in which he mentioned (p. 285) 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, and in southeastern Alaska. Of these specimens 17 were listed by Goepert 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 Newropteris acetabulata 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 Jakle (Gaklek or Aklek), contained in "grauwacken artigen Gesteine," two of which were described as resembling Calamites, in regard to which Goepert remarked: "nicht in den Bereich der Tertiär formation gehörend."

Three other papers by Goepert were issued under the same title—two of them identical with the original, the third one 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...
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 Alaska12 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 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 Jakliok [= 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.15 The figure is clearly indicative of a Calamites and may be definitely eliminated from the Tertiary flora.

In 1883 Lesquereux16 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 Cre-taceous and Tertiary floras.18

Also in 1883 Newberry17 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 Felix20 described and figured, under the name Pityojeylon inaequalis, a specimen of fossil coniferous wood, presumably of Tertiary age, collected by one of the Krause brothers—Arthur or Aurel—in the vicinity of Daniauk [= 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:

1. Carore, leaves, Sitka. E. W. Nelson, collector.22
2. Sagittaria d. sp.? idem.

In 1892 Dall and Harris23 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 (Toponica Creek and Ulukak

or paper regard to locality or stratigraphic In this contents with the original paper, under the heading "Report on the descriptions' of those previously intermediate locality), and 2 in the vicinity of Norton Alaska Peninsula coastal region. Of the Alaska, 1 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, 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 follow-

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, 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 follow-

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 hesitatingly 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, 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. 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, 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 1899 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, but this was subsequently recognized as an erroneous identification of a Cretaceous species 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, 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

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29 Idem, p. 133, pl. 53, figs. 1, 2; pl. 54, fig. 4.


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 Ter-
tiary 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 during brief reports by Knowlton
and by me, which were included, from time to time, in
papers on the geology of Alaska issued by the Geologi-
cal 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. Subse-
quent critical examination and study of the specimens
frequently resulted in more satisfactory identifica-
tions and in the elimination of errors. Nevertheless,
despite the occasional errors of identification in the
original lists, the general facies of the flora was cor-
correctly recognized in almost every instance and the
stratigraphic position of the plant-bearing beds was
seldom misinterpreted.

In connection with the Harriman Alaska Expedi-
tion 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 subse-
quently examined, identified as Tertiary species, and
described and figured by Knowlton. The list of
identifications was also included in a report by At-
twood published subsequently. Collier gives a
brief paragraph on fossil plants of Cenozoic age, and
a plate on which are depicted five characteristic Ter-
tiary species, reproduced from Heer.

In 1907 specimens of fossil wood from Alaska were
described by Platen, 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 un-
certain.

In 1911 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, 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, 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, on a more or less prob-
lematic 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 (Rhododeniales):
    - Rhodomelaceae:
      - Chondrites Sternberg:
        - Chondrites heeri Eichwald?
  - Pteridophyta:
    - Filicineae:
      - Filicales:
        - Polypodiaceae:
          - Onoclea Linnaeus:
            - Onoclea sensibilis Linnaeus,
              - Dryopteris Adanson:
                - Dryopteris meyeri (Heer) Hollick, n. comb.
    - Dennstaedtia Bernhardi:
      - Dennstaedtia blomstrandii (Heer) Hollick, n. comb.
  - Asplenium Linnaeus:
    - Asplenium alaskanum Hollick, n. sp.
  - Pteris Linnaeus:
    - Pteris inequilateralis Hollick, n. sp.
    - Pteris oenogena Unger?
    - Pteris pseudopennaeformis Lesquereux.
    - Pteris stiktensis Heer.

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SPECIES INCLUDED

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:
Equisetum Linnaeus:
Equisetum arcticum Heer.
Equisetum globulosum Lesquereux.

Gymnospermae—Continued.
Cycadaceae:
Ceratozamia Brongniart:
Ceratozamia wrightii Hollick.
Dioon Lindley:
Dioon inopinus Hollick.
Dioon praespinulosum Hollick.

Ginkgoales:
Ginkgo Linnaeus:
Ginkgo adiantoides (Unger) Heer.
Ginkgo reniformis conformis Hollick, n. var.

Coniferales:
Taxaceae:
Taxites Brongniart:
Taxites olriki Heer.
Taxites microphyllus Heer.
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 heeri Lesquereux.
Sequoia langsdorfi (Brongniart) Heer.
Sequoia spinosa Newberry.
Sequoia (cone) Knowlton.

Spermatophyta—Continued.
Gymnospermae—Continued.
Cycadaceae—Continued.

Pinaceae—Continued.
Taxodium L. C. Richard:
Taxodium crussum Hollick, n. sp.
Taxodium dubium (Sternberg) Heer.
Taxodium dubium longifolium Massalongo.
Taxodium dubium normalis Massalongo.
Taxodium occidentale Newberry.
Taxodium tianjurm Heer.
Taxodium sp. Grewingk.
Taxodium sp. Heer.

Glyptostrobus Endlicher:
Glyptostrobus europaeus (Brongniart) Unger.

Widdringtonia Endlicher:
Widdringtonia sp. Heer.

Thuites Sternberg:
Thuites ehrnswardi 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.

Alismatales:
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.

Arecales (Palmales):
Arecales:
Flabellaria Sternberg (1822), not Defrance (1829) nor Cavanilles (1790)
Flabellaria florissanti Lesquereux.
Flabellaria alaskana Hollick, n. sp.

Liliaceae:
Smilacaceae:
Smilax Linnaeus:
Smilax reticulata Heer.
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Spermatophyta—Continued.
Angiospermae (Dicotyledoneae—Choripetalae):

Piperales:

Piper Linnaeus:
Piper caplinii 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 banksiae folia Unger.
Myrica banksiae folia curta Hollick, n. var.
Myrica (Dryandroides) lignitum (Unger) Saporta.
Myrica speciosa Unger.
Myrica (Comptonia) windobonensis (Ettingshausen) Heer.

Juglandales:

Juglandaceae:

Juglans Linnaeus:

Juglans acuminata Hollick, n. sp.
Juglans acuminata latifolia (Alex. Braun) Heer.

Juglanites Goeppert and Berendt:

Juglans townsendi Knowlton.
Juglans valida Hollick, n. sp.
Juglans woodiana Heer.
Juglans sp.?

Hicoria Rafinesque:

Hicoria antiqua (Newberry) Knowlton.
Hicoria magnifica Knowlton.

Engelhardtia Leschen:

Engelhardtia ettingshauseniana Berry.

Fagales:

Betulaceae:

Betula Linnaeus:

Betula alaskana Lesquereux.
Betula brongniartii Ettingshausen.
Betula confusa lata Hollick, n. var.
Betula dubiosa Hollick, n. sp.
Betula grandifolia Ettingshausen.
Betula populoides Hollick, n. sp.
Betula priscia Ettingshausen.
Betula sp.? aments.

Alnus Gaertner:

Alnus alaskana Newberry.
Alnus abifolia (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 alnifolia Hollick, n. sp.
Fagus antipodi Abich.
Fagus decumatoris Unger.
Fagus feroniae Unger.
Fagus sp. Heer.
Castanea Adanson:
Castanea castaneaefolia (Unger) Knowlton.
Quercus Linnaeus:
Quercus alaskana Trelease?
Quercus artocarpites Ettingshausen.
Quercus chamiissoni Heer.
Quercus conjunctiva Hollick, n. sp.
Quercus daillii Lesquereux.
Quercus etymodrys Unger.
Quercus furuhjelmi Heer.
Quercus grünlandica Heer.
Quercus jugiaudina Heer?
Quercus meriani Heer.
Quercus neradensis Lesquereux.
Quercus olasceni Heer.
Quercus oregoniana Knowlton.
Quercus platania Heer.
Quercus pseudocastanea Goepert.
Quercus steenstrupiana Heer.
Dryophyllum Deby:
Dryophyllum aquilonium Hollick, n. sp.
Dryophyllum longipetiolatum Knowlton.
Dryophyllum stanleyanum Dawson.

Urticales:
Ulmaceae:
Ulmus Linnaeus:
Ulmus borealis Heer.
Ulmus braunii Heer.
Ulmus carpinifoliae Goepert.
Ulmus diptera Steenstrup?
Ulmus longifolia Unger.
Ulmus plurinervia Unger.
Ulmus pseudobraunii Hollick, n. sp.
Ulmus sorbifolia Goepert.
Planera Gmelin:
Planera aquaticaformis Hollick, n. sp.
Planera ungerii 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 stantonii Hollick, n. sp.
Protoficus Saorta:
Protoficus inaequalis Newberry?

Proteales:
Proteaceae:
Grevillea Salisbury and Knight:
Grevillea alaskana Hollick, n. sp.

Spermatophyta—Continued.
Angiospermae—Continued.
Proteales—Continued.
Proteaceae—Continued.
Hakea Schradel:
Hakea alaskana Hollick, n. sp.
Macclintockia Heer:
Macclintockia chignikensis Hollick, n. sp.
Polygonales:
Polygonaceae:
Coccolobis P. Browne:
Coccolobis chaplini Hollick, n. sp.

Ranales:
Nympheaceae:
 Nelumbo Adanson:
 Nelumbo protolutea Berry?

Magnoliaceae:
Magnolia Linnaeus:
Magnolia inglefieldi Heer.
Magnolia nordenskiöldi Heer.
Magnolia ovalis Lesquereux.
Magnolia wormskjöldi Heer.

Lauraceae:
Cinnamomum R. Brown:
Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb.
Cinnamomum ficoideus Hollick, n. sp.
Persea Gærtner:
Persea spatiosa Hollick, n. sp.
Sassafras Nees:
Sassafras alaskanum Hollick, n. sp.
Malapoena Adanson:
Malapoena carbonensis (Ward) Knowlton.
Malapoena magnifica (Saorta) Hollick, n. comb.

Benzoin Fabricius:
Benzoin antiquum Heer.

Laurus Linnaeus:
Laurus californica Lesquereux.
Laurus fürstenbergii Alex. Braun.
Laurus hamiltonensis Hollick, n. sp.
Laurus octoaelea Ettingshausen.
Laurus princeps Heer.
Laurus salicifolius Knowlton and Cockerell.

Daphne G. Unger:
Daphne genii kanli 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 rectirnervis Hollick, n. sp.
Platanus sp.? leaves, Dall.
Platanus sp. Knowlton.
THE TERTIARY FLORAS OF ALASKA

Spermatophyta—Continued.
Angiospermae—Continued.
Rosales—Continued.

Sapindales—Continued.

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.

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 Linnaeus—Continued.
Koelreuteria eakiini Hollick, n. sp.

Rhamnaceae:

Rhamnus Linnaeus:
Rhamnus brevifolius Alex. Braun.
Rhamnus decheni Weber.
Rhamnus gaudini Heer.
Rhamnus marginatus Lesquereux.
Rhamnus pseudogoldianus Lesquereux.
Rhamnus rosanaeassleri Unger.

Zizyphus Adanson.
Zizyphus hyperboreus Heer.
Zizyphus meigii (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 olkii Heer.

Cissus Linnaeus:
Cissus cissoides (Saporta) Hollick, n. sp.

Cissus pterospermoides Hollick, n. sp.

Malvaceae:

Elaeocarpaceae:

Elaeocarpus Linnaeus:
Elaeocarpus alaskensis Hollick, n. sp.

Tiliaceae:

Tilia Linnaeus:
Tilia alaskana Heer.
Tilia grevilloides Hollick, n. sp.
Tilia malmei Heer.
Tilia notabilis Hollick, n. sp.
Tilia sp. Hollick.

Acer Linnaeus:

Acer arcticum Heer.
Acer disputabilis Hollick, n. sp.
Acer grahamensis Knowlton and Cockerell.
Acer inaequale Heer?
Spermatophyta—Continued.

Angiospermae—Continued.

Malvales—Continued.

Parietales

Thymeleales

Myrtales

1Jnlbellales

Tiliaceae—Continued.

Malvaceae

Dilleliiaceae

Bombacaceae

Sterculiaceae

Araliaceae

Trapaceae

Elaeagnaceae

Saurauja

Grewia Linnaeus

Grewiopsis Saporta

Apeibopsis Heer

Hampea

Abutilon Gaertner

Terminalia Linnaeus

Dillenia Linnaeus

Pterospermites Heer

Pterospermites alternans Heer.

Pterospermites conjunctivus Hollick, n. sp.

Pterospermites dentatus Heer (previous identification not confirmed).

Pterospermites imparillus Hollick, n. sp.

Pterospermites magnifolia Hollick, n. sp.

Pterospermites spectabilis Heer.

Parietales

Dilleniaceae

Dillenia Linnaeus

Dillenites Berry

Dillenites ceterus Hollick, n. sp.

Dillenites ellipticus Hollick, n. sp.

Dillenites ellipticus ulnifolius Hollick, n. sp.

Dillenites microdentatus (Hollick) Berry.

Sauraula Willdenow

Sauraula alaska Hollick, n. sp.

Thymeaeales

Elaeagraceae

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 maccrarii Heer.

Aralia Linnaeus

Aralia delicatula Hollick, n. sp.

Aralia? sp. Hollick.

Aralia? sp. Hollick.

SPECIES INCLUDED

Spermatophyta—Continued.

Angiospermae—Continued.

Umbellales—Continued.

Cornaceae:

Cornus Linnaeus:

Cornus burchii Heer.

Cornus hyperborea Heer?

Cornus irregularis Hollick, n. sp.

Cornus orbifera Heer.

Nyssa Linnaeus:

Nyssa arctica Heer.

Nyssodium Heer:

Nyssodium ekmani Heer.

Angiospermae (Dicotyledonae—Gamopetalae):

Ericales:

Ericaceae:

Rhododendron Linnaeus:

Rhododendron ericoides Hollick, n. sp.

Vacciniaeae:

Vaccinium Linnaeus:

Vaccinium alaskanum Knowlton.

Vaccinium friezi Heer.

Vaccinium hollicki Knowlton.

Vaccinium sp. Heer.

Ebenacaeae:

Ebenaceae:

Diospyros Linnaeus:

Diospyros alaskan Schimper.

Diospyros anceps Heer.

Diospyros brachysepala Alex. Braun.

Diospyros stenosepala Heer.

Ebenoxylon Felix:

Ebenoxylon boreale Pluten.

Styracaceae:

Mohroodendron Britton:

Mohroodendron inopinum Hollick, n. sp.

Oieales:

Oleaceae:

Fraxinus Linnaeus:

Fraxinus herendiiensis Knowlton.

Fraxinus inordinata Hollick, n. sp.

Fraxinus johnstrapi Heer.

Fraxinus juglandina Saporta.

Fraxinus lateralis Hollick, n. sp.

Fraxinus? pseudobiloba Hollick, n. sp.

Fraxinus yukonensis Hollick, n. sp.

Rubiales:

Caprifoliaceae:

Viburnum Linnaeus:

Viburnum aestival Hollick, n. sp.

Viburnum antiquum (Newberry) Hollick.

Viburnum contortum Lesquereux.

Viburnum durioatum Hollick, n. sp.

Viburnum exuzum Hollick, n. sp.

Viburnum newyorknum Ward.

Viburnum nordenskiöldi Heer.

Viburnum obliquum Hollick.

Viburnum schmidtiam Heer?

Viburnum whymeri Heer?

Viburnum sp. fruit, Hollick.

Spermatophyta of undetermined ordinal and family relationship:

Nordenskiöldia Heer:

Nordenskiöldia borealis Heer.

Antholithes Brongniart:

Antholithes castaneoides Hollick, n. sp.

Paineanthus Newberry:

Paineanthus prinfle 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.
Carpolitites Schlotheim:
Carpolitites auriformis Hollick, n. sp.
Carpolitites etylasformis Hollick, n. sp.
Carpites Schimper:
Carpites sp. Knowlton.

**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:

<table>
<thead>
<tr>
<th>Taxonomic group</th>
<th>Species</th>
<th>Genera</th>
<th>Families</th>
<th>Orders</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thallophyta</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>0.2</td>
</tr>
<tr>
<td>Pteridophyta</td>
<td>16</td>
<td>11</td>
<td>4</td>
<td>2</td>
<td>4.1</td>
</tr>
<tr>
<td>Gymnospermae</td>
<td>40</td>
<td>15</td>
<td>4</td>
<td>3</td>
<td>10.3</td>
</tr>
<tr>
<td>Monocotyledoneae</td>
<td>15</td>
<td>10</td>
<td>7</td>
<td>21</td>
<td>3.9</td>
</tr>
<tr>
<td>Dicotyledoneae</td>
<td>306</td>
<td>94</td>
<td>47</td>
<td>21</td>
<td>78.9</td>
</tr>
<tr>
<td>Uncertain</td>
<td>10</td>
<td>8(7)</td>
<td>(7)</td>
<td>(7)</td>
<td>2.6</td>
</tr>
<tr>
<td>Total</td>
<td>388</td>
<td>139±</td>
<td>63+</td>
<td>33+</td>
<td>100.0</td>
</tr>
</tbody>
</table>

The single representative of the Thallophyta (Chondrites heirtii 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 Equisetetales 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 Hainemannia and Anthrophyopus; and Pecopteris and Neopteris, 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 Anthrophyopus hamiltonensis Hollick, n. sp., by reason of its apparent close relationship to species of the tropical genus Anthrophyopus (= Antherophyllum) 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, Dioon inopinus, and D. prae-spinulosum), 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 formis 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 olivki 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 langsdorffii (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
BOTANIC RELATIONS

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 langsdorffii, 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 (Linnaneus) 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 curopaenus (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 58.4 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 (Platellaria floris-santi 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 73.9 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 35.5 percent of the entire flora and 41 percent of the Dicotyledonae, are in the existing flora prevailing 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 Pterospermite, 8 each. Viburnum and Acer are characteristically north temperate in their distribution, and Pterospermite, 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, Coccobolis, Magnolia, Cinnamomum, Persea, Maloapenna, Laurus, Pithecolobium, Acacia, Sophora, Canavalia, Dolichos, Tetrapetra, Semecarpus, Elaeodendron, Cupania, Poullina, Sapindus, Zizyphus, Oisus, Elaeocarpus, Grewia (and Grewiopsis?), Apotheiopsis, Abutilon, Hampea, Dillenia (and Dillenites?), Sawaraja, 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 Smilac, 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 characteristic 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 Anthrophyopis, Ceratozamia, Dioön, and Flabellaria have been identified, associated with species of Piper, Laurus, Sapindus, Acaica, 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:

<table>
<thead>
<tr>
<th>Genera</th>
<th>Species</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coratozamia</td>
<td>6</td>
<td>Mexico</td>
</tr>
<tr>
<td>Dioön</td>
<td>2</td>
<td>Mexico</td>
</tr>
<tr>
<td>Sequoia</td>
<td>2</td>
<td>California</td>
</tr>
<tr>
<td>Taxodium</td>
<td>2</td>
<td>Southern North America and Mexico</td>
</tr>
<tr>
<td>Comptonia</td>
<td>1</td>
<td>Canada, eastern United States to Florida</td>
</tr>
<tr>
<td>Hicoria</td>
<td>10</td>
<td>Eastern North America and Mexico</td>
</tr>
<tr>
<td>Coccolobis</td>
<td>25</td>
<td>Tropical and subtropical regions</td>
</tr>
<tr>
<td>Tetrapteris</td>
<td>30</td>
<td>Tropical regions</td>
</tr>
<tr>
<td>Hampea</td>
<td>2</td>
<td>Tropical and subtropical regions</td>
</tr>
<tr>
<td>Leparypea</td>
<td>3</td>
<td>Temperate and boreal North America</td>
</tr>
<tr>
<td>Mohrodendron</td>
<td>3</td>
<td>Southeastern North America</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Genera</th>
<th>Species</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hausmannia</td>
<td>4</td>
<td>Southeastern Asia</td>
</tr>
<tr>
<td>Ginkgo</td>
<td>1</td>
<td>China and Japan</td>
</tr>
<tr>
<td>Glyptostrobus</td>
<td>2</td>
<td>China</td>
</tr>
<tr>
<td>Engelhardtia</td>
<td>9</td>
<td>Southern Asia</td>
</tr>
<tr>
<td>Artocarpus</td>
<td>40</td>
<td>Southeastern Asia</td>
</tr>
<tr>
<td>Grevillea</td>
<td>150</td>
<td>Australia</td>
</tr>
<tr>
<td>Hakea</td>
<td>100</td>
<td>Australia</td>
</tr>
<tr>
<td>Cinnamomum</td>
<td>50</td>
<td>Eastern Asia and Australasia</td>
</tr>
<tr>
<td>Semecarpus</td>
<td>40</td>
<td>Southern Asia and Australasia</td>
</tr>
<tr>
<td>Koeckreteria</td>
<td>2</td>
<td>China</td>
</tr>
<tr>
<td>Dillenia</td>
<td>25</td>
<td>Eastern Asia and Australasia</td>
</tr>
</tbody>
</table>

(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:

<table>
<thead>
<tr>
<th>Genera</th>
<th>Species</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onoclea</td>
<td>1</td>
<td>Eastern North America and Asia</td>
</tr>
<tr>
<td>Nelumbo</td>
<td>2</td>
<td>Eastern and southern North America, northern South America, and Asia, mostly eastern</td>
</tr>
<tr>
<td>Magnolia</td>
<td>20</td>
<td>Eastern North America and Asia, mostly eastern</td>
</tr>
<tr>
<td>Persea</td>
<td>10</td>
<td>Tropical and subtropical America and eastern Asia</td>
</tr>
</tbody>
</table>

11. Eiagraphe, 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.
Saurauya, 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:

Denstaedtia, about 15 Eastern North America, eastern Asia, and elsewhere.
Asplenium, about 200 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 Japan, China, and southern Europe. 4 species.
Paliurus, 2 species. Japan, China, and southern Europe.
Elaeocarpus, about Eastern Asia, Australia, and 60 species. Hawaii.
Grevia, about 80 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 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 Europe, temperate and boreal species. 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 Europe, temperate and boreal Asia, species. temperate and boreal North America.
Crataegus, about 40 Europe, temperate and boreal Asia, species. temperate and boreal North America.
Aesculus, about 14 Europe, northern temperate Asia, species. 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 nitifolia (Goepert) Hollick, n. comb.
Ulmus carpindrades Goepert.

7380. Kuiu Island:
Osmunda doroschkiana Goepert.
Castanea.castanesefolia (Unger) Knowlton.
Plana ungeri Ettingshausen.

3052. Kupreanof Island, Hamilton Bay:
Antrophyopsis hamiltonensis Hollick, n. sp.
Taxites oliri Heer.
Jugians nigeila Heer.
Jugians? pseudopunctata Hollick, n. sp.
Ulmus sorbifolia Goepert.
Malapoennea carbonensis (Ward) Knowlton?
Dillenites ellipticus unifolius Hollick, n. var.

4889. Kupreanof Island, Hamilton Bay, highest of three horizons:
Dioen inopinus Hollick.
Dioen praespinulosum Hollick.
Sequena langsdorfi (Brounart) Heer.
Glyptostrobus europeus (Brounart) Unger.
Piper concavum Hollick, n. sp.
Jugians longiapicnulata Hollick, n. sp.
Magnolia ingelli Heer?
Laurus hamiltonensis Hollick, n. sp.
Sassafras alaskanum Hollick, n. sp.
Malapoennea magnifica (Saporta) Hollick, n. comb.

Sapindus basilicus (Unger) Unger.
Dillenites ellipticus Hollick, n. sp.
Dillenites ellipticus umfoolius Hollick, n. var.
Dillenites microdentatus (Hollick) Berry.
Dicotyledonous leaf (gen. and sp.?).


Taxodium tinajorum Heer.
Sequoia langsdorffii (Brongniart) Heer.
Glyptostrobus europaeus (Brongniart) Unger.
Populus speciosa Ward?
Grewiopsis frustratorius Hollick, n. sp.
Grewiopsis defectivus Hollick, n. sp.
Pterospermites conjunctivus Hollick, n. sp.

4391. Kupreanof Island, Hamilton Bay, lowest of three horizons:

Anthropophyxis hamiltonensis Hollick, n. sp.
Dioöch praeplinusom 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.
Malapoena magnifica (Saporta) Hollick, n. comb.
Laurus fürstenbergii Alex. Braun.
Rhamnus rossmeassleri Unger.
Dillenites ceterus Hollick, n. sp.
Dillenites ellipticus Hollick, n. sp.
Fraxinus? pseudobiqua Hollick, n. sp.

4392. Kupreanof Island, Hamilton Bay, lowest of three horizons:

Onoclea sensibilis Linnaeus.
Ceratocazma wrightii Hollick.
Taxodium crassum Hollick, n. sp.
Laurus californica Lesquereux.
Dillenia alaskana Hollick, n. sp.
Dillenites ellipticus Hollick, n. sp.

7474. Kupreanof Island:

Onoclea sensibilis Linnaeus.
Ceratocazma wrightii Hollick.
Taxodium crassum Hollick, n. sp.
Laurus californica Lesquereux.
Dillenia alaskana Hollick, n. sp.
Dillenites ellipticus Hollick, n. sp.

7555. Kupreanof Island:

Pteris sitkensis Heer.
Dioöch praeplinusom Hollick.
Taxodium occidentale Newberry.
Sequoia langsdorffii (Brongniart) Heer.
Flabellaria alaskana Hollick, n. sp.
Populus balsamoides Goeppert.
Populus glandulifera Heer.
Castanea castaneaefolia (Unger) Knowlton.
Dryophyllum stanleyanum Dawson.
Magnolia ingledelli Heer.
Malapoena magnifica (Saporta) Hollick, n. comb.
Laurus californica Lesquer eux.
Vitis oerlii Heer.
Saurauja alaska Hollick, n. sp.

4390. Admiralty Island, Kootzmahoo Inlet—Continued.

Sequoia langsdorffii acuta Heer.
Sequoia langsdorffii angustifolia Heer.
Taxodium dubium longifolium Massalongo.
Taxodium dubium (Sternberg) Heer.
Populus ambyrhyzcha Ward.
Populus flexuosa Hollick, n. sp.
Juglans nigella Heer.
Juglans stroziana Gaudin?
Quercus furuhjelmi Heer.
Vitis atwoodi Hollick, n. sp.
Vitis grewioides Hollick, n. sp.
Vitis malmgreni Heer.

4390. Admiralty Island, Kootzmahoo Inlet—Continued.

Tilia notabilis Hollick, n. sp.
Tilia sp.?
Acacia aquilonia Hollick, n. sp.
Mohrodenron inopinum Hollick, n. sp.
Rhamnus pseudoldianus Hollick, n. sp.
Nyssidum ekmani Heer.

7518. Zarembo Island:

Sequoia langsdorffii (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 micenium Heer.

Alexander Archipelago (Sitka?). Nelson, E. W., fide Lesquereux:

Carex, leaves.
Sacittaria n. sp.
Ginkgo adiantoides (Unger) Heer.

Kuhi ("Kuhi") Island. Furuhjelm, fide Heer, Eichwald:

Pteris sitkensis Heer, fide Eichwald.
Pecopteris sp. (=P. ligniticum Siebel?), fide Heer.
Glyptostrobus europaeus (Brongniart) Unger, fide Heer.
Corylus macquarril (Forbes) Heer, fide Eichwald.

Kuhi Island. Dall:

Pteris.
Sequoia langsdorffii.
Glyptostrobus.

Kuku Island. Furuhjelm, fide Heer:

Sequoia langsdorffii (Brongniart) Heer.
Pecopteris sp. Heer.
Castanea.

Corylus macquarril (Forbes) Heer.

"Insel Hudson" (=Hudenuos, Kootzmahoo, or Admiralty Island). Doroschin, fide Goeppert, 1861; Newberry, 1882 (1881):

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.

Cockerell [may=Vitis rotundifolia Newberry (not V. rotundifolia Michaux)].

YAKUTAT-COPPER RIVER REGION

3879. Yakutat Bay:

Asplenium alaskanum Hollick, n. sp.
Pteris pseudopenaeformis Lesquereux.
Glyptostrobus europaeus (Brongniart) Unger.
Magnolia wormskioldi Heer.
Celastrus comparabalis Hollick, n. sp.
Tetrapteris harpigrarium Unger.
Hampea conditionalis Hollick, n. sp.
Carpothyes elytraeformis Hollick, n. sp.

"Dana’sku”, Silver Lake, Krause brothers, fide Felix:

Pityoxygen inaequale Felix.
## FOSSIL-PLANT LOCALITIES

### Bering River coal field:
- Fruit or nut? Thomas [shales of Toku formation, fide Kay].

### Grade trail, Cabin coal opening:
- Piper concavum Hollick, n. sp.

### Creek flowing into head of Canyon Creek:
- Piper disputabilis Hollick, n. sp.
- Dryophyllum stanleyanum Dawson.
- Cornus blichii Heer.
- Cornus hyperborea Heer.
- Cornus irregularis Hollick, n. sp.

### Happy Hollow trail, Berg Lake:
- Asplenium aquaticum (Saporta) Hollick, n. sp.
- Populus balsamoides Goeppert.
- Juglans thermalis Lesquereux.
- Planera aquatifica Hollick, n. sp.
- Ulmus pseudobrachii Hollick, n. sp.
- Dryophyllum stanleyanum Dawson.
- Cornus blichii Heer.
- Cornus hyperborea Heer.
- Cornus irregularis Hollick, n. sp.

### Glacier Creek:
- Magnolia inopinum Hollick, n. sp.
- Dryophyllum inordinatum Hollick, n. sp.
- Magnolia ovalis Lesquereux.
- Cinnamomum cinnamomeum (Rossmaessler) Hollick, n. comb.
- Persoonia spatiosa Hollick, n. sp.
- Malpeoa magnifica (Saporta) Hollick, n. comb.
- Rhamnus marginatus Lesquereux.
- Rhamnus pseudogoldianus Hollick, n. sp.
- Terminalia spinosa sp.
- Semecarpus alaskan Hollick, n. sp.
- Cornus hyperborea Heer.
- Fraxinus lateralis Hollick, n. sp.

### Copper River Basin, Gakona Glacier:
- Ulmus diptera Steenstrup.
- Taxites olriki Heer.

### Kings River:
- Alnus incana glandulosa Heer.
- Alnus incana glandulosa Heer.
- Populus amblyrhyncha Ward.
- Rhamnus gaudini Heer.
- Rhamnus gaudini Heer.
- Rhamnus gaudini Heer.
- Quercus alaskana Trelease?
- Quercus alaskana Trelease?
- Quercus conjunctiva Hollick, n. sp.
- Quercus conjunctiva Hollick, n. sp.

### Matanuska River near Moose Creek:
- Sequoia langsdorffii (Brongniart) Heer.
- Taraxacum officinale (Sternberg) Heer.
- Taxites olriki Heer.
- Piper septentrionalis Hollick, n. sp.
- Fraxinus lateralis Hollick, n. sp.
- Fraxinus lateralis Hollick, n. sp.
- Fraxinus lateralis Hollick, n. sp.
- Antholites castanacoides Hollick, n. sp.

### Matanuska River, west from Moose Creek:
- Juglans cernua Knowlton.
- Juglans cernua Knowlton.
- Quercus cuneata Hollick, n. sp.
- Quercus cuneata Hollick, n. sp.
- Quercus cuneata Hollick, n. sp.
- Quercus cuneata Hollick, n. sp.
- Quercus cuneata Hollick, n. sp.
- Fraxinus johnstrupi Heer.

### Kings River:
- Pterospermites spectabilis Heer.
- Viburnum contortum Lesquereux.

### Onedia sensila Linnaeus.
- Taxodium occidentale Newberry.
- Piper septentrionalis Hollick, n. sp.
- Hampea conditionalis Hollick, n. sp.
- Protopus inaequalis Newberry?

### Little Kings Creek, near Kings River:
- Finbellaria florissanti Lesquereux.

### South of pond on mountain between Kings River and Youngs Creek:
- Equisetum arcticum Heer.
- Glyptostrobus europaues (Brongniart) Unger.
- Piper convertabilis Hollick, n. sp.
- Nysodium ekmani Heer.

### Red Mountain, 4 miles north of Youngs Creek:
- Populus gaudini Fischer-Ooster.

### Elks Creek:
- Equisetum arcticum Heer.
- Glyptostrobus europaues (Brongniart) Unger.
- Piper convertabilis Hollick, n. sp.
- Nysodium ekmani Heer.
- Populus gaudini Fischer-Ooster.
- Populus latior Alex. Braun.
- Populus mutabilis Heer.
- Populus richardsoni Heer.
- Hakea alaskan Hollick, n. sp.
- Juglans nigella Heer.
- Juglans pseudopunctata Hollick, n. sp.
- Castanea autumnale (Unger) Knowlton.
- Quercus graminicola Heer.
- Ulmus longifolia Unger.
- Cœcolobis chapini Hollick, n. sp.
- Laurus ocaoefolia Ettingshausen.
- Dolichos convexus Hollick, n. sp.
Betula sp., aments.
Alnus corylina Knowlton and Cockerell.
Ulmus borealis Heer.
Grevillea alaskana Hollick, n. sp.
Laurus salicifolius Knowlton and Cockerell.
Rhamnus gaudini Heer.
Elaeocarpus alaskensis Hollick, n. sp.
Fraxinus juglandina Soparta.

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

6031. Southwest of Point Naskowhak:
Taxodium tinjorum Heer.
Corylus adunbrata Hollick, n. sp.
Carpinus grandis Unger.
Alnus alaskana Newberry.
Quercus olafsoni Heer.
Quercus dalli Lesquereux.
Fagus deucalionis Unger.

3505. Chinitna Bay:
Ginkgo reinformis conformis Hollick, n. var.
Taxodium tinjorum Heer.

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

Collections by others than members of the United States Geological Survey
[List compiled from paleobotanical literature]

Port Graham. Furubahlem, fide Heer:
Taxites olriki Heer.
Taxites microphyllus Heer.
Pinus sp. Heer.
Pinus sp. Heer.
Quercus langsdrufi (Brongniart) Heer.
Taxodium sp. Heer.
Taxodium distichum miocenum Heer [=T. dubium (Sternberg) Heer].
Taxodium tinjorum Heer.
Phragmites alaskana Heer.
Phragmites sp. Heer.
Poacites tenue-striatus Heer.
Poacites sp. Heer.
Carex servata Heer.
Populus balsamoles Goeppert.
Populus glandulifera Heer.
Populus laitior Alex. Braun.
Populus leucophylla Unger.
Populus zaddachi Heer?
Salix lavateri Heer.
Salix macrophylla Heer.
Salix sp. Heer.
Myrica banksiifolia Unger.
Juglans acuminata Alex. Braun.
Juglans nigella Heer.
Juglans pterocarpa Alex. Braun.
Juglans woodiana Heer.
Carpinus grandis Unger.
Corylus macquefii (Forbes) Heer.
Corylus macquefii macrophylla Heer.
Betula grandifolia Ettingshausen.
Betula priscia Ettingshausen.
Betula sp. Heer.
Alnus nostratum Unger [may = A. kefersteinii var. Heer].
Fagus antipodii Abich.
Fagus castaneaefolia Unger [= Castanea castaneaefolia (Unger) Knowlton].
Fagus feroniae Unger.
Fagus lancifolia Heer [= F. antipodii Abich].
Fagus sp. Heer.
Quercus alaskana Trelæse?
Quercus chamissoni Heer.
Quercus furuhjelmii Heer.
Quercus pandurata Heer [= Q. alaskana Trelæse?]?
Quercus pseudo-acastanea Goepert.
Ulmus plurinervia Unger.
Planera ungeri Ettingshausen.
Liquidambar europaeum Alex. Braun.
Spiraea andersonii Heer.
Spiraea sp. Heer.
Ilex insignis Heer.
Celastrus borealis Heer.
Celastrus sp.? Heer.
Acer graminensis Knowlton and Cockerell [= A. macropterum var. Heer (not A. macropterum Vissiani)].
Vitis heeriana Knowlton and Cockerell? [= V. crenata Heer].
Tilia alaskana Heer.
Trapa Dall.
Trapa borealis Heer.
Hedera auriculata Heer.
Vaccinium frersii Heer.
Vaccinium sp. Heer.
Diospyros alaskana Schimper [= D. lancifolia Lesquereux].
Diospyros stenocepala Heer.

Kachemak Bay, Kenai Peninsula. Furuhjelm, fide Heer and Elchwald:
Chondrites sp. Heer.
Chondrites heer Elchwald?

Ninilchik River, west shore of Cook Inlet. Furuhjelm:
Sequoia langsdorfi (Brongniart) Heer.
Taxodium dubium (Sternberg) Heer.
Taxodium sp. Heer.
Sparganium sp. Heer.
Myrica (Comptonia) vindobonensis (Ettingshausen) Heer.
Myrica sp. Heer.
Salix macophylla Heer [not S. macrophylla Reuss].
Salix varians Goepert.
Corylus macquarrii (Forbes) Heer.
Betula macophylla Goepert [not B. macrophylla Ettingshausen (= B. dubiosa Hollick, n. name)].
Betula priesca Ettingshausen.
Tilia sp. Heer.
Trapa borealis Heer.
Vaccinium sp. Heer.
Diospyros lancifolia Lesquéreux [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 Goepert:
Taxodium dubium (Sternberg) Heer.
Caulinia laevis (Goepert) Goepert.
Salix pilosula Goepert.
Salix wimmeriana Goepert.
Salix integra Goepert?
Alnus subsp. Nanthorst [= A. kefersteinii (Goepert) Unger].

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

Tschugas (Kenai) Peninsula, no locality. Grewingk, 1850:
Taxodium sp. Grewingk.
Alnus sp. Grewingk.

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

Cook Inlet, no locality. Newberry:
Sequoia spinosa Newberry.
Juglans nigella Heer.
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 Goepert).
Salix raana 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 grandisflora Newberry.
Ficus? alaskana Newberry.
Ficus dallii Cockerell [= F. membranacea Newberry].
Prunus variabilis Newberry.
Jugiana nigella Heer.

Cook Inlet, no locality. Dall, 1880, fide Lesquereux:
Quercus dallii Lesquereux.
Coronaria orbifera Heer.
Vaccinium hollicki Knowlton (= V. reticulatum Alex. Braun).

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

ALASKA PENINSULA REGION

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

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

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

3639. Cape Douglas:
Sequoia langsdorfi (Brongniart) Heer.
Myrica banksiaefolia curta Hollick, n. var.
3517. Kukak Bay:

Population congerminalian Hollick, n. sp.

Corylus evidens Hollick, n. sp.

Corylus sp.; stamineate aments.

Cupania comparabilis Hollick, n. sp.

3517. Kukak Bay:

P-21. King Salmon Lake:

Dryopteris meyeri (Heer) Hollick, n. comb.

Populus flexuosa Hollick, n. sp.

Myrica banksiaeolata curta Hollick, n. var.

Myrica (Dryandrodies) linnatum (Unger) Saporta.

1. Acispeciosa Heer.

P-23. Mountain 1 mile southwest of forks of Pumicestone Creek:

Dryopteris meyeri (Heer) Hollick, n. comb.

Populus arctica Heer.

Ulmus braunii Heer.

Praunus variabilis Newberry.

Zizyphus hyperboreus Heer.

Acer disputabilis Heer.

P-24. Mountain 1/2 mile east from head of north branch of Russell Creek:

Dryopteris meyeri (Heer) Hollick, n. comb.

Populus flexuosa Hollick, n. sp.

Myrica banksiaeolata curta Hollick, n. sp.

Myrica (Dryandrodies) linnatum (Unger) Saporta.

Myrica speciosa Heer.

Cinnamomum floides Hollick, n. sp.

Apelobopus discolor (Lesqueureux) Lesqueureux.

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 kfersteini (Goepert) Unger.

Ficus stantoni Hollick, n. sp.

Grewiopeis alaskana Hollick, n. sp.

Grewiopeis congerrninalis Hollick, n. sp.

Pterospermities auriculaceardatus Hollick, n. sp.

Pterospermities conjunctivus Hollick, n. sp.

Phyllites arctica Knowlton.

Viburnum exum Hollick, n. sp.

Dicotyledonous leaf (gen. and sp.?).

3522. Chignik Bay (Anchorage Bay):

Carpinus grandis Unger.

Piper verticabilis Hollick, n. sp.

Piper septentrcionalis Hollick, n. sp.

3523. Chignik Bay (Anchorage Bay):

Equisetum arcticum Heer.

Sequoia dietica Heer.

Populus richardsoni Heer.

Hicoria antiquior (Newberry) Knowlton.

Juglans pteroides Heer.

Pterospermities conjunctivus Hollick, n. sp.

Pterospermities imparilis Hollick, n. sp.

Fraxinus inordinata Hollick, n. sp.

Fraxinus juglandina Saporta.

Fraxinus? pseudobiqua Hollick, n. sp.

3524. Chignik Bay (Anchorage Bay):

Sequoia langsdorfi angustifolia Heer [= S. langsdorfi (Brongniart) Heer].

Taxodium crassum Hollick, n. sp.

Populus richardsoni Heer.

Viburnum nordenstamii Heer.

5177. Portage (Balboa) Bay:

Paliurus colombi Heer.

5178. Portage (Balboa) Bay:

Pteris oenogenes Heer?

Juglans egregia Lesqueureux.

Quercus arctoarbites Ettingshausen.

Acer arcticum Heer.

Nordenskioldia borealis Heer.

Populus arctica Heer.

5179. Portage (Balboa) Bay:

Aralia sp.?

530. Herendeen Bay:

Ginkgo adiantoides (Unger) Heer.

Poaiesis tenue-strictus Heer.

Carex servata Heer.

Salix minutu Knowlton.

Juglans townsendi Knowlton.

Rhus frigida Knowlton.

Zizyphus townsendi Knowlton.

Fraxinus herendeenensis Knowlton.

Phyllites arctica Knowlton.

5180. Herendeen Bay, east of Portage Valley:

Osmanthus dorocephkam Goepert.

Hausmannia utwoodii Hollick, n. sp.

Populus arctica Heer.

Comptonia cuspidata Lesqueureux.

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

Acer arcticum Heer.

5182. Herendeen Bay, west side, opposite Marble Point:

Salix grandiflora Weber.

Salix laeviter Alex. Braun.

Salix libbrei Lesqueureux?

Salix raana Heer.

Saix tenex Alex. Braun.

Salix sp.?, pistillate ament.

Populus zaddachi Heer?

5182. Herendeen Bay:

Populus zaddachi Heer?

5183. Herendeen Bay, west side, north of location 19:

Arundo pseudogoepperti Berry.

Piper convertabilis Hollick, n. sp.

Hedera maculata Heer.

5186. Between Herendeen Bay and Port Moller, shore east of Point Divide:

Sequoia langsdorfi (Brongniart) Heer.

Corylus americana fossils Newberry.

Betula brongniartii Ettingshausen.

Aralia delicata Hollick, n. sp.

Viburnum aquile Hollick, n. sp.

Viburnum duriusculum Hollick, n. sp.

Abutilon eakini Hollick, n. sp.

5298. Chignik River opposite Nun Point:

Sequoia langsdorfi (Brongniart) Heer.

Corylus americana fossils Newberry.

Betula brongniartii Ettingshausen.

Aralia delicata Hollick, n. sp.

Viburnum aquile Hollick, n. sp.

Viburnum duriusculum Hollick, n. sp.

Abutilon eakini Hollick, n. sp.
FOSSIL-PLANT LOCALITIES

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.
Phyllites arctica Knowlton.

Unga Island. Doroschin, 1847–52, fide Grewingk, 1850, Goeppert, 1861, and Heer, 1889; Dall, 1880, fide Lesquereux, 1889:
Neuropteris acutifolia, fide Grewingk (=N. acutifolia Brunoniart) and Osmunda doroschkiana Goeppert?.
Osmunda doroschkiana Goeppert.
Osmunda dubiosa Hollick, n. sp.?
Equisetum globulosum Lesquereux. Dall, fide Lesquereux (locality questioned).
Phylites pannonicus (Unger) Goeppert. Doroschin, fide Goeppert and Heer.
Sequoia langsdorfi (Bromniart) Heer. Doroschin, fide Goeppert.
Thuites (Chamaecypris) alaskensis Lesquereux.

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

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

Atka (Achka or Atta) Island; Andreanof Island; Korovin Bay. Doroschin, 1847–52, fide Goeppert:
Phylites sp. Goeppert.

LOWER YUKON-NORTH SOUND REGION

Uluak (="Ulukuk, a branch of Unalikikl) 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.

NORTHERN 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.

7283. 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?

7266. Lignite Creek:
Viburnum nordenskiöldi Heer.

POPLAR BUSH CREEK REGION

7269. Topanica Creek, Norton Sound region:
Populus obovata Hollick, n. sp.

7270. Red Cliffs Creek:
Populus angustifolia (Goeppert) Hollick, n. sp.

7271. Little Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7272. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7273. Red Cliffs Creek:
Populus angustifolia (Goeppert) Hollick, n. sp.

7274. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7275. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7276. Lignite Creek:
Populus angustifolia (Goeppert) Hollick, n. sp.

7277. Little Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7278. North Tanana River:
Populus obovata Hollick, n. sp.

7279. North Tanana River:
Populus obovata Hollick, n. sp.

7280. North Tanana River:
Populus obovata Hollick, n. sp.

7281. North Tanana River:
Populus obovata Hollick, n. sp.

7282. North Tanana River:
Populus obovata Hollick, n. sp.

7283. Conglomerate beds near center of sec. 10, T. 9 S., R. 6 W.:
Populus zaddachi Heer?

7284. Sec. 10, T. 9 S., R. 6 W.:
Populus zaddachi Heer?

7285. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7286. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7287. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7288. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7289. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7290. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7291. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7292. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7293. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7294. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7295. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7296. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7297. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7298. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

7299. North Tanana River:
Populus angustifolia (Goeppert) Hollick, n. sp.

8001. North Tanana River:
Populus obovata Hollick, n. sp.

8002. North Tanana River:
Populus obovata Hollick, n. sp.

8003. North Tanana River:
Populus obovata Hollick, n. sp.

8004. North Tanana River:
Populus obovata Hollick, n. sp.

8005. North Tanana River:
Populus obovata Hollick, n. sp.

8006. North Tanana River:
Populus obovata Hollick, n. sp.

8007. North Tanana River:
Populus obovata Hollick, n. sp.

8008. North Tanana River:
Populus obovata Hollick, n. sp.

8009. North Tanana River:
Populus obovata Hollick, n. sp.

8010. North Tanana River:
Populus obovata Hollick, n. sp.

8011. North Tanana River:
Populus obovata Hollick, n. sp.

8012. North Tanana River:
Populus obovata Hollick, n. sp.

8013. North Tanana River:
Populus obovata Hollick, n. sp.

8014. North Tanana River:
Populus obovata Hollick, n. sp.
7476. Fairbanks:
- Taxodium dubium normale Massalongo.
- Taxites olrki 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 Goepert.
- Crataegus cappsi Hollick, n. sp.
- Celastrus borealis Heer.
- Fraxinus yukanensis Hollick, n. sp.

7634. Coal Creek, near Jinx coal bed:
- Populus balsamoides Geopert.
- Juglas 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 langsdorfi (Brongniart) Heer.
- Sequoia brevifolia Heer.
- Populus hookeri Heer.
- Populus latior Alex. Braun.
- Quercus steenstrupianna Heer.
- Palaeanthus pringlei Hollick, n. sp.
- Semecarpus pringlei Hollick, n. sp.
- Equisetum arcticum Heer.

3331. 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 cogerinalis Hollick, n. sp.
- Pterospermites alternans Heer.
- Pterospermites spectabilis Heer.
- Viburnum whymperi Heer.
- Fraxinus yukanensis Hollick, n. sp.

**CENTRAL YUKON REGION**

3247. South bank just above Rampart:
- Thuites ehrensw²rdi Heer.
- Smilax reticulata Heer.
- Populus balsamoides Geopert.
- Populus glandulifera Heer.
- Corylus sp., aments.
- Quercus nervadensis Lesquereux.
- Artocarpus ordinarius Hollick, n. sp.
- Dryophyllum stanleyanum Dawson.
- Grewia orbiculata Hollick, n. sp.
- Grewia crenata (Unger) Heer.
- Diospyros brachysepala Alex. Braun.
- Nysodium 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 viabilis Hollick, n. sp.

6095. South bank, 1.5 miles above Rampart, 300 feet above
- 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 multiflora Hollick, n. sp.
- Cassia glenni Berry?
- Pithocolobium ceterum Hollick, n. sp.
- Paulinia 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 protolutes Berry?

4708. North bank, Drew's mine:
- Juglans acuminata latifolia (Alex. Braun) Heer.
- Crataegus yukanensis 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 (Goepert) 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 maccurlri 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:
- Poncites tenne-strictatus Heer, fide Eichwald.
- Ebenoxylon boreale Platen.
- Pityoxylon maccurlri (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.

Ceratopsicagna olivolli Hollick. Kupreanof Island.

Diöon inequale Hollick. Kupreanof Island.

Diöon praespinulosum Hollick. Kupreanof Island.

Taxites microphyllus Hollick. Port Graham.

Pityoixylon inaequale Felix. Dansåku.


Sequoia spinosa Newberry. Cook Inlet.

Thuiles (Chamaexycria) alaskensis Lesquereux. Unga Island.

Caulinia laevis (Goepert) Goepert. Ninilichik.

Poa caulescens stratus Heer. Port Graham, Herendeen Bay.

Carex servata Heer. Port Graham, Herendeen Bay.

Sulix pilosula Goepert. Ninilichik.

Sulix minutu Knowlton. Herendeen Bay.

Comptonia cuspidata Lesquereux. Unga Island. Herendeen Bay.

Comptonia praeornis Lesquereux. Unga Island. (?)


Corylus harrimani Knowlton. Kukak Bay.

Corylus palechil Knowlton. Kukak Bay.

Betula alaskana Lesquereux. Chignik Bay.


Alnus grandiflora Newberry. Cook Inlet.

Quercus alaskana Trelease. Port Graham, Matanuska River near Moose Creek.

Quercus chamissonii Heer. Port Graham.

Quercus furuhjelmi Heer. Port Graham, Kootznaahoo Inlet.


Ficus? dalli Cockerell. Cook Inlet.


Spiraea andersonii Heer. Port Graham.

Prunus variabilis Newberry?. Cook Inlet, Aitakchak 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.


Aesculus arctica Knowlton, Kukak Bay.

Ziziphus 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 flexuus Heer. Port Graham.

Ebenoxylon boreale Platen. Locality?

Fraxinus herendeeneensis Knowlton. Herendeen Bay.

Phyllites arctica Knowlton. Herendeen 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 98 Alaskan Tertiary species that are elements in the so-called Arctic Miocene flora:

- Pteris siksnensis Heer. Greenland.
- Osmunda doreoshikiana Goepert. Sakhalin.
- Pinus maclurii Heer. Banks Land, Greenland.
- Pityoxylon maclurii (Heer) Krauss. Banks Land.
- Sequoia distichica Heer. Svalbard.
- Taxodium tinaorum Heer. Svalbard, interior of Siberia.
- Populus arctica var. b Heer. Greenland.
- Populus latior Alex. Braun. Sakhalin.
- Populus hookeri Heer. Svalbard.
- Populus glandulifera Heer. Sakhalin.
- Populus balsamoides Goepert. Svalbard.
- Populus gaumini Fischer-Ooster. Greenland, Sakhalin.
- Populus mutabilis Heer. Greenland.
Salix varitana Goepert. Greenland (?), Svalbard, Sakhalin.
Salix macrophylla Heer. Svalbard.
Salix varia Alex. Braun. Greenland.
Myrica (Dryandroides) ligustrum (Unger) Saporta. Greenland, Svalbard.
Juglans stroziana Gaudin? Greenland.
Juglans variata Goeppert. Greenland.
Carpinus betula Ettingshausen. Grinnell Land, Greenland.
Quercus gronlandica Heer. Greenland, Svalbard.
Quercus pseudocastanea Goeppert. Greenland.
Betula brongniartii Ettingshausen. Grinnell Land, Greenland.
Populus richardsoni Heer. Canada, Greenland.
Phragmites alaskana (Brongniart) Heer. Greenland, Svalbard.
Grewia crenata (Unger) Heer. Svalbard.
Diospyros alaskana Schimper. Canada.
Diospyros aniceps Heer. Interior of Siberia.
Diospyros brachysepalae Alex. Braun. Greenland.

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 arctic 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 globosum Lesquereux.
*Ginkgo adiantoides (Unger) Heer.
Taxites olrikii Heer.
Sequoia langsdorfi (Brongniart) Heer.
Taxodium occidentale Newberry.
Glyptostrobus europaeus (Brongniart) Unger.
Praegmites alaskana Heer.
Populus richardsoni Heer.
*Populus speciosa Ward.
*Populus amblyrhyncha Ward.
*Populus genetrix Newberry.
Populus glandulifera Heer.
Salix larvatai Alex. Braun.
Juglans woodiana Heer.
Quercus platania Heer. Greenland, Svalbard.
Quercus pseudostanoea Goepert. Greenland.
Quercus steenstrupiana Heer. Greenland.
Ulmus brunnii Heer. Svalbard, Sakhalin.
Ulmus borealis Heer. Gronnland, Greenland.
Ulmus diptera Steenstrup. Iceland.
Ulmus pluriocenia Unger. Greenland, Sakhalin.
Magnolia ingefeldi Heer. Greenland.
Magnolia wormskjoldi Heer. Greenland.
Benzoin antiquum Heer. Greenland.
Daphnogene carit Heer. Greenland.
Liquidambar europaeum Alex. Braun. Greenland.
Prunus scotti Heer. Greenland.
Celastrus borealis Heer. Sakhalin.
Acer inaequale Heer? Svalbard.
Rhamnus brevifolius Alex. Braun. Greenland.
Rhamnus gaudini Heer. Greenland.
Rhamnus rossmaessleri Unger. Greenland.
Zizyphus hyperboreus Heer. Greenland.
Vitis alaskana Cockerell. Greenland.
Vitis olrikeri Heer. Greenland.
*Viburnum antiquum* (Newberry) Hollick.

*Viburnum newberryanum* Ward.

Viburnum nordenskioldii Heer.

Viburnum wyoming 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:

<table>
<thead>
<tr>
<th>Species</th>
<th>Wilcox</th>
<th>Lance</th>
<th>Fort Union</th>
<th>Paskapoo</th>
<th>Lance-Roan</th>
<th>Wyoming (Newberry)</th>
<th>Existing species</th>
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</thead>
<tbody>
<tr>
<td>Onoclea sensibilis Linnaeus</td>
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<td>Equisetum globosum Lew.</td>
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<td>Populus amblyrhynchos Ward</td>
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<tr>
<td>Populus genetrix Newberry</td>
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<td>Populus sectosa Ward</td>
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<tr>
<td>Hicoria antiqua (Newberry) Knowlton</td>
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<tr>
<td>Corylus americana fossilia</td>
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<td>Onoclea inaequalis Newberry</td>
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<td>Piatanus nobilis Newberry</td>
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<tr>
<td>Sapindus siliquastrum Newberry</td>
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<tr>
<td>Viburnum antiquum (Newberry)</td>
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<tr>
<td>Viburnum newberryanum Ward</td>
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</table>

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 written more than half a century ago and subsequently supported by published descriptions, discussion, and illustration of the following species of Tertiary age:

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Onoclea sensibilis fossils Newberry [op. cit., pp. 8-10, pl. 23, fig. 5; 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* fossils 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* fossils 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 hazel-nut" [C. rostrata Alton].

Alnus serrulata fossils 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 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 sub-tropical 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

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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 freshwater 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


GEOMETRY OF THE TERTIARY DEPOSITS OF ALASKA


SOUTHEASTERN ALASKA


COPPER RIVER REGION


COOK INLET AND SUSITNA REGION


SOUTHWESTEREN ALASKA


YUKON AND KUSKOKWIM BASINS


**THE TERTIARY FLORAS OF ALASKA**

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:

**Tokun formation:** Sandstones and shales with thin flaggy sandstones and scattered calcareous concretions; dominantly marine.

**Kushtaka formation:** Arkose with many coal beds and with some shale and sandstone, dominantly terrigenous.

**Stillwater formation:** Shale and sandstone; dominantly marine.

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 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.

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 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, 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 8,000 feet. The few

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44 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 Pavlov 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 Ninena 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 ver-
tical, 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:

<table>
<thead>
<tr>
<th>Foot</th>
<th>Conglomerates of lava cobbles with interbedded tuff and breccia, predominantly rhyolitic</th>
<th>1,000+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foot</td>
<td>Rhyolitic breccia and tuff</td>
<td>500±</td>
</tr>
<tr>
<td>Foot</td>
<td>Sandstone with intercalated conglomerate near top</td>
<td>1,200±</td>
</tr>
<tr>
<td>Foot</td>
<td>Basal conglomerate with intercalated sandstone</td>
<td>450± Unconformity</td>
</tr>
</tbody>
</table>

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, Etoin, 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 unformable 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 Suamex 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 4 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-Andreasfiski 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

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:

"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.

**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-geologische Bezeichnung über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 111, pl. 4 [VI], fig. 1, St. Petersburg, 1871.*

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

This well-defined alga was originally collected by Hjalmar Furubjelw at "Katchekmak" or "Katchesmak" (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 erraticio"—apparently drift or float material—and remarked: "Hinc specimen unicum determinationem speciei et formationis accuratum non permitterat." 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 tarnitzii* (Brongniart) Sternberg, 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 to the existing species *Fucus conicalatus* Linnaeus.

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*Eichwald, Geognosstisch-geologische Bezeichnung über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 111, pl. 4 [VI], fig. 1, St. Petersburg, 1871.*


*Pogge, S., Geognosstisch-geologische Bezeichnung über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 111, pl. 4 [VI], fig. 1, St. Petersburg, 1871.*

*Pogge, S., Geognosstisch-geologische Bezeichnung über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 111, pl. 4 [VI], fig. 1, St. Petersburg, 1871.*
Locality: Northeasternmost tip of Whitney Island in Cleveland Passage, southeastern Alaska (original no. K-21); collected by A. F. Buddington in 1922 (lot 7598). Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region.

Phylum PTERIDOPHYTA
Class FILICINAE
Order FILICALES
Family POLYPODIACEAE
Genus ONOCLEA Linnaeus
Onoclea sensibilis Linnaeus

Plate 2, figures 2-4


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


Woodwardites arcticus Heer (?), Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 88, pl. 1, figs. 16, 16b; pl. 45, fig. 2c; pl. 48, fig. 9, 1888.


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


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 22 in the upper Missouri River region, subsequently determined to be of Fort Union age, Newberry 23 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, oblate pinnules, to a pinnate form with wave-margined pinnae and broadly pinnate rachis—it plainly includes all the characters of the fossils before us, and I therefore find it impossible to separate them.

Subsequently 24 he also incidentally mentions having obtained specimens from Whatcom Lake, near Bellingham Bay, Washington; and specimens from southwestern Canada were identified by Dawson, 25 who gave "Porcupine Creek (longitude 106°), near the international boundary" as the locality where they were found.

In the meantime Heer 26 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 tertären Farn ähneln auch der Filicites hebridicus Forb. einigermassen unserer Pflanze, allein die Maschen sind anders gebildet." Subsequently 27 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 Grönländ nur kleine Fragmente dieses Farns zugekommen, die ich als Woodwardites arcticus beschrieben habe. Der Rand der blattresten erscheint 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, 28 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 Fougre de Mull, Filicites hebridicus, est effectivement identique avec

26 Heer, Oswald, Miocene Flora von Nordgrönland: Flora fossilis arctica, vol. 1, p. 88, pl. 1, figs. 16, 16b; pl. 45, fig. 2c; pl. 48, fig. 9, 1886; Contributions to the fossil flora of North Greenland: Iden, vol. 2, no. 4, p. 462, pl. 40, fig. 6, 1889.
27 Heer, Oswald, Die fossile Flora Grönlands, pt. 2; Flora fossilis arctica, vol. 7, pp. 260, pl. 70, fig. 6, 1883.
le Woodwardites arcticus de Heer; it 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 Cool Camp, 7 miles above mouth, talus slope at base of cliff, Matanuska-Cook Inlet region; collected by F. J. Katz in 1910 (lot 8986) (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 pinnales, 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 Svalbard, 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). Summit of mountain 1 mile southwest of forks of Pumicestone Creek, 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 atwoodii** Hollick, n. sp.

*Plate 6, figures 6-9*

Frons 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-triapalmate, 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," Protothrips Andrae, and other genera now relegated to synonymy, about 20 species have been described; but these are all of Mesozoic age, extending from Upper Triassic to Lower Cretaceous, and our species is the first one recorded from any horizon of more recent age. When first examined its striking similarity to *Hausmannia forsklilernerii* Bartholin, 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," from the Knoxville formation of California, and *Protothrips fischeri* Knowlton," from the Kootenai formation of Montana—both of Lower Cretaceous age; although Newberry described certain plant remains from the Upper Cretaceous Raritan formation of New Jersey under the name *Hausmannia rigid*, which, however, has no apparent close relationship with the genus, as was discussed by Berry, who renamed the species *Newberryana rigid*, giving it to a new generic name and remarking: "What its real nature is I am at a loss to say. It is probably a fern."

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


6 Bartholin, C. T., Nogle i den bornholmske Jurafornmation fore-kommende Planteforstænde, p. 1 and 2: Bot. Tidsskr., vol. 18, p. 26, pl. 11, figs. 4–6; pl. 12, figs. 1, 2, 1892.


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, 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, in which two new subspecies or varieties (*Hausmannia forchhammeri dentata* and *H. forchhammeri lacinuata*) and one new species (*Hausmannia (Protorhipis) acutidens*) 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, 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. atwoodii*, *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. Seward had previously found 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, 1883.

*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, 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 from the Eocene (Paskapoo) of British America, and *Asplenium tenerum Lesquerex* (not *A. tenerum* Forster, 1788), from the Eocene (Fort Union) of North Dakota, under the new generic and specific combination *Dennstaedtia americana*. Subsequently, 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).

Knowlton, F. H., Descriptions of fossil plants from the Mesozoic and Cainozoic of North America, I: Smithsonian Misc. Coll., vol. 82, pl. 4, p. 1844, pp. 493-495, pl. 32, fig. 4; pl. 34, figs. 5-6, 1897.

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. 399, pl. 10, figs. 1, 2, 2a, Brit. N. Am. Boundary Comm., 1875; Roy. Soc. Canada Trans., vol. 4, sec. 4, p. 21, pl. 1, figs. 1, 1a, 1b, 1888 [1877].


THE TERTIARY FLORAS OF ALASKA

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 chameled 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 pinnae 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 pinnatifaction 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 asplenoïd 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, \(^{10}\) under the name Lastrea (Goniopteris) knightiana, but was subsequently figured and identified as Lastrea (Goniopteris) fischeri Heer, \(^{11}\) 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 \(^{2}\) and by Knowlton \(^{3}\) 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, \(^{4}\) 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 Polypondites thelypteroides Brongniart, \(^{5a}\) as described and figured by Watelet \(^{6}\) from the Eocene of France, in which the shape of the pinnae and sori 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). Yakatat Bay, west shore, small creek at Dalton’s coal outcrop (original no. 141); collected by R. S. Carr in 1906 (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 1906 (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 pinnales confluent at their bases; divisions or pinnales entire, opposite, opposite.


\(^{11}\) Heer, Gaspard. Flora terrestre Helveticae, vol. 1, p. 34, pl. 9, figs. 3a-3e. Winterthur, 1855.


\(^{4}\) 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.


\(^{6}\) Watelet, Adolphe. Description des plantes fossiles du bassin de Paris, p. 48, pl. 13, fig. 1, 1886.
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; nervuration pinnate, once-forked.

This fragment apparently represents a large fern with inequilateral pinnae as are characteristic of several species in the genus *Pteris*. It has some resemblance to *Pteris inaequalis* Heer,\(^8\) from the Miocene of Switzerland, but is much larger and more conspicuously inequilateral. It may also be compared with *Pteris grönlandica* Heer,\(^8\) 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 3246).

### Pteris oeningensis Unger?

**Plate 7, 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 \(^8\) 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 \(^8\) of specimens from the Tertiary of Switzerland.

Our specimen is also suggestive of *Pteris inaequalis* Heer,\(^8\) 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 \(^8\) in his description of the pinnae of *Pteris oeningensis*, in regard to which he remarks that "sie ähneln sehr denen der Pt. inaequalis Heer, die fiederschen 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 5173).

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\(^8\) Heer, Oswald. Flora fossilia arctica, vol. 7, p. 49, pl. 70, figs. 1–3; pl. 107, fig. 1, 1885.

\(^8\) Heer, Oswald. Flora fossilia arctica, vol. 1, p. 87, pl. 45, figs. 8a, 8b, 1868:

"Nachträge zur fossilen Flora Grönlands; Idenem, vol. 6, pt. 2, p. 9, pl. 3, figs. 1–4, 8b, 1860.

\(^8\) Heer, Oswald. Flora tertiaria Helvetiae, vol. 1, p. 39, pl. 12, ffigs. 5a–5l, Winterthur, 1855; vol. 3, p. 154, pl. 145, figs. 5a, 6b, 6c, 1859.


\(^8\) Heer, Oswald. Flora fossilia arctica, vol. 6, p. 9, 1880.

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### Pteris pseudopennaeformis Lesquereux

**Plate 75, figure 1b**


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 \(^2\) and Berry \(^4\) from the Eocene of Louisiana.

Whether or not the species is distinct from *Pteris pennaeformis* Heer \(^6\) of the Old World has been discussed by nearly every author who has compared them. Lesquereux \(^6\) 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 106, figure 5a**

*Pteris sitkensis* Heer, Flora fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 21, pl. 1, fig. 7a, 1869.

Eichwald, Geognostisch-palaeontologische Bemerkungen neber die Halbinsel Mangtschulak und die Alteunischen Inseln, p. 112, St. Petersburg, 1871.


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

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\(^8\) Hollick, Arthur. A report on a collection of fossil plants from northwestern Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 270, pl. 32, fig. 1, 1890.

\(^4\) Berry, E. W. The lower Eocene flora of southeastern North America: U. S. Geol. Survey Prof. Pap. 51, p. 163, pl. 9, fig. 6, 1910.

\(^6\) Heer, Oswald. Flora tertiaria Helvetiae, vol. 1, p. 38, pl. 12, figs. 1a–1d, Winterthur, 1855.

places and by careful examination. Where the margins are not clearly defined it is difficult to distinguish between this species and *Pteris grönlandica* Heer 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 and in the Mackenzie River region of Canada.

Locality: Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7585).

**Family OSMUNDACEAE**

**Genus OSMUNDA Linnaeus**

*Osmunda doroschkiana* Goeppert

Plate 2, figure 1a; plate 100, figure 71


*Osmunda doroschkiana* Goeppert. Eichwald, Geognostisch-palaeontologische Bemerkungen über 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 as *Neuropteris acutiloba* 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 Saharooschen Bucht" (= Zachareffskai 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, from the Miocene of Italy, which appears to be specifically identical with it; and Heer 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 by Lesquereux, 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.

Localties: Head of Herendeen Bay, east of Portage Valley, Alaska Peninsula (original no. 10); collected by W. W. Atwood in 1906 (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. 106, 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 mid-veins subdentaling 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.

Localties: 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


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 collected by W. H. Dall at Coal Harbor, Unga Island, and is in fact identical with the specimen referred to *Osmunda doroschkiana* by Heer in 1861.

**Genus HERENTDELITES Heer**

*Herendelites* sp. Heer


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, forked and more or less acutely reticulated above.

It is with some hesitation that these specimens are referred to the genus Anthrophyopsis, originally so named by Nathorst in order to indicate its supposed relationship to the living fern genus Antrophyum but subsequently transferred by him to the fossil cycadean genus Otenis, 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 Otenis, 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 Casina eocenica Berry, 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. 18a); collected by E. M. Kindle in 1905 (lot 3632) (pl. 6, figs. 1, 2). South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III) collected by W. A. Atwood in 1907 (lot 3692) (pl. 6, figs. 3–5).

1 Anthrophyopsis Nathorst, Floran vid Bjuf, pt. 1: Sveriges geol. undersökning, ser. C, no. 27, p. 43, Stockholm, 1878. Type, A. nitensonii, pl. 7, fig. 5; pl. 8, fig. 8; Floran vid Hoganas och Holstingborg: Idem, no. 29, p. 19, pl. 1, fig. 10; pl. 2, fig. 1, 1875; Floran vid Bjuf, pt. 2: Idem, no. 33, p. 28, pl. 11, figs. 5, 3a, 7, 1879.

2 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.


4.2

by of Switzerland; E. ier,\textit{ll} 16,17

inowlt~2, from the Eocene of Wyoming; E. haguei Knowlton,\textit{18} E. canaliculatum Knowlton,\textit{18} and E. deciduum Knowlton,\textit{19} from the Miocene of the Yellowstone National Park; and E. florissantense Cockrell,\textit{20} from the Miocene of Colorado, which the author states is related to \textit{E. canaliculatum}. In his discussion of \textit{Equisetum haguei} Knowlton remarked that “among living species this seems to approach closely to \textit{E. limosum} L.; more closely, in fact, than does the specimen referred to \textit{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.

Localities: American Creek, 100 yards below crossing of Eaggie-Valdez trail, upper Yukon River region (original no. 2 A0 40); collected by A. J. Collier in 1902 (lot 2066) (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 King River and Lakes 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, Chigmit Bay, Alaska Peninsula, talus slopes on mountain about 1 mile southeast of Pacific Packing & Navigation Co.’s cannery (original no. 901); collected by T. W. Stone and R. W. Stone in 1904 (lot 5323) (pl. 5, 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. 8, figs. 8-10).

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\textit{Equisetum globulosum} Lesquereux

\textit{Equisetum globulosum} Lesquereux, U. S. Nat. Mus. Proc., vol. 5, p. 444, pl. 6, figs. 1, 2, 1882\textit{[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\textit{[2]1} however, gives Unga Island as Dall’s locality.

Fragmentary specimens from Kuikak Bay, collected by DeAlton Saunders in 1899, were identified but not figured by Knowlton\textit{[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\textit{[23]} from the Fort Union formation of North Dakota; and specimens described and figured by Newberry\textit{[24]} as \textit{“Equisetum sp.”}, probably also from the same formation and locality, are undoubtedly specifically identical with \textit{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 \textit{Equisetum arcticum} Heer, the species last described.

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\textit{Phylum SPERMATOPHYTA}

\textit{Class GYMNOSPERMAE}

\textit{Order CYCADALES}

\textit{Family CYCADACEAE}

\textit{Genus CERATOZAMIA} Brongnaiart

\textit{Ceratozamia wrightii} Hollick

Plate 12, figure 6


This specimen is the only fossil representative of the genus thus far described from the New World, but a Tertiary (Miocene) species from Switzerland (\textit{Ceratozamia hofmanni} Eitthhausen),\textit{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 (\textit{Ceratozamites vicetinus} Meschinielli),\textit{26} was described and figured in 1889. The relationship of each


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 DIOON Miguel, 1848 (=DION Lindley, 1843)

Dioon inopinus Hollick

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


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 Dioon thus far recorded from any American locality; although several species were described under the genus Dioonites, from Mesozoic strata, among which may be mentioned Dioonites borealis Dawson, from the Cretaceous of the Northwest Territory, which we may regard as an ancestral relative of the two species of Dioon now under consideration, from the nearby coastal region of Alaska.

It is also of interest to note, as was discussed in connection with the genus Ceratozamia, that the last representatives of the genus Dioon 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 Dioon, 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. 7); collected by W. W. Atwood in 1907 (lot 4389).

Dioon praespinulosum Hollick

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


This species is closely similar in its general superficial appearance to the existing Mexican species Dioon 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 Dioon inopinus Hollick, the species last described, and the leaflets more crowded. The two species occur together in the same collection.

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7365) (pl. 110, a).

Order GINKGOALES

Class GINKGOACEAE

Genus GINKGO Linnaeus

Ginkgo adiantoides (Unger) Heer

Plate 117, figures 1, 2


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,25 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,26 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 3005).

Order CONIFERALES
Family TAXACEAE
Genus TAXITES Brongniart

Taxis olivri Heer

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

Taxis olivri Heer, Naturf. Gesell. Zurich Vierteljahrschr., vol. 11, p. 275, 1896; Miocene Flora von Nordgrönland:

Flora fossilis arctica, vol. 1, p. 95, pl. 1, figs. 21–23, 24c; pl. 45, figs. 1a, b, c, 1888; Flora fossilis alaskana: Idem, vol. 2, no. 2, p. 23, pl. 1, fig. 8, pl. 2, fig. 5b, 1889.

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.27

A fine specimen was described and figured by Dawson 22 from the Eocene of Canada, which may be compared, especially, with our figure 8 on plate 16. Lesquereux 25 referred to the species, provisionally, a narrow-leaved specimen from the Miocene of California; and Knowlton 24 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.

Locality: Fairbanks district, Tanana region (original no. 21), 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 Chickaalon 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 Galakon Glacier, Yakutat-Copper River region (original no. 1048); collected by W. C. Mendenhall in 1902 (lot 3021) (pl. 48, fig. 4b).

Taxisites microphyllus Heer


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 coll.
PINACEAE

Genus PINUS Linnaeus

Pinus macrocarpa Heer


Pinus (Abies) macrocarpa Heer, Flora fossilia arctica, vol. 1, p. 134, pl. 20, figs. 16-18 (cones); pl. 35, fig. 1, pl. 36, figs. 1-5 (wood), 1889.


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 macrocarpa.”

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

Pinus sp. Heer


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


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 protolaroides Goeppert, from the Tertiary of Europe.

Pinites sp. Goeppert


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, Atka Island, one of the Andreanof group of the Aleutian Islands.

Pinites sp. Goeppert


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


This species is based upon a specimen of fossil wood from “the talus of a basalt mountain south of Danaaku [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 macrocarpa (Heer) Kraus


A specimen of this species was described by Paul Platen under the chapter heading "Holzer 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 *Picea macrocarpa*, 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


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 13, figure 8; plate 78, figure 6b


This species is exceedingly difficult to differentiate satisfactorily from certain of the short-leaved forms of *Sequoia langsdorffii*, such as are depicted in figures 1-6 on plate 9; and Heer 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. langsdorffii*, 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 from the Tertiary of the Baltic provinces of Germany, as well as from the Arctic regions; by Caspari from the Tertiary amber of East Prussia; by Lesquereux from the Upper Cretaceous (Montana formation) of Wyoming; and by Knowlton 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. langsdorffii*, but finally concluded that "it appears best to keep them separate." Subsequently, 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 he definitely established the new species and added to it another specimen, from the Upper Cretaceous (Vermejo formation) of Colorado, with the following remarks:

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. langsdorffii*. * * * 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.

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* Heer, Oswald, op. cit., vol. 1, p. 93.
* Heer, Oswald, Miocene, balthicae Flora, p. 21, pl. 3, figs. 10, 10b; pl. 9, fig. 5c, 1869.
* Caspari, Robert, K. preuss. geol. Landesanstalt Abh., neue Folge, no. 4, p. 126, pl. 25, figs. 112-112f, 1867.
Whether or not this separation into two distinct species is justified must remain largely a matter of individual opinion. In any event, however, the geological 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.

Locality: Bryant Creek, upper Yukon River region (original no. 3AP 350); collected by L. M. Prindle in 1908 (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 Spitzbergen: Flora fossils 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 langsdorfi 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 varied forms of Sequoia langsdorfi.

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


In Knowlton's descriptions of fossil plants collected by De Alton Saunders at Kukak Bay, Alaska Peninsula, in 1889, 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 langsdorfi, 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 langsdorfi (Bromniart) 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, 8; plate 32, figure 1b; plate 33, figure 1c; plate 36, figure 2b; plate 36b, figure 2; plate 110 b

Sequoia langsdorfi (Bromniart) Heer, Flora tertiai Helvetiae, vol. 1, p. 54, pl. 20, figs. 2a-2c; pl. 21, figs. 4a-4g, 1855; Flora fossils alaskana: Flora fossils arctica, vol. 2, no. 2, p. 23, pl. 1, figs. 10, 10b, 1869.


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 Sufficiently certain specimens are hardly to be distinguished from specimens of Tazodium tina

jorum Heer and T. dubium (Sternberg) Heer.

The difficulty of differentiating the species was recognized by Heer50 in his discussion of Sequoia langsdorfi, where he remarks that "die beblätterten Zweige sehen dem Tazodium dubium tausend ähnlich und können leicht damit verwechselt werden."

Comparison should also be made with Tazites ros

thorni Unger,51 from the Tertiary of Europe. Unger notes the close similarity to "Tazities langsdorfi."

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 Tazodium.

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. E., op. cit., p. 202 (west shore of Cook Inlet, "Landzunge Taktisches oder Oojanago" [locality not identified]); p. 203 (Unga Island, west shore of "Saharosenen Bucht" [Zachareff Island on Zachary Hill]).

45 Heer, Oswald, op. cit. (Flora fossils alaskana), p. 23 (east shore of Cook Inlet, "Sinus Anglorum" [English Bay or Port Graham] and Ninilichik; "Istua Kuku" [Kuku Island], "Archipelagus Indonorum" [Alexander Archipelago]).

46 Knowlton, F. H., op. cit. (U. S. Nat. Mus. Proc.), p. 218 (Heren


47 Heer, Oswald, Beitrage zur fossilen Flora Spitzbergen: Flora fossils 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; p. 13, figs. 1-8, 8.

49 Idem, p. 60, pl. 12, figs. 5a, 5a; pl. 13, fig. 7.


51 Unger, Franz, Chloris protogena, 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). Kootzahoo 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 4850) (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 Herring Bay and Port Moller, Alaska Peninsula (original no. 22); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5180) (pl. 12, fig. 2). West side of Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 902); 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. 3AP550); 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 1906 (lot 3298) (pl. 35, 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). Ninilichik, Matanuska-Cook Inlet region. West shore of Cook Inlet, Matanuska-Cook Inlet region. Keku Island, southeastern Unalaska, Alaska Peninsula region.

Sequoia spinosa Newberry

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.  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).

Genus TAXODIUM L. C. Richard

TAXODIUM crassum Hollick, n. sp.

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 spines.

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  and referred to Podocarpus elegans (De la Harpe); 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 (Stenbborg) Heer

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


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Taxodium distichum moicenum 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 fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 21, pl. 1, fig. 6; pl. 3, fig. 11c; pl. 4, figs. 5b, c, 1869.


Newberry, U. S. Geol. Survey Mon. 55, 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 moicenum 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 moicenum 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.

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 Takatsche oder Osipnago" [locality not identified], Alaska Peninsula; "nähe der Katmäschon" [near Mount Katmai?], Alaska Peninsula; southwest coast of Nakhalilek 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 Sephephagen mine and De Grof tunnel, Kootznaahoo Inlet, Alaska Peninsula; 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 langsdorffii (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. 10, fig. 5). Port Camden Bay, Kuitan Island, southeastern Alaska (original no. 10b); collected by E. M. Kindle in 1905 (lot 3651) (pl. 51, fig. 5a). Cook Inlet, no definite locality, Matanuska-Cook Inlet region. Kuit 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 stratigrafica 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: Kootznaahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).


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 Sini-gaglia, 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 as Taxodium distichum mioceneum, and others from Greenland described and figured by the same author, 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 10, figure 4; plate 13, figures 2, 3, 4c, 5, 6; plate 18, figure 5b


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 heretofore figured except by Newberry, although it is recorded by Knowlton from the Lance formation at localities in North Dakota, South Dakota, Montana, and Wyoming, and by Penhallow from Tertiary localities in British Columbia.

Attention should be called, however, to a certain figure of Taxites olrikHeer65 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 olrik.

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 5885) (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. 95, 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


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 langsdorffii (Bronniiart) 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 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

References:

62 Eichwald, Geognostisch-palaeontologische Bemerkungen über die Halbinsel Mangischlak und die Aleutischen Inseln, p. 119, pl. 4 [VI], fig. 4, St. Petersburg, 1871.
65 Heer, Oswald, Nachträge zur Miocene Flora Grünlands: Flora fossilis arctica, vol. 3, no. 1, p. 10, 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 zur fossilen Flora Sibirien und des Amurlands—IV, Tertiäre Pflanzen vom Teichlimyfelsen an der Lena: Idem, vol. 5, no. 2, pl. 33, pl. 8, figs. 30a, 38, 1878.
Ninilschick, [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 mioceum 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 langsdorfi, 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, Kuk Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3851) (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 4381) (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, Matanusca-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 3305) (pl. 13, fig. 5). Cook Inlet, west shore, half a mile south of Old Tyonek, Matanuska-Cook Inlet region (original no. 1); collected by C. A. Weaver in 1906 (lot 4130) (pl. 13, fig. 6).

Taxodium sp. Grewingk


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


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: "in ramulis nonnullis foliis sunt valde approximata, in alis in eodem lapide (tab. 1, fig. 8) distantia."
differentiating certain of the forms from species in other genera. The leafy twigs shown in figures 1, 2, 3, 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 as Taxodium distichum micoenum Heer (= T. dubium (Sternberg) Heer), and if Newberry's identification is correct then we must relegate to that species the other genera. The leafy twigs shown in figures 13, 14, and 16, plate 18, are very suggestive of 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 2, 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 détachés, 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, 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, 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:


"Nenilutschik" [Ninilichik], east shore of Cook Inlet. Idem, pl. 3, figs. 10, 10b, 11a. b. Collected by Hjalmar Furuhjelm in 1896.


Localities: Eeka 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, 4 miles above mouth of Chicken River, Matanuska-Cook Inlet region; collected by G. A. Parks in 1911 (lot 5209) (pl. 16, fig. 8b). 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 4391) (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 Edlricher

Widdringtonia sp. Heer


The specimen referred to this genus by Heer was collected by Hjalmar Furuhjelm on "Koku Island," southeastern Alaska. The genus was not subsequently mentioned by Heer in his Flora fossilia alaskana, but it is possible that a specimen there referred to Glyptostrobus europaeus and credited to Kuki [Kuu] Island may represent what was originally identified as a species of Widdringtonia, similar to W. helvetica Heer. Certain specimens of the two...
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, from the Tertiary of Europe, and to note that Unger discussed Taxodium europaeum Brongniart (=Glyptostrobus europaeus (Brongniart) Heer and G. ungeri Heer) in that connection.

Genus THUITES Sternberg
Thuites ehrenswardi Heer

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 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?) ehrenswardi; 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 ehrenswardi and which may not be ignored in making comparisons is Biota borealis Heer, from the Tertiary of Greenland; and it is significant that Heer originally identified this species as Thujopsis europaeus Saporta.

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 cannot be doubted.

Thuites (Chamaecyparis) alaskensis Lesquereux

Thuites (Chamaecyparis) alaskensis Lesquereux, U. S. Nat. Mus. Proc., vol. 3, p. 443, pl. 6, figs. 7-9, 1882 [1881].

Locality: Coal Harbor, Unga Island, Alaska Peninsula; collected by W. H. Dall in 1880 (U. S. Nat. Mus. no. 1376).

Coniferous wood

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


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 and he probably decided it to be erroneous and referred the specimen to some other monocotyledonous genus, without reference to the original identification.

Order NAJADALES

Family NAJADACEAE

Genus CAULINIA Wildenow

Caulinia laevis (Goeppeett) Goeppeett


Caulinites laevis Goeppeett, Palaeontographica, vol. 2, p. 283 [77], pl. 33 [1], fig. 1, 1862.

The Alaskan specimen described by Goeppeett in 1861 under the above name was collected by Lt. Peter Doroschin at Ninilchik, on the west side of Kenai

Peninsula in the Matanuska-Cook Inlet region. Goeppert apparently described it as a new species, under the genus Caulinia, although he had previously, in 1892, described similar fossil plant remains from the Miocene of North Germany under the name CauZinites, 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 CauZinites Brongniart 64 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 CauZinites laevis in 1892, but later he was apparently in doubt in regard to it, and in his discussion of CauZinites laevis in 1896 he compared the Alaskan and European specimens and said "Gehört vielleicht zu Phragmites oenigenesis Heer," 65 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 CauZinites, 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 Naiadaceae.

Order ALISMALES

Family ALISMAECE

Genus SAGITTARIA Linnæus

Sagittaria pulchella Heer


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


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 66 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 (GRAMINÆAS)

Family POACEÆ

Genus ARUNDO Linnæus

Arundo pseudogoepperti Berry?

Plate 10, figures 3-8; plate 20, figures 1-8; plate 22, figure 4

Arundo pseudogoepperti Berry, U. S. Geol. Survey Prof. Paper 84, p. 124, pl. 24, fig. 7, 1894.

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, 67 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 68 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-

65 Heer, Oswald, Flora territoria Helvetiae, vol. 1, p. 64, pl. 22, figs. 5a-5c; pl. 24, figs. 1-100; pl. 27, figs. 2b, 2d; pl. 29, fig. 8a, Winterthur, 1855.
67 Heer, Oswald, Flora territoria Helvetiae, vol. 1, p. 62, pl. 22, figs. 3a, 3b; pl. 23, figs. 1-11, Winterthur, 1855. — CauZinites goepperti Münster, Georg. Beiträge zur Petrefaktenkunde, no. 5, p. 109, pl. 3, figs. 1-5; pl. 4, figs. 1-3, Bayreuth, 1842.
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; 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 coarser 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, Cypelites, 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, and Arundo reperta Lesquereux 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, from the Eocene of France, and with similar remains of Arundo goepperti as depicted by Heer; and incidentally it is of interest to note that the type of this species, as recognized by Heer, is Caulinites goepperti Münster, 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 to Phragmites oeningensis Alex. Braun, and to others from the Miocene of Germany, so referred by Ludwig, and to a specimen of similar character from the Upper Cretaceous of Colorado, referred by Lesquereux to the same species.

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-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 3897) (pl. 19, figs. 3-8; pl. 20, figs. 2-8). West side of Heren-Geen 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 3582) (pl. 22, fig. 4).

Genus PHRAGMITES Triana
Phragmites alaskana Heer

Platte 109, figure 12


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, 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. oeningensis proxima et forte nonnisi varias." 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 and by Ward 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, Cypelites, 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: Kenai Peninsula, Port Graham, Matanuska-Cook Inlet region.


Phragmites sp. Heer


This generic determination probably refers to the same specimen to which Heer subsequently gave the name *Phragmites alaskaana*. In each instance the collector and locality are identical. (See p. 55.)

Genus POACITES Brongniart

*Poacites* tenue-striatus Heer


Eichwald, Geognostisch-palaeontologische Bemerkungen über die Halkinäel Mangischlak und die Altenischen Inseln, p. 114, pl. 4 [vii], fig. 7, St. Petersburg, 1871.


The specimen described and figured by Heer was collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region. 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


This generic reference, based on a specimen collected and figured by Heer was not subsequently mentioned by Heer in his *Flora fossilis.*

Eichwald did not give any exact locality for this specimen. Knowlton, idem, 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, was not subsequently mentioned by Heer in his *Flora fossilis.*


The original specimen upon which the species was based 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


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 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 *Carex 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)

*Flabellaria* florissanti Lesquereux

Plate 21


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 or to *Sabal inquienda* Knowlton.

The generic name *Flabellaria* Sternberg, 1822, is an amended name for *Flabellaria Cavalliales, 1790, a modern monotypic African genus of the Malphigiales (see Monadelphiea classis dissertationes marrth, ex typographia regia, 1790, no. 9, Novum dissertatio botanica, De Bornieria, Triplera, Tetrapteria, Molina et Flabellaria, p. 430), 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.

ton. 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 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, 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. It may be remarked, however, that the status of F. johnstrupi as a fossil plant has been questioned, and Potonié, under the chapter heading "Vermeintliche pflanzliche Fossilien" remarked:

Die von Wasser und Winderzeugten Weitereinrichen [ripple marks], * * * sind öfter als Pflanzenabdrücke untergebracht worden. Die von Heer (Fl. foss. arct., VII, 1883, Taf. 104-106) abgebildeten als Flabellaria johnstrupi beschrieben Gebilde * * * scheinen ebenfalls 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, Cocconthirone, and Serenoa occur in Florida; one species, Sabal mexicana, extends into southern Texas; and one, Washingtonia filamentos, 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 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, closely spaced, about a third of the distance from the outer margin to the base of the leaf; rays apparently about 50, 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 internal major 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, 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 and Flabellaria eocenica Lesquereux,


*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. 79, pl. 104, figs. 1, 3; pl. 106, fig. 1 (F. johnstrupi).


10Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 69, pl. 68, figs. 5-7, 1883.


from North America, and F. raphiofolia 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 7683) (pls. 111, 112).

Order LILIACEAE

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 1906 (lot 2427).

Subclass DICOTYLEDONAE

Division CHORIPETALAE

Order PIPERALES

Family PIPERACEAE

Genus PIPER Linnaeus

Piper septentrionalis Hollick, n. sp.

Plate 135, 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, acrodrome, 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 acrodrome.

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 heterophyll 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. eurupaeum Engelhardt, from North Germany; P. guineense Schumann, from Africa; P. heeric 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. guinecostatus 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

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\(^ {15}\) Ettingshausen, Constantin von. Die Eocene Flora des Monte Pro- minae; K. Akad. Wiss. [Wien], Math-naturwiss. Cl., Denkschr., vol. 8, p. 28 (12), pl. 3, fig. 4; pl. 14, fig. 1, 1866.

\(^ {16}\) Rossmaessler, E. A. Beiträge zur Versteinerungskunde, no. 1, p. 26, pl. 11, fig. 49, Dresden and Leipzig, 1840.


\(^ {19}\) Berry, E. W., Tertiary fossil plants from the Dominican Republic: U. S. Nat. Mus. Proc., vol. 59, p. 171, pl. 22, fig. 1, 1921.

\(^ {20}\) Ibid., p. 172, pl. 22, fig. 2.

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. 340622) (pl. 113, fig. 1). T. E. O'Brien coal claim, three-fourths mile south of Matanuska River, 14 miles above mouth of Chicka-loom 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 5896) (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 heterophyll 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 Heenleem Bay, Alaska Peninsula, north of location 19 (original no. 20); collected by W. W. Atwood and H. M. Eskin in 1908 (lot 5185) (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 oeningeis* Alex. Braun, as depicted by Heer 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. 5); collected by W. W. Atwood in 1907 (lot 4380) (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

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 gracilis* Heer; 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 Vierteljahressch., vol. 11, p. 275, 1866; Flora fossilia 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. 157, pl. 21, figs. 14a, 15a; p. 156, pl. 90, fig. 8a?, 1885.


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. Heer26 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 suborbiculate base and crenate margin, is comparable with Heer's figure 6, plate 5, and, as far as the suborbiculate 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 fossilia arctica, vol. 2, no. 3, p. 53, 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 suborbiculate 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. maccartii* Heer,27 rather than a...
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, 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, 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) Cocke- rell). It is commonly regarded as a typical Eocene species; but Kryštáfovič 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 in identifying all of the fossil flora of Sakhalin as Tertiary, despite the presence of Nilsonia, partly because a leaf identified as Populus arctica was found in the same piece of matrix with the Nilsonia. Kryštáfovič 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. 998); 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). Esku 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 Pumice 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 butt 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 Nordgrönlund:
Flora fossilaria arctica, vol. 1, p. 101, pl. 5, figs. 1a, 2b, 3, 4, 7b; pl. 17, fig. 5c, 1898.

There seems to be no question that this specimen represents the variety b of Populus arctica which Heer described as “folis 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 sinus 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, figures 2; plate 29, figures 1–3; plate 33, figure 1a


This species is better defined in its essential characters than Populus arctica (see above), and it can
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.28

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,24 Siberia,26 and Canada.26 It may be regarded as a characteristic Arctic Eocene species. Specimens from the island of New Siberia were described and figured by Schmalhausen,27 and others from the Amur River region in eastern Siberia by Konstantow.28 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 richardsonii* 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.29 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 5323) (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. 3AII 9b); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3246b) (pl. 29, fig. 3).

*Populus speciosa* Ward?

Plate 31, figure 2


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.44

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 Penhallow44 from the Eocene of British Columbia, but without any description or figure, and this appears to be the only

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28 Heer, Oswald, *Miocene Flora von Nordgermanien: Flora fossilia arctica*, vol. 1, p. 96, pl. 4, figs. 1-5, 6b; pl. 6, figs. 7, 8; pl. 15, fig. 1c, 1888; *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. 75, pl. 66, fig. 1, 1883.
29 Heer, Oswald, *Miocene Flora von Spitzbergen*: *Flora fossilia arctica*, vol. 1, p. 155, 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. 85, pl. 17, fig. 7e; pl. 14, fig. 4; pl. 32, figs. 1, 2, 1877.
34 Lesquereux, Leo, *Contributions to the Miocene flora of Asia*: U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 9, fig. 1, 1882 (1883).

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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 4590).

**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 supra-basilar—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 even be made between two figures of *P. speciosa* Ward and two of *P. amblyrhyncha* Ward 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 8, plate 6, in Bulletin 37. The species is abundantly represented in the Fort Union (Eocene) and Lances (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 5598) (pl. 25, fig. 5). Kootzmahoo 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). Neina 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 7286) (pl. 118, fig. 7). Matanuska-Cook Inlet region, Eska Creek; collected by Theodore Chapin in 1910 (lot 5597).

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**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-palminate 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 from 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: Kootzmahoo 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 Russell 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


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 obtirita* Dawson, 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;
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 published record relating to *P. gendri* is that by Dawson, 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


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 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. Figures 1 and 2, plate 26, which possess well-defined lateral primaries, suggest the variety *attenuata* (Braun) Braun, which he, apparently, originally described as a distinct species and afterward relegated to varietal rank. Heer 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 as described and figured by Heer, 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 and referred to *Populus glandulifera* Heer. The only specimen figured by Heer in his Flora fossils alaskana, 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 were listed by Penhallow 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, but his figure shows only the basal portion of the leaf and in connection with it he mentions a previous description of a specimen from the same locality, which he originally referred to the variety *transversa* (Alex. Braun) Heer but which he here remarks is apparently referable to the variety *cordifolia*. A similar imperfect specimen, referred to...
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.

**Locality:** Eska Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897) (pl. 25, fig. 4; pl. 28, figs. 2-4). Bryant Creek, upper Yukon region (original no. 3AP 350); collected by L. M. Prindle in 1908 (lot 3229) (pl. 26, fig. 1). Port Graham, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm, file Heer.

**Populus hookeri Heer**

Plate 24, figure 6

**Populus hookeri Heer,** Miocene Pflanzen vom Mackenzie: Flora fossilia arctica, vol. 1, p. 137, pl. 21, figs. 16, 16b, 16c (?), 1898.

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 Dawson65 figured a specimen from the same region and referred it to the species. Dawson's figure, however, is of doubtful identity and, in any case, 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 1908 (lot 3229).

**Populus glandulifera Heer**

Plate 31, figure 1; plate 32, figures 5, 6; plate 116, figure 1


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, Poland, 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 Knowlton69 from North Dakota, Montana, and the Yellowstone National Park, respectively.

**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) (pl. 31, fig. 1, pl. 32, fig. 5). Yukon River, south bank, 1/2 miles above Rampart and 300 feet above 11AE1, central Yukon region (original no. 11AE2); collected by H. M. Eakin in 1911 (lot 605) (pl. 32, fig. 6). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7505) (pl. 116, fig. 1). Port Graham, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm, file Heer.

**Populus balsamoides Goepert**

Plate 23, figures 3, 4; plate 25, figure 1; plate 118, figures 3, 4


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.*
**THE TERTIARY FLORAS OF ALASKA**

balsamoides eximia (Goeppter) Heer,⁷ as depicted by Goeppter,⁷ Heer,⁷ Lesquereux,⁷ and others. Goeppter 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,⁷ in his discussion of a relatively small specimen of this species, collected 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,⁶ California,⁶ and the Yellowstone National Park,⁵¹ and from the Eocene of North Dakota.⁶² 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,⁶⁶ 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). Yukutat-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. 23, fig. 1). Near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 55); collected by A. F. Buddington in 1922 (lot 7365) (pl. 116, fig. 3). Nenana coal field, near Jinx coal bed, above mouth of Cool Creek, Tanana region; collected by Mrs. John A. Davis in 1923, filed by S. R. Capps (lot 7634) (pl. 116, fig. 4). Port Graham, Matanuska-Cook Inlet region; collected by Goeppter, H. R. Ueber die Tertiärflora der Polargegenden: Schlesiische Gesell. vaterl. Cultur 30te Jahresber., Abt. Naturwiss. u. Med., Abh., no. 2, p. 204, 1891.


¹⁰ Heer, Oswald, Flora tertiarí Heritae, vol. 3, p. 150, fig. 11, 1859.


¹⁴ idem., p. 184 (68).

¹⁵ Wessel, Philipp, Neuer Beitrag zur tertiär Flora der niederbärmischen Braunkohlenformation: Palaeontographica, vol. 4, no. 4, p. 141 (31), pl. 24 (5), fig. 1, 1853. 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 "Hudnoi" [Kootznaahoo or Admiralty] Island, southeastern Alaska,⁶⁴ 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,⁶⁶ California,⁶⁶ and the Yellowstone National Park,⁵¹ and from the Eocene of North Dakota.⁶² 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,⁶⁶ 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*.
SALICACEAE

67

Polypus gaudini Fischer-Ooster

Plate 25, figures 2, 3


The only previous record of this species in America was made by Lesquereux,24 based upon the identification of a single specimen from the Eocene of Colorado; but unfortunately the specimen was not figured. Dawson,35 however, described and figured under the name Polypus balsamoides Goeppert [for P. balsamoides Goeppert], specimens from the Tertiary (Eocene?) of British Columbia that are almost certainly referable to Polypus gaudini; and his figure 9 is almost identical in size and shape with our specimen, especially with the one represented by our figure 2.

Polypus 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,36 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 Polypus but may, at least in part, be referable to the genus Ficus and perhaps be identical with certain leaves included under Ficus monadon (Lesquereux) Berry37; but that is largely a matter of individual opinion.

Localities: Eска 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 3004) (pl. 25, fig. 3).

Polypus conglomeralis 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 Polypus gaudini Fischer-Ooster,38 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 Polypus balsamoides Goeppert39 and P. exigua producta Goeppert,40 from the Miocene of Silesia, but both of these species have margins that are distinctly and uniformly denticate. A considerable diversity of forms, however, have been included in P. balsamoides by various authors, and two specimens figured by Heer41 simulate ours very closely, except in their obviously denticulate margins. Lesquereux42 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

25 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.
26 Heer, Oswald, Flora von Nordrügenland: Flora fossilia arctica, vol. 1, p. 99, pl. 50, fig. 5, 1868.
28 Polypus monadon Lesquereux, Leo, On fossil leaves from Fort Ellsworth, Nebr.: Am. Philos. Soc. Trans., vol. 13, p. 413, pl. 15, figs. 1, 2, 1869.

40 Fischer-Ooster, Carl von, in Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 24, pl. 64, figs. 1-9, Winterthur, 1856.
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 Nukshak (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3517).

**Populus mutabilis Heer**

Plate 33, figure 1b


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.92

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 93 from Wyoming but was not figured or subsequently referred to by Lesquereux or any other author.

Locality: Eskik Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897)

**Populus leucophylla Unger**


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,94 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,95 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:96 “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 3298).

92 Heer, Oswald, op. cit., vol. 2, pl. 63, figs. 2, 3.
**Populus zaddachi Heer?**

Plate 24, figures 4, 5; plate 116, figures 5, 6


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 and Colorado, and from the Eocene of Wyoming; by Knowlton from the Miocene of the Yellowstone National Park and Oregon; by Smith and Duror, Jennings, and Chaney 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, 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 redefinition of 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.

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) (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. 54, fig. 5). Nenana coal field, Tanana region, conglomerate beds, about 0.8 mile N. 45° 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. 45° 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.?*

**Genus SALIX Linnæus**

**Salix alaskaana Hollick, n. sp.**

Plate 81, 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 type of *Salix* as are represented by the existing *S. stichensis* 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,
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, about 145 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 5820).

### *Salix angusta* Alex. Braun

Plate 20, figures 4, 5; plate 30, figure 3


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

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\(^{13}\) Newberry, J. S., The later extinct floras of North America: U. S. Geol. Survey Mon. 35, p. 64, pl. 65, fig. 2, 1896.


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Salix lavateri Alex. Braun

Plate 34, figures 7a, b


Heer, Flora territaria Helvetiae, vol. 2, p. 28, pl. 66, figs. 1-12; pl. 98, fig. 6, 1856; Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 27, pl. 2, fig. 10, 1869.


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 Furulijelm 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. Eakins in 1908 (lot 5182).

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\(^{17}\) 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. 55, 1898.

Salix variana Goeppert
Plate 31, figure 5


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 from leaves, in which the marginal denticulations, although microscopic in size. The specimens upon which Heer indicates a leaf with entire margin. But a little larger, and has the same erose-dentate margin. This figure apparently represents the species. In respect to the identity of our specimen with the type specimens the denticulations are

Salix wimmeriana Goeppert


Whether or not Salix wimmeriana should be regarded as distinct from or specifically identical with Salix variana is, apparently, merely a matter of individual opinion. Heer treated them as a single species and relegated S. wimmeriana to synonymy. Goepert, the author of both specific names, protested against this interpretation of their systematic status, in connection with his description of a specimen collected by L. Peter Doroshkin at Ninilichik, Kenai Peninsula, in the Matanuska-Cook Inlet region, in the following words:

The Die Mitte eines Weidenblattes, wohl von Salix wimmeriana, einer Art, die ich nicht, wie Heer meint, mit der Salix variana zu vereinigen vermag, und die namentlich durch die abgerundete Form ihrer Basis viel mehr von S. variana abweicht als die von Heer aufgestellte Salix macrophylla die ich in derselben Grüsse, wie Heer zu Oeningen, in Schossnitz beobachtete, ohne sie deswegen als besondere Art betrachten zu können.

Salix macrophylla Heer


Eichwald, Geomorphologisch-palaeontologische Bemerkungen neber die Halbinsel Mangschik und die Alentischen Inseln, p. 113, pl. 4 (6 on plate), fig. 5, St. Petersburg, 1874.


Fragmentary remains of a leaf collected at Port Graham, Kenai Peninsula, in the Matanuska-Cook


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Inlet region, by Hjalmar Furuhjelm, were figured by Heer in his Flora fossilia alaskaana and referred to this species. It is apparently specifically identical with certain leaves figured in plate 3, figures 1–5, of the same work and referred to Salix varians Goeppert. (See p. 71.)

**Salix tenera** Alex. Braun

Plate 34, figures 5–10

*Salix tenera* Alex. Braun, Neues Jahrb., 1845, p. 169.


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 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, Lesquereux, 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. 84, 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, Palaearctographica, 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 to *Salix varians* Goeppert as described and depicted by Heer; 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:


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 1908 (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 racemosa** Heer

Plate 34, figure 5, 6a; plate 117, figure 3

*Salix racemosa* Heer, Naturf. Gesell. Zurich Vierteljahrschr., vol. 11, p. 276, 1886; Flora fossilia arctica, vol. 1, p. 102, pl. 4, figs. 11–13; pl. 47, fig. 13; p. 137, pl. 21, fig. 15, 1888.


Our specimens are apparently large leaves of this species, which varies considerably in size and shape.

**Goeppert, H. E., Uber die Braunackenflora des nordostlichen Deutschlands: Deutsche geol. Gesell. Zeitschr., vol. 4, p. 395, 1852; Die tellurische Flora von Schosnitz in Schlesien, p. 26, pl. 19, figs. 17, 18; pl. 20, figs. 1, 2, Götitz, 1855.**

**Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 26, pl. 65, figs. 1–3, 6–15, Winterthur, 1856.**
In shape a leaf from the Mackenzie River region in British America, represented by Heer's figure 18, plate 21, approaches ours most nearly. Our specimens may be compared with one from Greenland, also figured by Heer.  

A specimen collected at Cook Inlet by W. H. Dall in 1880 was figured and referred to the species by Lesquereux. 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. 29

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. racena mostly in the secondaryervation, 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. racena differ from S. grönlandica far less than many of the larger and smaller forms of S. racena 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 1906 (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 abbreviata Lesquereux?**

*Plate 34, figures 4, 6b, 6c*


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 1906 (lot 5182).

**Salix abbreviata Goeppert**

*Plate 30, figure 2*


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**


Eichwald, Geognostisch-paläontologische Bemerkungen über die Halbinsel Mangschäkl und die Alentischen Inseln, p. 108, St. Petersburg, 1871.

This specimen, collected by L. T. 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

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38 Lesquereux, Leo, Contributions to the Miocene flora of Alaska: U. S. Nat. Mus. Proc., vol. 5, p. 447, pl. 8, fig. 6, 1882 (1883).
40 Heer, Oswald, Die fossile Flora Grönland's, pt. 2: Flora fossilia arctica, vol. 7, p. 76, pl. 49, fig. 2, 1893.
42 Idem (Schossnitz), pl. 19, figs. 1–16.
Ein Salix-Blatt, dessen untere vorliegende Fliicke mit zahlreichen feinen, die Nerven verdeckenden und von ihrer Verbreitung ganz unabhängigen Längstrichen versehen ist, die ich von Raen den ableite, in welchem Falle es als neue Art anzusehen ist,6 da wir bis jetzt noch nirgend ein beharrtes Wiedelblatt 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?**


This specimen, collected by Lt. Peter Doroshkin 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 überreimend, am nächsten noch mit *Salix integra* m.” It is, however, listed by Knowlton under the species suggested for comparison by Goeppert.

**Salix minuta Knowlton**


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. Övers. Förh., vol. 25, no. 1, p. 64, 1888.

One of the specimens collected by Hjalmur Furuhjelm at Fort 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 variana* Goeppert. (See p. 71.)

**Pistillate ament of Salix sp.?**

Plate 34, figure 3

Associated with leaves of *Salix raecana* Heer, *S. lavateri* Alex. Braun, and *S. libbyi* 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. Ekin in 1908 (lot 5182).

**Order MYRICALES**

**Family MYRICACEAE**

**Genus COMPTONIA Banks**

*Comptonia cuspidata* Lesquereux

Plate 2, figure 1b; plate 33, figures 4-6


*Myrica (Comptonia) cuspidata* (Lesquereux) Dawson, G. M., Roy. Soc. Canada Trans., vol. 8, sec. 4, p. 80, fig. 9, 1890.


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,6 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


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.

*6 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 Linnæus**

**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 alaska: Flora fossils arctica, vol. 2, no. 2, p. 27, pl. 3, figs. 4, 5, 1859.


**Dryandra vindobonensis** Ettingshausen, K.-k. geol. Reichsanstalt Abh., vol. 2, pt. 3, no. 1, p. 18, pl. 3, fig. 6, 1851.


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 alaska 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 46 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 44 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 46 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 5001), was included by me 54 in a list of fossil plants of that region; but its specific identity is open to question.

### Myrica banksiaefolia Unger


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 43—appear to be so closely similar to certain figures referred to forms of *M. lignitum*, such as the variety *serrata* of Ettingshausen and Standfest, 24 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

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46 Heer, Oswald, Beiträge zur Naturkunde Preussens: Miozene talische Flora: no. 2, p. 32, pl. 7, figs. 5–10, Königsberg, 1869.


Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 102, pl. 100, figs. 2–10, Winterthur, 1866.

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 Dryandrodes. 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 45 and M. lignitum serrata Ettingshausen and Standfes,46 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 46 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,46 with serrate dentition and secondary nerves that subend 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 46 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 specimen from Saxony are more or less suggestive of the figure of a specimen from Alaska identified by Heer 46 as Myrica banksiaefolia Unger. (See p. 75.)

Certain specimens from Colorado and Utah identified as M. acuminata by Lesquereux,49 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 W. R. Stone in 1904 (lot 5339) (pl. 32, figs. 2, 3). 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 (pl. 109, figs. 14-16).

Myrica (Dryandrodes) lignitum (Unger) SAPORTA

Plate 32, figure 4; plate 109, figure 13


Quercus lignitum Unger, Synopsis plantarum fossilium, p. 217, Leipzig, 1845; Chloris protogaea, pl. 6, p. lxxxix, 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, Dryandrodes, and Myrica. If all the leaf forms that have been so included are actually referable to a single species it is about as liethophyllous 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 Standfes,64 in a review and discussion of the species, named and figured 30


Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 1, pt. 3, 47, 1863; Annales sci. nat. [Paris], sér. 4, Botanique, vol. 9, p. 201, pl. 5, fig. 1, 1865; Myriophyllum zachariense SAPORTA, op. cit., p. 80; p. 220, pl. 8, fig. 2.


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. 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, 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 described and figured a specimen with entire margin, from the island of Sakhalin, and two with dentate margins, from Greenland. 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, 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 Russell Creek, Alaska Peninsula (original no. P-24); collected by W. R. Smith in 1922 (pl. 108, fig. 13).

Myrica speciosa Unger

Plate 32, figure 1a; plate 33, figure 3


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 banksiaeolata 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, and also certain figures of M. lignitum depicted by Heer under the genus Dryandroide that appear to represent that variety.

Comparison may also be made with certain figures referred to Myrica ungeri Heer, 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 banksiaeolata, 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


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; the species was recorded, without illustration, from British Columbia, by Penhallow; a fragmentary specimen from the Pleistocene of Maryland was provisionally referred to the species by Hollick; an almost perfectly preserved leaf, from the Miocene of Oregon, was given the name, provisionally, by Knowlton 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 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.

Heer, Oswald, Beiträge zur Miocenen Flora von Nord-Canada: Flora fossilis arctica, vol. 6, pt. 1, no. 3, p. 15, pl. 1, fig. 2c, 1889.


Localities: 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 7022).

Juglans acuminata latifolia (Alex. Braun) Heer

Plate 41, figure 3


Juglans latifolia Alex. Braun, Neues Jahrh., 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


Gaudin and Strozzi. Soc. helvétique sci. nat. Nouv. mém., vol. 16, no. 3, p. 38, 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 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 and Juglans rugosa Lesquereux. In shape our specimen also resembles J. longifolia Heer, 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 published...
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,\(^{a}\) 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: Kootzmaho Inlet, Admiralty Island, southeastern Alaska (original no. IX) ; collected by W. W. Atwood in 1907 (lot 4390).

**Juglans salicifolia Goeppert**

**Plate 28, figure 3**


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,\(^{a}\) in accordance with Heer,\(^{b}\) or to question its generic relationship as suggested by Menzel\(^{c}\) under "Rhws salicifolia n. sp.," and by Kräusel\(^{d}\) 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,\(^{a}\) 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 there is 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 4390).

**Juglans thermalis Lesquereux**

**Plate 60, figure 1a**


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 where specimens were discovered in Alaska that are, apparently, referable 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) (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


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 80 and included in it a number of relatively narrow leaf forms from the Miocene of Switzerland and one from the Miocene of Bohemia, which seems to have been first described and figured under the name "Carya ungeri Ettingsh." 84 in regard to which he remarked:

Diese Theilblättchen eines offenbar zusammengesetzten Blattes haben bis auf 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.

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) (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 5801) (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 Pflanzen, p. 149, Leipzig, 1852.


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. 99 The only previous record of the species in America was by Lesquereux, 89 based

80 Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilis arctica, vol. 7, p. 160, pl. 69, fig. 8, 1885.
82 Heer, Oswald, Flora terraria Helvetiae, vol. 3, p. 94, pl. 121, figs. 5-7, Winterthur, 1859.
84 Heer, Oswald, Flora terraria Helvetiae, vol. 3, p. 130, figs. 5-7, 9, 10, 15-17, Winterthur, 1859; Die fossile Flora Grönlands, pt. 2; Flora fossilis arctica, vol. 7, p. 69, fig. 5, 1883.
85 Unger, Franz, Genera et species plantarum fossilium, p. 409, Vienna, 1850.
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 denticulations, 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 5922) (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. helvetic. sci. nat., Neue Denkschr., vol. 21, no. 3, p. 9, pl. 2, figs. 4-7, 1855; *K. svenska vet.-akad. Öfvers. Förh.*, vol. 25, no. 1, p. 65, 1858.

\(^1\) Heer, Oswald. *Die fossile Flora Grönlands*, pt. 2: *Flora fossilis arctica*, vol. 7, pl. 66, fig. 8.

\(^2\) Heer, Oswald. Contributions to the fossil flora of North Greenland: *Flora fossilis arctica*, vol. 2, no. 4, p. 483, pl. 58, figs. 6-0a, 1869.

\(^3\) Heer, Oswald. *Die fossile Flora Grönlands*, pt. 2: *Flora fossilis arctica*, vol. 7, pl. 74, 75, 76, 1869.

**Lesquereux**


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. picioides* Heer, and one figure by McBride,\(^4\) which bears very little resemblance to those of the type species.

**Juglans nigella Heer**

Plate 38, figures 1-5

*Juglans nigella* Heer. *Flora fossilis alaskana: Flora fossilis arctica*, vol. 2, no. 2, p. 38, pl. 2, figs. 2a, b, 2c, 3, 4, 1869.


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.\(^3\)


\(^5\) This locality, so designated in Newberry's manuscript, has not been satisfactorily identified. It may have been Yukatán Bay, in the Mont 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.


\(^8\) 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. 265, 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.

Locality: Head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. 16a); collected by E. M. Kindle in 1905 (lot 5652) (pl. 38, fig. 1). Kootenai Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4590) (pl. 38, figs. 2-4). Eiska 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


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 evident 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 W. W. Atwood and R. W. Stone in 1904 (lot 3023) (pl. 37, fig. 2). Nenana coal field, Tanana region, near Jinx coal bed, about 500 yards above mouth of Coal Creek; collected by Mrs. John A. Davis in 1923 (lot 7034) (pl. 43, fig. 7).

Juglans valida Hollick, n. sp.
Plate 104, figure 1

Leaffet ovate-lanceolate, sessile, asymmetric proximal, 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 denticles; 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 distal.

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 4992).

Juglans? pseudopunctata Hollick, n. sp.
Plate 104, figures 2-5

Leaffets 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.


eral 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 5601).

**Genus HICORIA Raesanke**

**Hicoria antiquora** (Newberry) Knowlton

*Plate 37, figure 1*


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,26 from Washington by Smith and Duror,21 from Louisiana by Berry,22 and from localities in Wyoming, Montana, and the Dakotas by Lesquereux,22 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.

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24 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 antiqua* (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 antiqua* 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 Page 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 146a); collected by A. J. Collier in 1902 (pl. 2572) (pl. 35, 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 had referred to *Pterocarya dentiulata* Weber sp. [= *Juglans dentiulata* Weber a], 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 dentiulata* Heer, *Quercus juglandina* Heer, *Q. laharpisi* Gaudin, etc.), as figured by Heer, 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 Alate 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 3882).

**Genus ENGELHARDTIA Leschen**

Engelharddia *ettinghauseni* Berry

Plate 119, figure 3

*Engelharddia ettinghauseni* Berry, U. S. Geol. Survey Prof. Paper 91, p. 185, pl. 19, figs. 1, 5, 10, 1019.

I was at first inclined to identify this leaf as a species of *Sapindus*, such as *S. psuedaffinis* Berry, from the Eocene of Tennessee, but the configuration of the base is that of *Engelharddia* 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 cited, as identical in part, *Sapindus dubius* Unger, *fide* Lesquereux, from the Eocene of Kentucky, in connection with which he remarked: “A specimen from Wickliffe that was referred to *Sapindus dubius* by Lesquereux is unquestionably a leaf of this species, *Engelharddia ettinghauseni*.”

**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


*Heer, Oswald, Die fossile Flora Grönländs, pt. 2: Flora fossilia arctica, vol. 7, p. 102, pl. 76, fig. 1, 1888.*

*Weber, C. O., Die Tertiärflora der niedersächsischen Braunkohlenformation: Paläontographica, vol. 2, p. 211 (97), pl. 23 (6), figs. 10a, b, 1891 (1882).*


*Berry, E. W., op. cit., p. 272, pl. 67, fig. 6.*

*Idem, p. 185.*


*Berry, E. W., op. cit., p. 196.*


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. Its distribution embraces practically the whole of the Alaskan Peninsula, known from other localities in southern Alaska. It is represented by specimens from various authors, and in the literature of European paleobotany it is found associated together in a single locality or region. Specimens from Colorado and Nevada were described and figured by Lesquereux, and from Washington by Newberry, and the species was recorded from Oregon by Knowlton, from Virginia by Berry, and from Vermont by Lesquereux. It was also listed from several localities in British Columbia by Penhallow.

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 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.

Locality: Port Camden Bay, Kuna 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 3652) (pl. 50, fig. 9).

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 Goepert, an Old World Tertiary species—especially to a leaf figured and referred to the species by Unger, 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 7206) (pl. 49, fig. 2).

Carpinus sp.


This generic identification was based upon specimens described as having been collected "am Meerbusen Ugoni, 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 Goepert 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 60° with the midrib, curving upward and branched from the under sides distal, 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 Goepert, an Old World Tertiary species—especially to a leaf figured and referred to the species by Unger, 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 7206) (pl. 49, fig. 2).


Genus CORYLUS Linnaeus

Corylus adunbrata 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, crispedodrome; secondary nerves about 10 on each side, irregularly disposed, the lower ones opposite or sub-opposite 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. 108, 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, fig. 3b; plate 48, figures 1-3

Corylus americana fossilis Newberry, U. S. Geol. Survey Mon. 35, p. 60, pl. 29, figs. 8-10, 1888.


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, and the species was recorded from several localities in British Columbia and listed by Penhallow; otherwise it does not appear to have been recognized in paleobotanic literature, although certain figures of specimens referred to Corylus macquarii (Forbes) Heer (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 Mohler, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1905 (lot 5196) (pl. 45, 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 distal 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


46 Heer, Oswald, Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 29, pl. 4, figs. 2-4, 1899.
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 macquarii* (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 Nukshak, 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. macquarii*, but * * * differs in certain details." It might, indeed, be regarded merely as a large form of the same leaf as that figured by Heer48 from Port Graham, Kenai Peninsula, in the Matanuska-Cook Inlet region and referred to *Corylus macquarii* by Heer, but comparison with the type of this species49 shows them to be so characteristically different that there is no apparent difficulty in distinguishing between them. *C. macquarii* 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. macquarii*: "Frequens in terra Alaskana; collecto Furuhjelmi continent 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 Cockrell (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* fossils Newberry (see pl. 48, figs. 1-3).

Heer's figures of *Corylus macquarii* 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,

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 basal 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 macquarii* by Heer, but comparison with the type of this species49 shows them to be so characteristically different that there is no apparent difficulty in distinguishing between them. *C. macquarii* 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* Hollick, n. sp.

Plate 45, figures 1-3a; plate 46, figures 1b, 2-5; plate 47, figures 1-5

*Corylus macquarii* (Forbes) Heer, Flora fossils alaskana:

Flora fossils arctica, vol. 2, no. 2, p. 29, pl. 4, figs. 1-4, 5a, 6-8 (excl. fig. 9, pl. 3), 1899.


47 Heer, Oswald, Flora fossils alaskana: Flora fossils arctica, vol. 2, no. 2, pl. 4, fig. 3, 1899.

48 Heer, Oswald, Flora fossils alaskana: Flora fossils arctica, vol. 2, no. 2, p. 29, pl. 4, fig. 1.

49 This paper, pl. 46, fig. 6. Heer, Oswald, Flora fossils arctica, vol. 1, p. 104, pl. 9, fig. 1, 1888.
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 Ardun 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, for comparison with his specimens from Greenland, which are evidently specifically identical with the type. One of the Alaska specimens figured by Heer may also be properly referred to the species; but others from the same region 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, 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 and Newberry, and a specimen of what appears to be the species, from the Miocene (? ) of the Yellowstone National Park, was described and figured by Knowlton. The species was also recorded by Penhallow 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.

The species, even with all doubtful forms eliminated, had an extensive geographic distribution in early...
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 works cited. With descriptions of specimens from Puy-de-Dôme, we are able, by a reproduction of a figure by Heer, to illustrate a form that, botanically and geologically, may be found in connection with descriptions of specimens from Spitsbergen, illustrated by excellent examples of leaf forms specifically identical with the type specimen and, for comparison, a reproduction of a figure by Heer.

Localities: Collected by Furuhjelm, side Heer and Eichwald, from Port Graham and Ninilchik village and river, east shore of Cook Inlet, Matanuska-Cook Inlet region; and from Kula Island, southeastern Alaska. Collected by De Alton Saunders, 1890, at Kukak Bay, Alaska Peninsula.

**Corylus macquarrii macrophylla Heer**

*Corylus macquarrii macrophylla* Heer, Miocene Flora von Nordgriinnland; Flora fossilia 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 fossilia alaskana: Idem, vol. 2, no. 2, p. 30, pl. 4, figs. 6, 7, 1889.


In his description and discussion of leaves of *Corylus macquarrii* from Greenland, Iceland, and the Mackenzie River region in British America, Heer mentions specimens that are bis bis einen halben Fuss Lange erreicht haben mussen. Wir bezeichnen diese Form als *Corylus macquarrii macrophylla* und halten sie nur fur eine, aber allerdings sehr beachtenswerthe Varietat.

The Alaskan specimens that Heer referred to this variety were collected by Hjalmar Furuhjelm, at Port Graham, Kennai Peninsula, in the Matanuska-Cook Inlet region. The dimensions of these specimens are not given, but Heer 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, from the Eocene (Fort Union formation) of North Dakota, a distinct species, but subsequently recognized by Newberry 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 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 ahnliche Art scheint die *C. grandifolia* zu sein, so weit sich dies aus der kurzen Beschreibung ohne Abbildung ermitteln lasst." 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. 30068), 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

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64 Lauret, Louis, Flore fossile des steppes de Menat (Puy-de-Dôme) : Mus. hist. nat. Marseille Annals, vol. 14, p. 79, pl. 6, figs. 3, 6; pl. 5, figs. 3, 4, 5c; pl. 9, fig. 1, and text figs. 37 (p. 80), 38 (p. 31), 39 (p. 82), 1912.
65 Heer, Oswald, Die Miocene Flora des Grinsell-Landes : Flora fossilis arctica, vol. 5, no. 1, p. 53, pl. 6, fig. 8, 1872.
66 Heer, Oswald, op. cit., vol. 1, p. 105.
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*. 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 referred to *Alnus kefersteini* (Goeppert) Unger, on account of their association with leaves referred to that species, and also to a staminate ament mentioned in connection with a leaf of *Corylus insignis* Heer in regard to which Engelhardt remarked: "Das wahrscheinlich hierher zu rechnen ist."

**Locality:** Kukak Bay, north side, 1 mile west of Cape Nakshak, Alaska Peninsula (original no. 941); collected by T. W. Stanton and R. W. Stone in 1904 (lot 3317).

**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 of what appear to be similar remains collected by Hjalmar Furuhjelm in the Cook Inlet region. These he included under *Corylus macpwarrii* (Forbes) Heer, with the remark: "Tab. 111, fig. 9, b, c, amenta mascula Coryli representantem 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 Field Co.'s mine (original no. 911); collected by T. W. Stanton and R. W. Stone in 1904 (lot 5821) (pl. 56, fig. 6). Yukon River, south bank, just above Rampart, central Yukon region (original no. 3A10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 50, fig. 7).

**Genus *Betula* Linnaeus**

**Betula brongniarti** Ettingshausen

*Plate 57, figure 8*

*Betula brongniarti* Ettingshausen, K.-k. geol. Reichsanstalt, Abh., vol. 2, pt. 3, no. 3, p. 12, pl. 1, fig. 15, 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.

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 1906 (lot 5198).

**Heer, Oswald. Flora fossilia alaskana : Flora fossilia arctica, vol. 2, no. 2, p. 30, pl. 4, figs. 9b, 9c, 1869.**

**Heer, Oswald. Die Mioceene Flora des Grinnell-Landes : Flora fossilia arctica, vol. 5, no. 1, p. 32, pl. 6, fig. 1 : pl. 8, fig. 7, 1875 ; Mioceene Flora der Insel Sachalin : Idem, no. 5, p. 52, pl. 6, fig. 4 : pl. 15, fig. 5, 1875 ; Beiträge zur Mioceene Flora von Sachalin : Idem, no. 4, p. 6, pl. 2, fig. 2, 1878.**

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17 *Corylus macpwarrii* (Forbes) Heer (p. 88), *C. kenaiana* Hollick (p. 87), *C. americana* Newberry (p. 86), *C. harrimani* Knowlton (p. 87), and *C. polacki* Knowlton (p. 89).


19 Idem, fig. 1.

20 Idem, fig. 24.

21 Idem, p. 320 (24).
Betula confusa Saporta var. lata Hollick, n. var.

This leaf differs so little from the species Betula confusa Saporta, based upon specimens from the Miocene of France, that I am almost inclined to regard them as identical. Our specimen is merely varietal.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Buff Point, 7 miles west of Homer, about 1⅔ 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

It was recorded from British America by Penhallow, 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, in connection with a specimen from the Eocene (Fort Union formation) of Montana.

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, Buff Point, 7 miles west of Homer, about 1⅔ 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.

Leaf lanceolate-deltoïd, 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, 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, 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

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*Saporta, Gaston de, Recherches sur la végétation du niveau Aquitanien de Manauque: Soc. géol. France Mémoire, Paléontologie, vol. 3, pl. 1, Mém. 9, p. 35, pl. 10 (14), figs. 5, 6; pl. 20 (19), figs. 6, 6a, 7, 7a, 1892.
*Heer, Oswald, op. cit. (1889), p. 29.
Betula alaskaensis Lesquereux


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


Heer, Flora fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 29, pl. 5, fig. 8, 1889.


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


Alnus macrophylla Goeppert, Deutsch. geol. Gesell. Zeitschr., vol. 4, p. 491, 1852; Die tertiäre Flora von Schlesien in Schlesien, p. 12, pl. 4, fig. 6; pl. 5, fig. 1, Göritz, 1855.

Among the species of fossil leaves collected by Hjalmar Furuhjelm at Ninilchik, Kenai Peninsula, Heer 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 fossilia alaskana, 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 macquarii.

Leaves from Iceland, Spitsbergen, and Canada that differ widely among themselves in size, shape, and marginal dentition were referred to the species by Heer; 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, 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 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 59, 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.
Figure 3b, plate 50, shows one of the amens in close association with a leaf of *Betula priscoc* Ethinghausen, (p. 91), and a similar association of leaves and amens was described and figured by Heer in connection with specimens collected by Hjalmar Furuhjelm at Ninilchik and Port Graham, Kenai Peninsula, all of which Heer included under *Betula priscoc*. It is quite probable that they are specifically identical and that merely to note the more or less close association.

Locality: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region, at entrance to Troublesome Guich (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 5520) (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 5521) (pl. 50, figs. 3b, 4).

**Betula** (branch) Knowlton


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 Gärtn.**

**Alnus alnifolia** (Geoppepp) Hollick, n. comb.

Plate 47, figures 7b, 8; plate 51, figures 3, 4, 5b, 6, 7


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 be best 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 appellation. The only apparent difference, however, between Goeppepp'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 corollina* Lesquereux, 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, from the Eocene of Oregon; with *Corylus insignis* Heer, as figured by Abich and Menzel; and with *Carpinus betuloides* Unger.

A number of other figures of species in these and allied genera in the Amertaceae 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.

Locality: Port Camden Bay, Kuiu Island, southeastern Alaska (original no. 15b); collected by E. M. Kindel in 1905 (lot 3651) (pl. 47, fig. 7b; pl. 51, figs. 3, 4, 5b, 6, 7). Divide between Folger Creek and Nowitna River, 10.15 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


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, from...
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 1889. Fragmentary and imperfect specimens, however, are liable to be mistaken for certain forms of Corylus macquarrii (Forbes) Heer (see p. 58), 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 5822) (pl. 50, fig. 1; pl. 46, fig. 18; 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


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 1 to "Corylus macquarrii Forbes sp."

Newberry 1 described the type locality as "Kootz-nahoo 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 Tinonek, Matanuska-Cook Inlet region (original no. 1); collected by C. A. Weaver in 1906 (lot 4130).

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1 Heer, Oswald. Pedaggio zur fossilen Flora Spitzbergens: Flora fossilia arctica, vol. 4, no. 1, p. 72, pl. 16, fig. 1, 1876.
2 Newberry, J. S., op. cit. (Mon. 35), p. 66.

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1 Heer, Oswald. Die fossilen Flora Grönlands, pt. 2: Flora fossilia arctica, vol. 7, p. 80, pl. 96, fig. 1, 1888.
2 Newberry, J. S., op. cit. (Mon. 35), p. 66.

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**Alnus kefersteinii** (Goeppe) Unger

Plate 22, figure 5b

*Alnus kefersteinii* (Goeppe) Unger, Synopsis plantarum fossilium, p. 215, Leipzig, 1845; Chloris protogaea, pt. 6, p. 283, figs. 1–4, Leipzig, 1846.


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 23, 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 paleobotanical 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 subgla- tinosa 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, ithe Eichwald, at Ninilchik village, west shore of Kenai Peninsula, Matanuska-Cook Inlet region.

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6 Heer, Oswald, Miocene baltische Flora, p. 68, pl. 19, fig. 7; pl. 20, figs. 1–4, Königsberg, 1888.
7 Idem, pl. 19, figs. 9, 10; pl. 20, figs. 5–11.
8 Idem, pl. 19, figs. 1–4, 8.
10 Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 140, pl. 33, figs. 1–2; pl. 84, fig. 11, 1878.
Alnus kefersteinii var. Heer


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 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 macrocarraii* (Forbes) Heer. (See p. 88.)

Alnus grandiflora Newberry


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,” 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


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. 153, pl. 28, fig. 2 (U. S. Nat. Mus. no. 30064); pl. 33, fig. 4 (U. S. Nat. Mus. no. 30063), 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 1889. 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.-Petersbourg Mém., sér. 6, Sci. math. et phys., vol. 7, p. 572 (39), pl. 8, fig. 2, 1858.

Heer, Flora fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 30, pl. 5, fig. 4a; pl. 7, figs. 4–5; pl. 8, fig. 1, 1889.


Fagus lanatofoilia Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1868; Flora fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 30, pl. 5, fig. 4a; pl. 7, figs. 4–5, 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 from Italy; but it appears to be probable that

Sordelli, Ferdinando, Flora fossilia nesourica, p. 118, pl. 17, figs. 2–6; pl. 18, figs. 7–10, Milan, 1896.
in Europe it has occasionally been confused with *Fagus pristina* Saporta \(^{18}\) or vice versa. It is certainly very difficult, for example, to discern any characters that indicate a specific difference between *Fagus antipo\(\_\)fii* as figured by Abich and Heer, and *F. pristina* as figured originally and subsequently \(^{18}\) by Saporta.

Specimens referred to *Fagus antipo\(\_\)fii* 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 ola\(\_\)s\(\_\)eni* and *Q. ne\(\_\)dae\(\_\)s\(\_\)eni*, 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 antipo\(\_\)fii* 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.

Localit\(\_\)y: Kenai Peninsula, Matanuska-Cook Inlet region, station 116, 2\(\frac{1}{2}\) miles southwest of Point Naskowbak (original no. 116); collected by G. C. Martin in 1911 (lot 6001).

**Fagus feroniae** Unger

*Fagus feroniae* Unger, Synopsis plantarum fossilium, p. 219, Leipzig, 1845; Chloris protogaea, pt. 6, p. lxxix, Leipzig, 1846; Idem, pl. 9, p. 106, pl. 29, 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.


A single specimen, collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, in the Matanuska-

\(^{18}\) Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, pt. 3; Annales sci. nat. (Paris), sér. 5, Botanique, vol. 5, p. 69, pl. 6, figs. 1–3, 1867.


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 Kacheman Bay, Kenai Peninsula, that I have referred to *Q. ola\(\_\)s\(\_\)eni* (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 differential of the three species *Fagus antipo\(\_\)fii* Abich (p. 93), *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*, reclassifying *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. 218, 1845; Chloris protogaea, pt. 6, p. lxxix, 1845; pt. 9, p. 106, pl. 28, figs. 3, 4, 1847.


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,\(^{25}\)


\(^{28}\) Ettingshausen, Constantin von, Die Formenkreise der pseudo­tertiären Vegetation (Fagus feroniae Unger): K. Akad. Wiss. (Wien), Math.-naturwiss. Cl., Denkschr., vol. 61, pl. 1–6, 1894.

\(^{29}\) Idem, pl. 6, pl. 1, figs. 17, 18.

\(^{30}\) Nathorst, A. G., Contributions à la flore fossile du Japon: K. svenska vet.-akad. Handl., vol. 20, no. 2, pl. 3, 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. 203 (8), 204 (10), 210 (16), 211 (17), 218 (22), 222 (9), 223 (29), 227 (33), 231 (37), pl. 19 (2), fig. 3; pl. 19 (3), figs. 2, 3, 5; pl. 21 (6), 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 deuclationis** Unger

Plate 53, figure 3

*Fagus deuclationis* Unger, Synopsis plantarum fossilium, p. 218, Leipzig, 1845; Chloris protectae, pt. 6, p. lxix, Leipzig, 1845; pt. 1, p. 101, pl. 27, figs. 1–6, 1847.


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 rarietal character or feature, although it is of interest to note that a similar peculiarity was depicted by Heer in a leaf from Greenland that he referred to the species, but at the same time remarked on its resemblance to *Fagus anti-pofii* 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 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.

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**Localities:** 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 alnifolia* Hellick, 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 pinate, 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* Geoeffert, 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 under the name *Fagus antipoysi* 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.

**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).

*Fagus sp. Heer*

**Fagus sp. Heer.** K. svenska vet.-akad. Övers. Förh., vol. 25, no. 1, p. 64, 1888.

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 anti-pofii* Abich. (See p. 95.)

**Genus CASTANEA** Adanson

**Castanea castaneaefolia** (Unger) Knowlton

Plate 53, figures 4–6


*Fagus castaneaefolia* Unger, Synopsis plantarum fossilium, p. 218, Leipzig, 1845; Chloris protectae, pt. 6, p. lxix, pl. 28, fig. 1, Leipzig, 1845.

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27 Heer, Oswald. Miocene Flora von Norderland: Flora fossilis arctica, vol. 1, p. 105, pl. 8, figs. 1–4; pl. 10, fig. 6; pl. 46, fig. 4, 1888; Miocene Flora von Island: Idem, p. 140, pl. 25, fig. 52; Miocene Flora von Spitzbergen: Idem, p. 150, pl. 31, fig. 2b; Nachträge zur Miocene Flora Grönländs: Idem, vol. 3, no. 3, pp. 5, 11, pl. 3, figs. 11, 15, 1874; Beiträge zur fossilen Flora Spitzbergen’s: Idem, vol. 4, no. 1, p. 73, pl. 15, figs. Sb 6; pl. 18, fig. 2b; pl. 31, fig. 7, 1876; Nachträge zur fossilen Flora Grönländs: Idem, vol. 6, pl. 1, no. 2, p. 10, pl. 4, figs. 2, 3, 1880; Die fossile Flora Grönlánds, pt. 2: Idem, vol. 7, p. 83, pl. 95, figs. 8–12, 1883.


29 Heer, Oswald. Flora fossilis alaskana: Flora fossilis arctica, vol. 2, no. 2, p. 31, pl. 8, fig. 1, 1869.

Alaska were collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, and were identified, described, and figured by Heer, first under the name *Castanea ungeri* Heer and subsequently under *Castanea pseudo-castanea* Unger.


The first specimens of this species recorded from Alaska were collected by Hjalmar Furuhjelm at Port Graham, Kenai Peninsula, and on Keku [Kuik] 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, and specimens from the Miocene of California were described and figured by Lesquereux. 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. 53); collected by A. F. Buddington in 1922 (lot 7965) (pl. 35, 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 7690) (pl. 53, fig. 5). Eski 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, 1891.

There appears 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 from the upper Eocene of the Quesnel River region, British Columbia, but it has not been recognized from elsewhere in America.

**Localties**: 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 6963) (pl. 54, fig. 4). Neilena 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. 6, figs. 1, 2, 1891.


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 mid-rib, 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**: Kootanahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4990).

**Quercus etymodrys Unger**

Plate 54, figures 6, 7


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 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

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with Massalongo's figure 3, 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), *amphysia* (pl. 22-23, fig. 7; pl. 31, fig. 5), and *entelia* (pl. 22-23, figs. 10-12; pl. 42, fig. 12). Incidentally, also, it may be noted that he maintained *Q. pseudo-castanea* 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 grønlantica Heer**

Plate 54, figure 3; plate 57, figure 6

*Quercus grønlantica* Heer, Naturf. Gesell. Zurich Vierteljahrschr., vol. 2, p. 278, 1896; Flora fossilis arctica, vol. 1, p. 108, pl. 8, fig. 8; pl. 10, figs. 3, 4; pl. 11, fig. 4; pl. 47, fig. 1, 1898.

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 in connection with the specimens described and figured from the Arctic region.

Specimens from Cook Inlet, Alaska, figured by Newberry, 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, under the name *Quercites grønlanticus*; Upper Silesia, by Steger; and Italy, by Paolucci. In this connection, however, it may be pertinent to remark that certain specimens recorded in paleobotanical literature as *Fagus dentata* Goep Pert, *Quercus furuhjelmi* Heer, *Quercus pseudo-castanea* Goep Pert, *Castanea atavica Unger, Castanea castaneaefolia* (Unger) Knowlton (= *Fagus castaneae-

\[\textit{foli}a\textit{ Unger, Castanea ungeri Heer, Planera ungeri Ettingshausen, etc., are very difficult to separate from certain forms referred to *Quercus grønlantica*, 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, 244 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


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 1908 (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. 140, pl. 26, fig. 6, 1868; Contributions to the fossil flora of North Greenland: Idem, vol. 2, no. 4, p. 471, pl. 46, fig. 2, 1899; Miocene Flora der Insel Sachalin: Idem, vol. 5, no. 3, p. 33, 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 ellipsoid 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 grønlantica* Heer, described above; from which it is said by the author to differ in the character of the dentition—*Q. grønlantica* having a single series of teeth and *Q. olafseni* having a major and a minor series.
This distinction does not persist throughout, however, as certain specimens of the latter species, including eurs, have single teeth above and are irregularly dentate below. A fragmentary specimen might therefore be identified as either one of the species.

*Quercus oalaseni* 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 46—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, 48 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 1888.

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 42 under the name *Quercus diplodon*, in connection with which the authors remarked 48 that "Le Quercus oalaseni ressemble évi-
Another specimen, from Alberta, referred to the species by Dawson, was also regarded by Knowlton 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.

Our figures may be especially compared with those of Heer's Greenland specimens.

Localities: Matanuska coal field, Matanuska-Cook Inlet region, 3/4 miles northwest of United States locating monument 1, elevation 2,750 feet; collected by G. C. Martin in 1910 (lot 5698) (pl. 44, fig. 5). Sheep Valley, Matanuska coal field, Matanuska-Cook Inlet region, arkose series; collected by G. C. Martin in 1910 (lot 5690) (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 fossilia 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, 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 negating 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 weedi* Knowlton, 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 5862) (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, camptodromedrome; 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 dentications.

These leaves, which I have ventured to describe under a new specific name, combine the characters of *Quercus haidingeri* Ettingshausen, as depicted by Heer from the Tertiary of Switzerland, especially his figures 8 and 14; *Q. singularis* Saporta, from the Tertiary of France; *Q. doljensis* Pilar, from the Tertiary of the Balkan region; *Q. chamissoni* Heer, from Alaska (see p. 102); and *Q. yanceyi* Knowlton, 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 and referred to *Quercus doljensis*; but they appear to resemble *Q. chamissoni* more nearly than they do *Q. doljensis*.


*Heer, Oswald*, *Flora territaria Helvetiae*, vol. 2, p. 53, pl. 70, figs. 5, 7, 8, 10, Winterthur, 1866.


*Heer, Oswald*, *Flora fossilia alaskana*: Flora fossilia arctica, vol. 2, no. 2, p. 33, pl. 6, figs. 7, 8, 1899.


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 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. 4).

**Quercus arctocarpus** Ettingshausen
Plate 48, figure 1; plate 56, figure 6


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 but can generally be distinguished by the character of its margin, which is sharply triangular-denticate 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. Elkin in 1908 (lot 5178) pl. 56, fig. 6.

**Quercus meriani** Heer
Plate 44, figure 1

**Quercus meriani** Heer, Flora tertiaaria Helvetiae, vol. 2, p. 53, pl. 76, fig. 12, 1896.

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 from the Tertiary (Pliocene?) of Italy.

**Quercus alaskana** Trelease?
Plate 44, figure 2


**Quercus pandurata** Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 34, 1865; Flora fossilis alaskana: Flora fossilis arcticae, vol. 2, no. 2, p. 33, pl. 6, fig. 6, 1869.

**Quercus pandurata** Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1865; Flora fossilis alaskana: Flora fossilis arcticae, vol. 2, no. 2, p. 33, pl. 6, fig. 6, 1869.


**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 Fort 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 assigned in the same collection. It is also more or less suggestive of **Quercus gmelinii** Alex. Braun as depicted by Heer, 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.

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).

**Quercus chamissoni** Heer

**Quercus chamissoni** Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1865; Flora fossilis alaskana: Flora fossilis arcticae, vol. 2, no. 2, p. 33, pl. 6, figs. 7, 8, 1869.


**Not Quercus chamissoni** Heer

**Quercus chamissoni** Heer, K. svenska vet.-akad. Öfvers. Förh., vol. 25, no. 1, p. 64, 1865; Flora fossilis alaskana: Flora fossilis arcticae, vol. 2, no. 2, p. 33, pl. 6, figs. 7, 8, 1869.

**Meschinelli, Aloysius, and Squinabol, X., Flora tertiaaria italica, p. 225, Padua, 1892.

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. 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 acceptance 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


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, 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* Goepert, from the Tertiary of Silesia.

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 4180).

*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* Goepert, *Q. pseudoalnus* Ettingshausen as depicted by Engelhardt, and *Q. goepperti* Lesquereux.

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


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* Debev

*Dryophyllum stanleyanum* Dawson

Plate 56, figures 3-5


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.

67 Heer, Oswald, Flora tertiaris Helvetiae, vol. 2, p. 51, pl. 77, fig. 6, Winterthur, 1856.
and figured in connection with *D. subcretaceum* Saporta; and Dawson suggested, as probable, that they might be identical with the leaves identified as *Quercus furcineris* Rossmüller by Lesquereux, 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 obscurely, though this is uncertain. Margin entire or slightly undulate, so as to give a denticulate appearance. * * * In venation it somewhat resembles *Quercus castanoeopsis* 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. Budge, in 1922 (lot 7965) (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*


In size, shape, and dentition of the margin our specimen agrees perfectly with the species described and figured by Knowlton from the Tertiary (Mio-

A species that appears to be closely related, however, to both Heer’s specimens and to ours, is *Dryophyllum bruneri* Ward,* originally described and figured by Ward from the Upper Cretaceous (Laramie!) of Wyoming, and subsequently by Knowlton 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 Atabia 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 5601).
Order URTICALES

Family ULMACEAE

Genus ULMUS Linnaeus

Ulmus braunii Heer?
Plate 58, figures 6–12


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, 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. 3); collected by R. W. Stone in 1904 (lot 3526) (pl. 58, figs. 6-12). Summit of mountain 1 mile south-west of forks of Punificestone Creek, Alaska Peninsula (original no. P. 22); collected by W. E. 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 dichotomousforking 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, p. 221, Leipzig, 1846; Chloris protogaea, pl. 6, p. lxxx; pt. 8, p. 95, pl. 25, figs. 1–4, Leipzig, 1845 (1847).


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. This specimen, however, was not figured.

Ulmus carpinoides Goeppert

Plate 51, figures 1, 2

Ulmus carpinoides Goeppert, Die tertiiäre 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, who relegated a great

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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, for example, in his discussion of *Carpinus grandis* Unger, included *Betula carpinoides* Goeppert, *Ulmus longifolia* Unger, *U. carpinoides* Goeppert, *U. pyramidalis* Goeppert, and *U. urceae-folia* Goeppert as synonyms, and Gaudin, 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, Kuku Island, southeastern Alaska (original no. 15b); collected by E. M. Kindle in 1905 (lot 3651).

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**Ulmus sorbifolia** Goeppert

*Plate 57, figures 3–5*


It seems somewhat remarkable that this well-defined species should be recorded only from the type locality

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88 Heer, Oswald, *Flora tertiaria Helvetiae*, vol. 2, p. 40, pl. 71, figs. 19–19a; pl. 72, figs. 2–24; pl. 73, figs. 2–4, Winterthur, 1856.

89 Goeppert, H. R., *Die tertiäre Flora von Schossnitz in Schlesien*, pp. 12, 28–30, pl. 5, fig. 10; pl. 13, figs. 1–3, 4–9, 10–12; pl. 14, fig. 1, 2–3, Görlitz, 1855.


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. 18a); 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).

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**Ulmus borealis** Heer

*Plate 57, figures 1, 2*

**Ulmus borealis** Heer, *Die Miocene Flora des Grinnell-Landes*: *Flora fossils arctica*, vol. 5, no. 1, p. 35, pl. 5, fig. 10; pl. 7, figs. 1–4; pl. 9, figs. 2–5, 1875.

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* Stenstrup (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* Stenstrup as figured by Heer, 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. 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*.

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88 Heer, Oswald, *Miocene Flora von Island*: *Flora fossils arctica*, vol. 1, pl. 27, fig. 2.

ULMACEAE

Localities: Kachemak Bay, Kenai Peninsula, Matanuska-Cook Inlet region. Bluff Point, 7 miles west of Homer, about ½ 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


Our specimen appears to belong to this species as described and figured by Heer in connection with specimens from the Tertiary of Iceland. It has not been heretofore recorded from North 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.

Localities: 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 5

Ulmus longifolia Unger, Chloris protogaea, pt. 6, p. ixxx, 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 under Ulmus brownii Heer appears to be more properly referable to U. longifolia and to be specifically identical with our specimen from Alaska.

Locality: Eesa Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5837).

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 cuneate 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 and in the Pleistocene floras of the southeastern United States by Lesquereux under the name Planera gmelini (Michaux) and by Berry.

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).

Planera ungerii Ettingshausen

Plate 58, figure 5


A single fragment of a leaf of this species, collected by Hjalmar Furuhjem 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.

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satisfactorily is represented by Ettingshausen's figure 13. An even wider diversity of forms, however, was depicted by Heer 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 from the Miocene of Colorado and Oregon, by Berry from the Miocene of Virginia, and by me 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 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. P. Buddington in 1922 (lot 7890).

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, but in nearly every such case the generic resemblance to Artocarpus appears to be closer 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) 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 56, 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 olmediaeifolium Unger, from the Miocene of Styria, but they are relatively shorter and broader and not so conspicuously narrowed and elongated toward the apex. A. olmediaeifolium was tentatively identified by Lesquereux 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; and a com...
The only other recognized representative of the genus in America is *Artocarpidium cretaceum* Ettingshausen, an entire-leaved species, originally described from the Cretaceous of the Old World and subsequently identified by Lesquereux 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 Artocarpaceae, 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**: Yukutat-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 Page, and A. G. Maddren in 1906 (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 7470) (pl. 59, fig. 5).

**Genus Ficus Linnæus**

*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.


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, with a query after the generic designation. It is evident, from a comparison of figures, that they should be referred to the genus *Dobeyopsis* and apparently to *D. deckeri* Weber, from the Miocene of Europe; 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 *Dobeyopsis deckeri*; but Knowlton 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 1 1/2 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 69, 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 campodrome 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 campodrome.

This specimen is apparently generically related to one of four leaves from southern Alaska described and figured by Newberry 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
it as more closely related to *Phyllites* sp. Menzel, 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 overbeckii* Hollick, n. sp.

Plate 60, figure 7

Leaf apparently oblong-ovulate, 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—an Upper Cretaceous species—and *F. sordida* Lesquereux, 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.

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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, 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, 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.

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. 936); collected by T. W. Stanton in 1904 (lot 3539).

*Ficus dalli* Cockerell


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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 pre-occupied, having been previously applied to a living species, and the name F. dalli was given to it by Cockerrill. 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, 1885; 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 undulately emphasized in his figures, especially in figure 1, plate 60, in which the irregular, ragged margins, 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 5886).

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,18 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 118, figure 8

Leaf spatulate (1), 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. stenocarpofolia Ettichsenhauen,19 from the Tertiary of Croatia;

18 Saporta, Gaston de, "Etudes sur la vegetacion du sud-est de la France a l’epoque terriente," pl. 2, no. 2: Annales sci. nat. [Paris], sér. 4, Botanique, vol. 17, p. 251 (38), pl. 5, figs. 9, 9a (pl. 7, fig. 15), error in text, 1865.
17 Watelet, Adolphe, "Description des plantes fossiles du bassin de Paris," pl. 192 (text), pl. 53, figs. 3, 3a (atlas), Paris, 1866.
16 Schmalhausen, Johannes, "Beiträge zur Terith-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 (8), fig. 14; pl. 35 (8), figs. 11-17, "[H. myrtilloides]," Berlin, 1894.
and *H. arctica* Heer, 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 under the name *Corinaria loolensis*, 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 MACCINTOCKIA Heer**

*Maccintockia 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 vena-
tions, 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 *Maccintockia*, 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. Elkin in 1908 (lot 2298).

**Order POLYGONALES**

**Family POLYGONACEAE**

**Genus COCCOLOBIS P. Browne, 1764 (=COCCOLOBA Linnaeus 1794)**

*Coccolobis chapini* Hollick, n. sp.

**Plates 121, 122**


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 flex-
uous 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* Lesquerer.*" Coccolobis esquinitica* Berry, and *Coccolobis usiferafolia* Berry—have been elsewhere recorded from localities in the United States, and one Cretaceous species—*Coccolobites cretaceus* Berry—in the closely allied if not synonymous genus *Coccolobites.* 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 under the name *Phyllites coccolobaeola*, from the Tertiary of Chile.

Six European species—*Coccolobites massalangiana* Visiani,* C. morindioides* Massalongo,* C. mazz.
Coccoloba bilinica Ettingshausen,\textsuperscript{31} C. acutangula Ettingshausen,\textsuperscript{32} and C. sp. ? Marty\textsuperscript{33}—all of Tertiary age, have been described and some of them figured. All are small, compared with ours, except, apparently, \textit{C. muscosolonica}, which is described as \textit{folium} \textit{probabiliter} \textit{longum} 135 centim., latum 140 cent., \textit{Coccolobae pubescenti} maxime proximum.\textsuperscript{37} This indicates a leaf about four times the size of ours and a mutual resemblance to the living \textit{Coccoloba pubescenti}.

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 \textbf{BANALES}

Family \textbf{NYMPHAEEAE}

\textbf{Nelumbo} \textit{Adanson}

\textbf{Nelumbo protolutea} Berry?

Plate 61, figures 1-3

\textit{Nelumbo protolutea} Berry, U. S. Geol. Survey Prof. Paper 108, p. 64, pl. 24, figs. 1, 2; pl. 25, figs. 1-4, 1897.

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.\textsuperscript{34} No other described American fossil species of the genus is comparable with this in size, except the Cretaceous species \textit{Nelumbo kempi} (Hollick) Hollick,\textsuperscript{35} from Long Island, New York, which may be compared with \textit{N. provinciale} = \textit{Nelumbium provinciale} Saporta,\textsuperscript{44} from the Cretaceous of France; but a comparison of the venation 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 \textit{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—\textit{Nelumbo nelumbo} (Linnaeus) Karsten, found in the southern and south-eastern Asiatic region from southern Japan to northern Australia and westward to the Caspian Sea, and \textit{Nelumbo lutea} (Wildenow) 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.\textsuperscript{37}

None of the American Tertiary species, other than \textit{Nelumbo protolutea}, are comparable in size with certain of the European species of equivalent age. \textit{N. lakesiana} (=\textit{Nelumbium lakesii} Lesquereux\textsuperscript{45}) and \textit{N. tetrafolia} (=\textit{Nelumbium tetrafolium} Lesquereux\textsuperscript{45}), from Colorado—the former with a maximum diameter not exceeding 20 centimeters—are the largest, whereas certain European Tertiary species, such as \textit{N. protospeciosum} (=\textit{Nelumbium protospeciosum} Saporta\textsuperscript{46}), from France, are represented by leaves with diameters of 30 centimeters or more. Berry\textsuperscript{41} notes the resem-
In 1911 Knowlton,\(^4^3\) in a review of Lesquereux's descriptions of fossil plants from Miocene auriferous gravel of California, identified Magnolia californica Lesquereux \(^4^4\) 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 4839) (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 4128) (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 5601) (pl. 62, fig. 4).

**Magnolia ovalis Lesquereux**

Plate 63, figures 1, 2


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 \(^4^7\) under the name *Magnolia cordifolia*. These two species or forms were included in a single species and relegated to the genus *Combretum* by Berry, \(^4^8\) 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, \(^4^9\) 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

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\(^{44}\) Lesquereux, Leo, Recent determinations of fossil plants from Kentucky, Louisiana, Oregon, California, Alaska, Greenland, etc.: U. S. Nat. Mus. Proc., vol. 11, p. 10, 1888.


\(^{46}\) Ettingshausen, Constantin von, Die Eocene Flora des Monte Promont: K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 6, p. 96 [26], pl. 10, figs. 3, 3; pl. 11, fig. 1; pl. 12, 1854 [1855].


\(^{48}\) Lesquereux, Leo, op. cit., pl. 22, figs. 1, 2.


\(^{50}\) 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, fig. 1, 1917 [1918].
conspecific, and remarked:22 “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 specimen, 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 identified.

Locality: Yukon-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 1906 (lot 3847).

**Magnolia nordenskioldii Heer**

*Magnolia nordenskioldii* Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 82, pl. 21, fig. 3; pl. 30, fig. 1, 1876.


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 23 expressed the opinion that among fossil species it approaches most nearly *Magnolia ovalis* Lesquereux, the species last described.

22 Knowlton, F. H., op. cit., p. 316.
23 Heer, Oswald, op. cit., p. 83.
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. The validity of the species in connection with these two specimens has, however, been questioned by Knowlton, 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 1906 (lot 8847).

Cinnamomum ficoide 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 secondary 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, 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, 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 pseudopopuln Lesquereux, 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 pseudopopuln by other authors, 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 ofRussel Creek, Alaska Peninsula. (original no. P-24); collected by W. R. Smith in 1922.

Genus Persea Gartnere

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

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[^4]: Lesquereux, Leo, The Tertiary flora: U. S. Geol. Survey Terr. Rept., vol. 7, p. 221, pl. 37, fig. 6 (excl. fig. 10), 1878.
[^6]: 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. 112, 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 guisardi* (Gaudin) Schimper (= *Laurus guisardi* Gaudin) and *Laurus furstenbergii* Alex. Braun, fide Heer—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, from the Miocene of California, and *M. pulchra* Ward 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 5847).

**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 from 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 and *S. selugyni* Dawson—but both presumably from Eocene deposits of southeastern 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 and *S. primigenioides* Engelhardt, but the entire-leaved forms that have been described, such as *S. aesculapii* Heer, 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 oreodaphnifoia* Massalongo, 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...
Virginia by *S. paraefolium* Fontaine,\(^6\) *S. cretaceum heterolobum* Fontaine,\(^7\) *S. bilobatum* Fontaine,\(^8\) and *S. potomacensis* Berry.\(^9\) 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 \(^10\) and its subsequent elaboration by Lesquereux,\(^11\) 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 anulilobum* Lesquereux \(^12\) and *Sassafras protophyllum* Saporta \(^13\)—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 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 aesculapii* Heer \(^17\) 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.\(^7\) 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 \(^7\) and Berry.\(^8\)

Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. V); collected by W. W. Atwood in 1907 (lot 4980).

**Genus MALAPOEMMA** Adanson

*Malapoemenia magnifica* (Saporta) Hollick, n. comb.

Plate 60, figures 1-5

*Listaea magnifica* Saporta, Annales sci. nat. (Paris), sér. 5, Botanique, vol. 4, p. 289 (139), 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 *Listaea expansa* Saporta and Marion,\(^61\) from the Eocene of Belgium, and our smaller specimens with *Listaea deehoffleri* Engelhardt,\(^44\) 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 4932) (pl. 86, figs. 1, 4). Idem
(original no. V, lot 4359) (pl. 68, 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 Page, 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 7665) (pl. 66, fig. 2).

Malapoenna carbonensis (Ward) Knowlton?

Plate 65, figure 6


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. Kindie in 1905 (lot 3852).

Genus BENZOIN Fabricius

Benzoin antiquum Heer

Plate 65, figures 2-5


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; and it was recorded from Colorado, with a query, by Lesquereux 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, the peculiar irregularity of the secondary venation 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).

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Genus LAURUS Linnæus

Laurus californica Lesquereux

Plate 64, figure 4a; plate 100, figure 8b

Laurus californica Lesquereux, U. S. Geol. Survey Terr. Rept., vol. 8, p. 232, pl. 57, fig. 3; pl. 58, figs. 8-9, 1883.

The only figures of this species heretofore published are those by Lesquereux, from the Miocene of California, although it was recorded by Knowlton 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 Laurus oregonensis Chaney, 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 7665) (pl. 109, fig. 8b).

Laurus fürstenbergii Alex. Braun

Plate 67, figure 9


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 1866, by Heer.

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, 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.  

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Heer, Oswald, Flora tertiaria Helvetiae, vol. 2, p. 77, pl. 64, figs. 1-4, 1855.


originally described from the Miocene of Germany and also described and figured by Heer from the Miocene of Switzerland, and *Persea tibergienni* Pilar, from the Tertiary of Croatia. *Laurus obovata* was described by Lesquereux, 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.

Localitp: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4382).

*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 an acute angle with the midrib, 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 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.

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

*Laurus ocoetafolia* Ettingshausen

Plate 67, figure 10

*Laurus ocoetafolia* Ettingshausen, K.-x. geol. Reichsanstalt, 1851.

This specimen represents one of the many leaf forms that might be referred either to this species or to *Laurus primigenia* Unger.

As far as I am aware there is no previous record of any American fossil leaf having been identified as *L. ocoetafolia*, 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. ocoetafolia* 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. ocoetafolia*, 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, Lesquereux, and Engelhardt; *L. ocoetafolia* Ettingshausen and *L. svecosoviciana* Unger according to Heer; and *Mespilodaphne purpurea* Lesquereux. 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: Esha Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1916 (lot 1897).

*Laurus princeps* Heer

Plate 67, figure 1

*Laurus princeps* Heer, Flore tertiaaria Helvetiae, vol. 2, pl. 77, 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 and one from the Eocene of the Yellowstone National
Park by Knowlton, 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 and L. primigenia Unger. These species, however, may be readily differentiated from each other and from L. primiceps 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 2-3


The seven specimens that are here included in this species might, almost equally well, be referred to Laurus primigenia Unger, 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, from the Eocene of Wyoming; by Hollick, 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; 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.

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) (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 DAPHNOCENE Unger

Daphnogene kanii Heer

Plate 67, figure 11


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 the species in America was made when I tentatively identified it in connection with a specimen from the Eocene of Louisiana; but this was subsequently described as a new species, Cinnamomum postnewberryi, by Berry, 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-


Hollick, Arthur, A report on a collection of fossil plants from northwest Louisiana: Louisiana Geol. Survey Special Rept. 5, p. 284, pl. 41, fig. 2 (excl. fig. 17), 1899.
sence of any trace of secondary nervation in the Alaska specimen renders satisfactory comparison with *Cinna-
momum postneuberryi* impossible; but in any event it is probably related to the leaves of the Arctic re-
gions 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 in-
cluded it in the Lauraceae and subsequently, under the genus *Cocculites*, in the Menispermaceae. It was also
included in the Menispermaceae under the names *Coc-
culus kanii* (Heer) by Saporta and Marion and *Mac-
ciintockia kanii* (Heer) by Schimper; and was again
relegated to the Lauraceae, under the name *Cinna-
momum kanii* (Heer), by Staub. 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 Chilikat Village, Yaku-
tat-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 se-
everal from Tertiary horizons in both the Old World
and the New, that have been referred to the genera
*Getonia*, *Viburnum*, *Porana*, and *Hydrangea* 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

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 spec-
imens 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: Taku Mountain, 8½ miles northeast of Gates of
Crate, 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 pin-
nate, 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 rec-
ognized 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 forthergilloides* Saporta, originally described from the Tertiary of France and
subsequently identified by Ward from the Eocene
(Fort Union formation) of Montana. It is also al-

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12 Saporta, Gaston de, and Marion, A. F., Essai sur l'état de la végétation à l'époque des marais hercyniens de Galindes: Acad. roy.
scl. Belgique Mém. cour. et mém. sav. étrangers, vol. 37, no. 6, p. 63,
pl. 10, fig. 1, 1873.

13 Schimper, W. F., Traité de paléontologie végétale, atlas, pl. 98,
fig. 18, 1874.

14 Staub, Moritz, Die Geschichte des Genus *Cinnamomum*: Math. u.

15 *Getonia oenogena* v. Unget, G. Weber, C. D., Die Tertiärflora der
niederrheinischen Braunkohlenformation: Paläonographyca, vol. 2,
p. 215 (101), pl. 7, fig. 2, 1851 [reprint 1852], = *Viburnum weberti* Schenk.

16 *Porana oenogena* (Alex. Braun) Heer, Oswald, Flora tertia-

17 *Hydrangea bendirei* (Ward) Knowlton, F. H., Fossil flora of the
John Day Basin, Oregon: U. S. Geol. Survey Bull. 294, p. 60, pl. 6,

18 *Hydrangea bendirei* (Ward) Knowlton, F. H., Fossil flora of the
John Day Basin, Oregon: U. S. Geol. Survey Bull. 294, p. 60, pl. 6,

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, pl. 2, p. 45, 1866; Predrome d'une flore fossile des
travertins anciens de Séance: Soc. géol. France Méém., sér. 2, vol. 8,
no. 3, p. 393 (105), p. 32 (11), fig. 8, 1866, = *Hamamelites forthergilloides*
(Saporta) Schenk, Die fossilen Pflanzenreste, p. 241, Breslau,
1888.

Survey 6th Ann. Rept., p. 554, pl. 49, fig. 6, 1888; 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, 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, 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, Seventy mile Creek, half a mile below Mogul Creek (original no. 10); collected by W. W. Atwood in 1907 (lot 4711).

**Genus LIQUIDAMBAR** Linnaeus

*Liquidambar europaeeum* Alex. Braun


Unger, Chloris protograea, pt. 1, p. 120, pl. 35, figs. 1-5, 1847.


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, and from the Eocene of Oregon by Newberry, 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


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, and one from the Eocene of Greenland, figured by the same author 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, which appear to be not very far apart specifically; indeed, Knowlton, 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 Ram-part and 300 feet above 11AE 1, central Yukon region (original no. 11AE 2); collected by H. M. Eakin in 1911 (lot 8066).

*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 curled up-
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 described), approaches it more closely in some respects it resembles \( \text{Platanus aceroides} \) Goep- pert \( ^9 \) and \( \text{P. oeynhausiana} \) Goeppert \( ^1 \) 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 \( \text{P. aceroides} \) by various authors failed to indicate anything except a general resemblance to our specimen. \( \text{Platanus aceroides} \) 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 second- ary 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 0065).

\textbf{Platanus nobilis Newberry}


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 \( \text{Platanus nobilis} \) 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 \( ^\text{2} \) from the Eocene of Saskatchewan and Alberta.

It is unfortunate that no mention was made of the authority for the identification of the species.

\textbf{Leaves of Platanus}

"Leaves of \( \text{Platanus} \)" Dall, U. S. Geol. Survey Bull. 84, p. 246, 1892.


\( ^1 \) Idem (Schossnitz), p. 20, pl. 19, figs. 1–4.


In connection with a geologic section on the Ulukuk River, in the lower Yukon-Norton Sound region, Dall mentioned "argillaceous shale, with leaves of \( \text{Platanus} \)," and we may infer, probably, that the leaves are those of \( \text{P. nobilis} \) Newberry, the species last discussed, as they were all found in the same general region.

\textbf{Platanus sp. Knowlton}


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 Draw 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 \( \text{Platanus} \) leaves subsequently collected in the same general region.

\textbf{Family ROSACEAE}

\textbf{Genus SPIRAEA Linnaeus}

\textbf{Spiraea andersoni Heer}


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 Furubjelm 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.

\textbf{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 mar- ginal 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 \( \text{Spiraea prunifolia} \) Et-
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 431).

Spiraea sp. Heer


The above generic identification was included in a list of fossil plants collected by Hjalmar Furuholm 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 andersonii*. (See p. 124.)

**Genus Rosa Linnaeus**

*Rosa confirma* 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 pinnate, 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 sparsely 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.? inquerea* Knowlton, is a calyx; one, *R. ruwimana* Cockerell, is a flower bud; and the other three, *R. hilliae* Lesquereux, *R. willmatiae* Cockerell, and *R. scudderii* Knowlton, 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.

**Family POMACEAE**

**Genus Crataegus Linnaeus**

*Crataegus alaskensis* Hollick, n. sp.

Plate 71, figure 5

Leaflet oblong-obovate, 5 centimeters in length by 2.25 centimeters in maximum width, petiolate, the petiole

Our specimen differs little from any of them, and its resemblance to the terminal leaflet of *R. scudderii* 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: 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 589).

*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 undersides 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 confirma*), 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, and *R. lignitum* Heer as figured by Engelhardt, 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, 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 590).
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 Pomoaceae, 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, 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 capsii 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. 25AC 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 DRUPEACEAE

### Genus PRUNUS Linnaeus

**Prunus scottii** Heer  
**Plate 70, figure 4**


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, 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

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4 Menzel, Paul, Über die flora der Senftenberger Braunkohlenablagerungen: K. preuss. geol. Landesanstalt Abb., n. ser., no. 46, p. 80, pl. 4, fig. 10b; pl. 5, fig. 10, 1906.

5 Heer, Oswald, Flora tertiaris Helvetiae, vol. 3, p. 306, Winterthur, 1850; Miocene baltische Flora: Beiträge zur Naturkunde Preussens, no. 2, p. 46, pl. 12, figs. 3, 3b, 4, 4b, Königsberg, 1869.
Baltic region of Prussia, and later from the Eocene of Greenland,\(^4\) 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 8820).

**Prunus olympica** Eitingshausen

Plate 70, figures 5, 6


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 Eitingshausen and later by Engelhardt,\(^5\) 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. *aegualias*, 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 8820).

**Prunus variabilis** Newberry?

Plate 71, figures 1, 2


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 denticate 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* Lesquererux,\(^6\) 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\(^7\)

*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, campodrome; 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 tentifolium* Engelhardt,\(^8\) from the Tertiary of Colombia; and *P. eocenicum* Berry,\(^9\) from the Eocene of Tennessee.

**Locality:** Yukon River, right (north) bank, at Drew mine, central Yukon region (original no. 5AH 5); collected by Arthur Hollick and Sidney Paige in 1903 (lot 5246).

**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

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\(^4\) Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossilia actea, vol. 7, p. 137, pl. 92, figs. 5, 6, 1883.


\(^7\) Martius, C. F. P., Hortus region monacensis, 1829. Martius established the genus as *Pithecolobium* but without generic or other description. In 1837 (Herbarium florae brasiliensis, pp. 114–116), he corrected the name to *Pithecolobium*, with full generic description. This form, with one f omitted, is usually followed by modern authors.


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, 53 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. oregoniaca* 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. macroasperma* Knowlton, 54 *A. lamarcensis* Knowlton, 55 and *A. wardii* Knowlton, 56 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 *Calypria europea* Saporta; 57 and comparisons may also be made with legumes of living species in the genera *Cercis* and *Cladrastis*.

**Locality:** Kootzhahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4386).

53 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.
55 *Idem*, p. 730, pl. 98, fig. 6.
56 *Idem*, pl. 98, fig. 7.

Family **CAESALPINIACEAE**

Genus *CASSIA* Linnæus

*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 58 as identified by Heer 59 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 undulata* Unger, 60 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.

**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 2346) (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 5001) (pl. 72, fig. 4).

Cassia phaseolites Unger?

Plate 72, figures 5, 6

*Cassia phaseolites* Unger, K. Akad. Wiss. [Wien], Math.-naturwiss. Cl., Denkschr., vol. 2, p. 198 (53), pl. 95 (41), figs. 1-5; pl. 60 (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. Heterophyllly 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 simple 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.

60 Heer, Oswald, *Flora tertiaaria Helvetiae*, vol. 3, p. 119, pl. 137, figs. 60-74; pl. 138, figs. 1-12, 1889.

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 19 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 oblone-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 kennedyaeformium* 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 Page in 1903 (lot 3248).

Genus CANAVALLIA 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 differen-
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) has been referred to the genus, and this species has the same geologic and geographic distribution as C. ecenica. 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, 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 conv- 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 tetragonolobus* Linnaeus of the Philippine Islands, and the European Tertiary species *Dolichites maximus* Unger, which he compared with the existing *Dolichos citatus* Wallich, of the East Indies.

The only other American fossil species heretofore described in either genus is *Dolichites deusseni*. Berry, from the Eocene of Texas; but between this species and ours there is only a very remote resemblance.

Locality: Esk Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897).

**Order GERANIALES**

**Family MALPIGHIACEAE**

**Genus TETRAPTERIS** Cavanilles

*Tetrapetis harpyiarum* Unger

Plate 93, figure 3

Locality: Yakutat Bay, west shore, at Dalton's coal outcrop, Yakutat-Copper River region (original no. 14); 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-
though Saporta\(^1\) 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 1906 (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 vei-lets; tertiary venation at right angles to the secondary throughout, closely spaced, often forked and connected, with fine veins in between, forming a uniform, finely reticulated network throughout the entire leaf.

These leaves appear to be generically identical with *Anacardites alnifolius* Saporta,\(^1\) 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,\(^2\) 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 bali* Berry,\(^3\) 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


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 meriana* Heer,\(^4\) from which, he said, it is almost impossible to distinguish it.

**Family ILCICAEAE**

**Genus ILEX Linnaeus**

*Ilex insignis* Heer

Plate 73; plate 74, figure 1


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-

\(^1\) Saporta, Gaston de, *Études sur la végétation du sud-est de la France à l’époque tertiaire*, pt. 1: Annales sci. nat., sér. 4, Botanique, vol. 17, p. 201 (48), pl. 2, figs. 1a, 1b, 1c, 1862.


\(^3\) Heer, Oswald. *Die fossile Flora Grönlands*, pt. 2: Flora fossils arctica, vol. 7, p. 139, pl. 84, fig. 18, 1883.

\(^4\) Heer, Oswald. *Flora tertiaaria Helvetica*, vol. 5, p. 82, pl. 129, figs. 5-11, Winterthur, 1869.
ticate in the upper part, apparently entire near the base; venation pinnate, campito-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, 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, 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 Nukshak, 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 7034) (pl. 74, fig. 1). Port Graham, Kenai Peninsula, Matanuska-Cook Inlet region; collected by Hjalmar Furuhjelm.

*Ilex? reticulata* Heer

Plate 103, figure 3b


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 incurred 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 5992).

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Family **Celastraceae**

Genus **Celastrus** Linnaeus

*Celastrus comparabillis* 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 curling upward, the lower and middle ones merging into the tertiary venation toward their extremities, with veinlets extending to and terminating in the marginal denticulations, those near the summit extending directly from midrib to margin.

This species differs but little from *Celastrus ferrugineus* Ward, 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, 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 1906 (lot 3879) (pl. 75, fig. 1a). Yukon River, north bank, at Drew's mine, central Yukon region (original no. 3347); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3240) (pl. 75, fig. 2b).

*Celastrus borealis* Heer

Plate 74, figures 2, 3


The species to which our specimens are tentatively referred was based by Heer upon a single fragment...
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 and C. ainitifolius Ward, 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 7922).

Celastrus sp.? Heer


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 Sis

Elaeodendron helveticum Heer


A specimen of this species [U. S. Nat. Mus. no. 1831] was collected by W. H. Dall in 1850 on Unalaska 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.

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, p. 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, but the description was not accompanied by a figure. He remarked, however, that “the identification of this finely preserved leaf is positive.” The same author 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, 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”; and Heer 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-

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33 Idem, p. 61.


37 Heer, Oswald, op. cit., p. 87.
mens from Alaska. Should this apparent identity be satisfactorily determined, the distribution of the species, according to Penhallow, 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 5857) (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 triplaminate, craspedodrome; lateral primaries subtending acute angles with the midrib, at first ascending and curving slightly outward, 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, 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, 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 otoperix* Goeppert, 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, 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 vitisfolium* Alex. Braun, as described and figured by Weber, as being closely related to or identical with the Arctic specimens; and the species is also mentioned in connection with *Acer aequidentatum* Lesquereux 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


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.
Acer inaequale Heer?

Plate 77, figures 2, 3

*Acer inaequale* Heer, Beiträge zur fossilen Flora Spitzbergens: Flora fossilis arctica, vol. 4, no. 1, p. 80, pl. 24, figs. 4-6, 1878.

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 Entwicklung der beiden Blattseiten spricht für ein zusammengesetztes Blatt und da bei *Acer* zusammengesetzte Blätter mit ähnlicher Nervation vorkommen, habe ich sie *Acer* eingerührt, 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, 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. 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 3872) (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 78, figures 2


U. S. Nat. Mus. Proc., vol. 17, p. 227, pl. 9, fig. 3, 1894;


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 and Oregon, but the identity of the former is open to question, and three of the Oregon specimens (figs. 1, 2, 4) represent *Acer bentirei* Lesquereux and the other one (fig. 3) represents *Platanus dissection* Lesquereux. 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*

Plate 79, 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...
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. Leaves tentatively referred to *A. trilobatum productum* (see p. 185) 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. Carps in 1911 (lot 6063).

**Family AESCULACEAE**

**Genus AESCULUS Linnaeus**

*Aesculus arctica* Knowlton


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. The two species were collected at Kukak Bay, Alaska Peninsula, by De Alton Saunders in 1899.

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2. Knowlton, P. H., op. cit., p. 153, pl. 27; pl. 29, fig. 1.

**Genus CUPANIA Linnaeus**

*Cupania comparablibis* 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 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 Nukshak, 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, 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-

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4. Saporta, Gaston de, Études sur la végétation du sud-est de la France à l'époque tertiaire, vol. 5, pl. 2; Annales sci. nat. (Paris), sér. 5, Botanique, vol. 4, p. 327 (1883), pl. 8, fig. 7, 1885.
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


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, 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, 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 5987).

Sapindus angustifolius Lesquereux? (not Blume)

Plate 76, figure 6


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 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 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: 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 caekini 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


\footnote{Berry, E. W., The lower Eocene flora of southeastern North America: U. S. Geol. Survey Prof. Paper 91, p. 274, pl. 62, fig. 1; pl. 64, fig. 10; pl. 66, figs. 1, 2; pl. 100, fig. 1; p. 275, pl. 63, figs. 2–5; pl. 69, fig. 4; p. 276, pl. 68, figs. 3–7, 1918.}
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 *Koebrucheria* 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 leaves of suggestively similar type, from the Tertiary of Colorado, were described and figured by Lesquereux under the name *Myrica diversifolia*, subsequently referred to the genus *Sorbus* by Cockerell. Dawson described and figured a leaf of similar aspect to ours, from the Tertiary (Oligocene?) of British Columbia, under the name *Acerites neundilingifoliium*.

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 palaeobotanical specimens of the region.

Locality: Yukon River, south bank, 1½ miles above Rampart, central Yukon region (original no. 31AE 1); collected by H. M. Eakin in 1911 (lot 6094).

Order RHAMNALES
Family RHAMNACEAE
Genus RHAMNUS Linnaeus

*Rhamnus rossmaessleri* Unger

Plate 78, figure 6b


*Phyllites rhamnoides* Rossmaessler, Beiträge zur Versteinerungskunde, no. 1, p. 33, 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, which compare very closely with ours both in size and shape, and one, somewhat larger, by Sismonda.


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 described by Heer. In the existing flora of northern North America the genus *Sorbus* is represented by 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 leaves of suggestively similar type, from the Tertiary of Colorado, were described and figured by Lesquereux, subsequently referred to the genus *Sorbus* by Cockerell. Dawson described and figured a leaf of similar aspect to ours, from the Tertiary (Oligocene?) of British Columbia, under the name *Acerites neundilingifoliium*.

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 palaeobotanical specimens of the region.

 Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4992).

*Rhamnus brevifolius* Alex. Braun

Plate 79, figure 3


This species has not been heretofore recorded from the North American continent; but it was described and figured by Heer 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 described by Heer. In the existing flora of northern North America the genus *Sorbus* is represented by 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 leaves of suggestively similar type, from the Tertiary of Colorado, were described and figured by Lesquereux, subsequently referred to the genus *Sorbus* by Cockerell. Dawson described and figured a leaf of similar aspect to ours, from the Tertiary (Oligocene?) of British Columbia, under the name *Acerites neundilingifoliium*.

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 palaeobotanical specimens of the region.

 Locality: South side near head of Hamilton Bay, Kupreanof Island, southeastern Alaska (original no. III); collected by W. W. Atwood in 1907 (lot 4992).
Rhamnaceae

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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 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, Sismonda, and others. An American species that approaches it very closely in appearance, however, is Rhamnus belmontensis Knowlton and Cockerell, 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 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 tertiaire Helvetiae, vol. 3, p. 79, pl. 124, figs. 4–15; pl. 125, figs. 1, 7, 13, 1839.

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, but the marginal denti-
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). Kootzannahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4380) (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, 1880.

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 species subsequently identified by Lesquereux and Berry, 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 campledomere 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 Nordgrönl.: Flora fossilia arctica, vol. 1, p. 125, pl. 49, figs. 2, 2b; 1880; Contributions to the flora of North Greenland: Idem, vol. 2, no. 4, p. 483, pl. 59, fig. 20, 1889; Die fossile Flora Grönländs, 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, which is suggestive of the form represented by our figure 6, and a specimen of Z. meigsii Lesquereux 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


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 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. Eakins in 1908 (lot 5529).

Zizyphus townsendi Knowlton


Adanson, P. F. H., Geology and paleontology of the Raton region, 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 and *Z. cinnamomoides* (Lesquereux). 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


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 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, Ward, and Knowlton, and these specimens vary but little among themselves and compare quite satisfactorily with Heer's figures of the type specimens of the species.

**Locality:** Jam Mountain, 8½ miles northeast of Gates of Crater, Alaska Peninsula (original no. P–29); 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. 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 ovoides* (Goeppter) Heer, 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 identified a leaf strikingly similar to ours, from supposed Cretaceous rocks of Sakhalin, as *Cocosillus extinctus* Velenovsky, but any resemblance to Velenovsky's figures is difficult to discern. It appears to be...
more probable that the geologic age of the rock in which the specimen from Sakhalin was found was not correctly determined.

Localities: Eskka Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chapin in 1910 (lot 5897). Matanuska coal field, 24 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 olivi Heer

Plate 51, figure 2

Vitis olivi Heer, Flora fossils 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; an imperfect specimen, from the Tertiary (Miocene?) of Canada, was provisionally identified and listed by Penhallow; 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. 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 7655).

Vitis atwoodi Hollick, n. sp.

Plate 50, figure 4

Leaf apparently orbiculate-cordate, about 8 centimeters in length by 8 centimeters in maximum width; margin acutely suboblate, 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 distal, 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 olivi 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: Kootznaahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4390).

Vitis heeriana Knowlton

Plate 50, figure 3


Not Vitis crenata Thumb, 1825.


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 7296) (pl. 50, fig. 3).

Vitis alaskana Cockrell


Vitis rotundifolia Newberry, U. S. Nat. Mus. Proc., vol. 5, p. 518, 1882 [1883]; U. S. Geol. Survey Mon. 35, p. 120, pl. 51, fig. 2 in part; pl. 53, fig. 3, 1898.


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
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 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 Quichena in 1906.”

Genus Cissus Linnaeus

Cissus cissoides (Saporta) Hollick, n. comb.

Plate 80, figure 2


Cissus primaevas 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, 1988.

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.

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, 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 grislandica Heer but subsequently included by the author under Pterospermites alternans Heer. 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 ELAECARPACEAE

Genus ELAEOCARPOS 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 photiniae-folia Nathorst, from recent Tertiary (Pliocene) deposits of Japan, and with leaves which Florin referred directly to the existing Japanese species Elaeocarpus photiniae-folia 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.

8 Saporta. Gustav de, Progrème d’une flore fossile des travertins anciens de Suzanne : 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, 1866.
9 Heer, Oswald, Flora fossile de Nordgrönland : Flora fossiles arctiques, vol. 1, p. 111, pl. 49, fig. 8, 1866.
10 Heer, Oswald, Contributions to the fossil flora of North Greenland : Ideem, vol. 2, no. 4, p. 480, 1869.
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 Linnæus**

*Tilia malmgreni* Heer

Plate 103, figure 1c


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,²² from Sakhalin; and the figures of the imperfectly defined species *T. alaskana* Heer,²³ 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: Kootzahoo Inlet, Admiralty Island, southeastern Alaska (original no. IX); collected by W. W. Atwood in 1907 (lot 4890).

²² Heer, Oswald, Die Miocene Flora der Insel Sakhalin: Flora fossilia arctica, vol. 5, no. 3, p. 47, pl. 12, figs. 6, 7, 1878.

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*Tilia alaskana* Heer


Two fragmentary leaf specimens, collected by J. 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 ²⁴ from Spitsbergen, and briefly remarked: "Sed dentibus majoribus discrepat."

*Tilia gregiioides* 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 *Grevia crenata* (Unger) Heer ²⁵ 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 *Grevia* 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,²⁶ 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 ²⁷ by Heer, is almost exactly like the similar parts of our

²⁵ Heer, Oswald, Flora terraria Helvetiae, vol. 3, p. 42, pl. 110, figs. 3, 6, Winterthur, 1868.
²⁷ Heer, Oswald, Beiträge zur Miocene Flora von Nord-Canada: Flora fossilia arctica, vol. 6, pt. 1, no. 3, p. 17, pl. 3, fig. 2, 1880.
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specimens. This fragment, however, does not compare satisfactorily with the type specimen from Spitsbergen as described and figured by Heer,\(^\text{a8}\) 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\(^\text{25}\) under the name Tilia malmgreni, in which the generic characters may be seen to be compared satisfactorily with those preserved in our specimen, but even the largest of Heer's specimens,\(^\text{69}\) 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\(^\text{61}\) 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\(^\text{62}\) under the name T. sachalinensis. The fossil species that appears to approach ours most closely is Tilia speciosissima Knowlton,\(^\text{23}\) 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 Linnæus

Grewia crenata (Unger) Heer

Plate 84, figure 1


Dombeyopis crenata Unger, Genera et species plantarum fossilium. p. 448, Vienna, 1850.


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 referred by Heer. The particular specimen with which

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\(^\text{a8}\) Heer, Oswald, Miocene Flora von Spitsbergen: Flora fossilarosa arctica, vol. 1, p. 160, pl. 33, figs. 1, 2, 1868.


\(^\text{62}\) Heer, Oswald, Miocene Flora der Insel Sachalin: Flora fossilarosa arctica, vol. 5, no. 3, p. 47, pl. 12, figs. 6, 7, 1878.

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 Knowltom; 66 and were recorded from southwestern Canada by Pennalw.67

The resemblance of certain forms of the species to Populus saddachi 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 saddachi 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 saddachi 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 2247).

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 [Dontbéopsis] 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 69 protested against the merging of the two species by Heer in the following words:

Herr O. Heer zieht meine Dontbéopsis crenata zu seiner Grewia crenata. Es steht mir kein Urthell 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 auszeichnet.

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 auriculata, 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

65 Newberry, J. S., The later extinct forms of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 46, fig. 2; pl. 48, figs. 2, 3, 1898.
68 Heer, Oswald, Flora territaria Helvetiae, vol. 3, p. 307, 1859; Miocene flora von Nordg.-u-China: Flora fossilia arctica, vol. 1, p. 87, pl. 0, figs. 1-4; pl. 15, fig. 1b. 1868.
70 Idem: (Syllage), p. 15.
72 Newberry, J. S., The later extinct forms of North America: U. S. Geol. Survey Mon. 35, p. 120, pl. 46, fig. 2; pl. 48, figs. 2, 3, 1898.
73 Heer, Oswald, Beitrag zur fossilen Flora Spitzbergen: Flora fossilia arctica, vol. 4, no. 1, p. 84, pl. 19, figs. 12a-14, 1870.
74 Idem, p. 85, pl. 16, fig. 8b; pl. 19, figs. 16, 17.
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. 3A H 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 craspedodromous through veinlets extending from the marginal loops to the dentations.

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.13 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,14 and in this connection it is interesting to note the opinion expressed by Ward,15 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 nervules 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 Rhamnaceae would seem to be the order into which it must find its way, where it will find analogs in Palisurus, Ceanothus, Zizyphus, etc.


I am also inclined to think that certain leaves from the upper Eocene (Clarno formation) of Oregon, referred to Grewia crenata by Newberry,16 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,17 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,18 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. 87); collected by W. W. Atwood and H. M. Eakin in 1909 (lot 5208).

Genus GREWIOPSIS Saporta

Grewiopsis grandicus 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

16 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, 1889.


their branches would probably terminate in the denticles. In that event we should have a leaf similar in appearance and general characters to *Grewiopsis credneriaeformis* (Saporta) Saporta,\(^9\) 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 denticles 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,\(^9\) 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 denticles receiving the termini of the secondaries and their branches; tertiary venation subdenticating 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\(^9\) and *G. viburnifolia* Ward,\(^4\) 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\(^8\) 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. tiliae Saporta).”

Locality: South side near the head of Hamilton Bay, Kupre-anof Island, southeastern Alaska, intermediate of three horizons (original no. IV); collected by W. W. Atwood in 1907 (lot 4391).

**Grewiopsis congenualis 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-
nate, lower pair simulating lateral primaries, supra-basilar, 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 under the name *Grewioipsis populisfolia*. 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. 35, fig. 5).

Chignik, about 200 yards south of the native village, Chignik Bay, Alaska Peninsula (original no. 866); collected by T. W. Stanton in 1904 (lot 3618) (pl. 35, fig. 6).

*Grewioipsis alaskana* Hollick, n. sp.

Plate 35, 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-crasspedodrome; 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 crasspedodrome.

This species resembles *Grewioipsis populisfolia* Ward, 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 *Grewioipsis orbiculata* (Saporta) Saporta, 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. 866); collected by T. W. Stanton in 1904 (lot 3519) (pl. 55, fig. 1). Esk Creek, Matanuska coal field, Matanuska-Cook Inlet region; collected by Theodore Chaplin in 1910 (lot 3597) (pl. 85, figs. 2-4).

Genus *APEIBOPSIS* Heer

*Apeibopsis? discolor* (Lesquereux) Lesquereux

Plate 51, figure 3


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, crasspedodrome; 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*,

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88 Saporta, Gaston de, Prodrome d'une flore fossile des travertins anciens de Sézanne; Soc. géol. France Mém., sér. 2, vol. 6, no. 3, p. 411 (128), pl. 32 (9), figs. 11, 12, 1898.
such as *P. nebrascensis* Newberry and, in particular, *P. nebrascensis grandidentata* Lesquereux, 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 which was not accompanied by any illustration. Work of the collector, Mr. H. M. Eakin. 

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 eakinii*, 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 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 superficial resemblance to the leaf described and figured under the name *Cinnamomum mississippiense* Lesquereux, 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.

Localitys: 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 fossilia arctica, vol. 2, no. 4, p. 480, pl. 43, fig. 15b; pl. 53, figs. 1-4a, 1899.

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

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size. 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 1905 (lot 3556) (pl. 57, 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, 1889.

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) belong to the same species. * * * Plate 13, figures 2-5, of my 'Flora arctica' belong, I believe, to this species." And in his discussion of Flora grönlandica 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 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, 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.

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).

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 inequilaterial, 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, 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 spectabilis 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 5802) (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 auriculaceordatus Hollick, n. sp.

Plate 92, figures 1-5; plate 93, figures 1, 2

Leaves varying in size, apparently ovate to ovate-oblanceolate, with auriculate-cordate bases and wavy or coarsely crenate-dentate margins; venation pinnate-
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 hesitation that I have decided to describe these specimen under a new specific name. They appear to be intermediate in form between Pterospemites imparilis (the species last described) and P. dentatus Heer.\(^\text{98}\) 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\(^\text{99}\) 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.\(^\text{1}\) 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 Pterospemites, Pseudoprotophyllum, and Credneria. In the same category may also be included the genera Grevioptis and Proto phyllum. They all appear to be more or less closely related, but their systematic position in the Dictyole donae cannot be said to be satisfactorily determined. Stratigraphically the probability appears to be that Cretaceous species may properly be referred to either Proto phyllum, Pseudoprotophyllum, or Credneria, and Tertiary species to Pterospemites or Grevioptis; 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 5819) (pl. 93, fig. 1). Matanuska coal field, 4,600-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. 95, fig. 2).

Pterospemites dentatus Heer

Pterospemites dentatus Heer. Newberry, U. S. Geol. Survey Mon. 35, p. 335, 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.\(^\text{2}\) under the above name, although the fragments which he had did not permit him to give a full characterization or satisfactory figures.”\(^\text{3}\) Newberry’s identification was subsequently discovered to be erroneous and the specimens to be of Cretaceous age, and they were redescribed, refurred, and renamed.\(^\text{4}\) 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.

Pterospemites dentatus Heer is a poorly defined species, and I have not been able to identify it in any of the collections from Alaska.

Pterospemites 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 pinate, 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.

\(^\text{Heer, Oswald, Miocene Pflanzen vom Mackenzie: Flora fossilis arctica, vol. 1, p. 138, pl. 21, fig. 15b; pl. 23, figs. 6–9, 1868.}\)

\(^\text{9}^{\text{Newberry, J. S., The later extinct forms of North America: U. S. Geol. Survey Mon. 95, p. 135, pl. 53, figs. 1, 2; pl. 54, fig. 4, 1898.}}\)

\(^\text{10}^{\text{Hollick, Arthur, The Upper Cretaceous Fossils of Alaska: U. S. Geol. Survey Prof. Paper 159, p. 86, pl. 58, figs. 1, 2; p. 94, pl. 71, fig. 1; p. 95, pl. 72, figs. 1, 2, 1930.}}\)
These leaves, like many others that may be referred to the genus *Pterospemites*, are difficult to differentiate specifically from certain others in the same genus. They resemble *P. imparilis* (p. 161) in shape, but the dentate margin and straighter secondary veins of *P. conjunctivus* are distinguishing characters. The marginal denticles and somewhat auriculate base are suggestive of *P. auriculaceoradatus* (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. 866); collected by T. W. Stanton in 1904 (lot 3519) (pl. 93, fig. 2). Anchorage Bay, Chignik Bay, Alaska Peninsula (original no. 961); collected by T. W. Stanton and R. W. Stone in 1894 (lot 3323) (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).

*Pterospemites alaskana* Knowlton

*Pterospemites 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.

*Pterospemites magnifolia* Knowlton


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 PARIALES**

**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 denticulation, 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,* 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. 67); 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.

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

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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,4 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 Berry5 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 (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 prevailing 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 Berry7 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. 166); 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).

4 Berry, E. W., The lower Eocene floras of southeastern North America; U. S. Geol. Survey Prof. Pap. 91, p. 291, pl. 76, fig. 2; pl. 77, fig. 1; pl. 114, fig. 5, 1916. = Quercus microdentata Hollick, in Harris, G. D., and Yeatich, A. C., A preliminary report on the geology of Louisiana, p. 280, pl. 34, 1899.
5 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 Saurauja [Saurauja] roborans Langeron, from the Eocene of France. The resemblance, however, is indicative of family rather than generic relationship.

A species that appears to resemble somewhat more nearly is Saurauja deformis (Unger) Ettingshausen, from the Tertiary of Croatia, originally described by Unger as a species of Juglans. In fact, it was the superficial 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 accepted the name Juglans deformis and applied it to a fragmentary leaf from the Miocene of Germany, in connection with which he remarked: "Ahneln in so hohem Grade den Blättern von Carya [Hicoria] alba, dass man fast geneigt wird, sie für identisch zu halten."

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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 under the name Ficus alcalina, 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 THYMIEALES

Family ELAEAGNACEAE

Genus LEPARGYREA Rafinesque

Lepargyrea 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 Lepargyrea 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 Linnæus

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...
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).

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 micropythyla* Lesquereux, from the Upper Cretaceous (1) 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 geological horizons and localities elsewhere in America, were described under various specific names by Knowlton 17

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. 318, pl. 6, fig. 1, 1869; 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.
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. 5, p. 733, pl. 102, fig. 7a, 1898. *Trapa occidentalis.*—Idem, p. 724, pl. 102, fig. 7b.

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 biornis* 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 macrullii* Heer


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.

19 Heer, Oswald, op. cit., vol. 5, p. 44, pl. 7, fig. 9b.
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 dis-tended, and I am not certain whether this appearance is a result of distortion during the process of fossiliza-tion 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 and Spitsbergen, and the fragmentary large leaf represented by our figure 2 may be compared with another of Heer’s specimens from Spitsbergen.

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 5138) (pl. 98, figs. 1, 2). Nenana coal field, Tanana region, about 0.8 mile N. 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 7294) (pl. 98, fig. 3).

Hedera auriculata Heer


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 Linnæus

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 quinquepartite, 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.

Localities: Shore east of Point Divide, between Herendeen Bay and Port Moller, Alaska Peninsula (original no. 8); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5179).

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, Devaliacea, 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.

Localities: 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 tripalimate 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.

Localities: 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 Linnæus

Cornus buchii Heer

Plate 98, figure 7


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 neuberryi Hollick, from the Eocene breccias

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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 biuchii*.

Another closely similar species is *Cornus ovalis* Les-querieux, from the Miocene of California; but the figures of this species represent specimens that are too imperfect for satisfactory comparison. *Cornus biuchii* 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 0.5 centimeters from the base; margin entire; midrib conspicuously thickened toward the base; venation strong, pinnate, particularly 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, 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. biuchii* Heer, the species last described; but this can hardly be regarded in any other light than as a mere coincidence; although Saporta figured two specimens of *Cornus platypylla* 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 fossilia arctica, vol. 2, no. 4, p. 476, pl. 60, figs. 3, 4, 1890.

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.

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, but this specimen was subsequently identified and listed by Knowlton as *Magnolia inofeldi* 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.

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Heer, Oswald, Die Miocene Flora und Fossilien Spitzbergens. 2. Flora fossilia arctica, vol. 2, no. 3, p. 61, pl. 18, figs. 34, 55a, 1870; Nachträge zur Miocenia 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.

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. 3, fig. 3, 1888.

Its affiliations are apparently with *Cornus studeri* Heer.

Localities: Yukutat-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). Yukutak-Copper River region, bed of creek flowing into head of Canyon Creek from Mount Chezum, at an elevation of 2,000 feet (original no. 33); collected by A. G. Maddren in 1905 (lot 3846) (pl. 99, fig. 3).

**Cornus orbifera** Heer

*Cornus orbifera* Heer, Gartenflora, vol. 2, p. 203, pl. 66, fig. 9, 1853.


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, rather than *C. orbifera*.

**Genus NYSSA** Linnaeus

*Nyssa arctica* Heer

*Nyssa arctica* Heer, Contributions to the fossil flora of North Greenland: *Flora fossilia arctica*, vol. 2, no. 4, p. 477, pl. 49, fig. 12b; pl. 50, figs. 6, 6b, 7, 1852.


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*, 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.
**Yukon River, south bank, just above Rampart, central Yukon region (original no. 3A10); collected by Arthur Hollick and Sidney Paige in 1903 (lot 3247) (pl. 120, figs. 10, 11).**

**Division GAMBOPETALAE**

**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.

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 eolignatica* Hollick, 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, *Magnolia primigenia* Unger, *Myrsine centamorium* Unger, *Rhododendron flos saurini* Unger, *R. megistos* Unger, and *Lauras obovata* Weber, and it is possible that our specimen may be specifically identical with one or another of these.

Localities: Yukon-Copper River region, elevation 1,000 feet above creek emptying into Berge 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 5847).

**Family VACCINIACEAE**

**Genus VACCINIUM** Linnaeus

**Vaccinium friesi Heer**


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 holliickii** Knowlton


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**


The above generic identification by Heer was recorded in the list of fossil plants collected by Hjalmar.
EBENACEAE

Furuhjelm at Port Graham, Alaska Peninsula. It probably represents the specimen subsequently described and figured by Heer under the name Vaccinium friesi. (See p. 160.)

Order EBENALES

Family EBENACEAE

Genus DIOSPYROS Linnaeus

Diospyros brachysepala Alex. Braun

Plate 105, figure 1


The principal distinction that appears to have been recognized by Heer 46 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 Tennes-see 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).

46 Heer, Oswald. Flora territoria Helvetiae, vol. 3, pp. 11-13, pl. 102, figs. 1-14b; pl. 153, fig. 39 (Diospyros brachysepala); pl. 192, figs. 15-18 (Diospyros anceps), Winterthur, 1859.


Diospyros anceps Heer

Plate 105, figure 2

Diospyros anceps Heer, Flora territoria Helvetiae, vol. 3, p. 12, pl. 102, figs. 15-18, Winterthur, 1859.


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


Not D. lanceifolia 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 lanceifolia 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, L. On some fossil plants of recent formations: Am. Jour. Sci., vol. 27, p. 361, 1899.
to represent a species of *Rhamnus*, closely similar to *R. cœbursii* Lesquerueux. Further than this, specimens from British Columbia, described and figured by Heer 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 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* Lesquerueux 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 from the Miocene of Oregon, and by Penhallow from the Tertiary (Eocene) of British Columbia.

*Diospyros stenosepala* Heer


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 Lesquerueux from the Upper Cretaceous (1) of Wyoming but was not subsequently mentioned by him. The species appears to be of doubtful validity.

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**Genus EBENOXYLON Felix**

*Ebinoxyylon boreale* Platen


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. aniceps* 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. 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 carolinum* (Linnaeus) Britton (= *Halesia tetraetera* Linnaeus), the silverbell 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 Knowlton.
ton, with reservation, to Elaeodendron polymorphum Ward, 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, Cymoxia, 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). Kootzanhoo 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, Bonnique, vol. 8, p. 86, 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 and Staphylea acuminata Lesquereux, are more or less suggestive of the general type with which ours may be superficially 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, 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 8531) (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 acuminate 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 Lesquier, from the Miocene of Colorado—in fact, our smaller leaflets are so closely similar to those represented by Lesquier'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 Lesquier 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, 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, 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 8531) (pl. 101, fig. 10).
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? pseudobilqua 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, although Heer apparently regarded them as specifically identical with *Rhox obliqua* Alex. Braun. 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 5823) (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 4892) (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. 6). Yukon-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 1906 (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 dentition; 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*, 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. 105, 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 Grönlunds, pt. 2: Flora fossilis arctica, vol. 7, p. 33, pl. 80, figs. 1-3, 1883.

**Heer, Oswald, Die fossile Flora Grönlunds, pt. 2:** Flora fossilis arctica, vol. 7, p. 119, 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.

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


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** Lindau ex Willd.

_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. Ward's figures of the specimens from the type locality in Montana are the only ones published, other than the ones 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 5907).

_Viburnum obliquum_ Hollick, n. sp.

Plate 106, 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 68 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 5907).

_Viburnum contortum_ Lesquereux

Plate 106, figure 1


_Viburnum marginatum_ Lesquereux, U. S. Geol. Survey Terr. Ann. Rept., vol. 7, p. 223, pl. 33, fig. 2 (excl. fig. 11, pl. 37, and figs. 1, 3, 4, 5, pl. 38), 1876.

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

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species and was subsequently included by him under *V. marginatum*; but later their specific distinction was reestablished by Knowlton in connection with a specimen from the Eocene (Raton formation) of Colorado. The matter was also rendered somewhat more complicated by Heer, 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 the Tertiary of Greenland that differed widely from the Tertiary of Montana, described by Ward under the name *Viburnum tilioides (=V. antiquum (Newberry) Hollick)*. 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.

**Viburnum antiquum (Newberry) Hollick**

Plate 106, figure 3

*Viburnum antiquum* (Newberry) Hollick, in Newberry, U. S. Geol. Survey Mon. 65, p. 128, pl. 33, figs. 1, 2, 1883.


*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. 1–8; pl. 51, figs. 1–8; pl. 32, 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.

**Viburnum evexum Hollick, n. sp.**

Plate 110, 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 denticles; 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; although in our specimen the marginal denticles 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.

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Heer, Oswald, Die fossile Flora Grönlands, pt. 2: Flora fossílls arctica, vol. 7, p. 97, pl. 98, figs. 3–5; pl. 99, figs. 2, 3; pl. 101, fig. 5, 1883.

Knowlton, F. H., 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.


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 13 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 Herenden Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Eakin in 1908 (lot 5180).

Viburnum schmidtianum Heer?

Plate 106, figure 4

Viburnum schmidtianum Heer, Miozene Flora der Insel Sachalin: Flora fossilia 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. 59, fig. 10; p. 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 76 in V. nordenskiöldii Heer,79 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 Krystshofovich 80 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 nordenskiöldii Heer

Plate 107, figures 1–3

Viburnum nordenskiöldii Heer, Flora fossilia alaskana: Flora fossilia arctica, vol. 2, no. 2, p. 38, pl. 3, fig. 13, 1888; 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, 1878; Die Miozene 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, 1890; Die fossile Flora Grönlands, pt. 2: Idem, vol. 7, p. 115, pl. 92, fig. 11; p. 96, fig. 2, 1883.


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 Leskeureux 81 and by Ward.82 It was also identified in the Tertiary of Siberia by Konstantow 83 and from Manchuria by Florin.84

Localities: Chignik Bay, Alaska Peninsula, west side of Anchorage Bay, near upper end, about 500 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


The several figures of this species given by Heer vary considerably, but his figure 18, 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, 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 anomalerven*um, by Knowlton, 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, 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 to *Viburnum hollickii* Berry.

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, 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, 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 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 Excalibur Creek (original no. 2A; 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 denticles.

This leaf is described as a new species, although it may be specifically identical with *Viburnum dichotomyum* Lesquereux 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 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 Hereedeen Bay and Port Moller, Alaska Peninsula (original no. 32); collected by W. W. Atwood and H. M. Elkin in 1905 (lot 5168).

**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 and discussed under *Viburnum tilioides*. Whether or not they are properly referable to that species, or even to the genus *Viburnum*, may...
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 84 under Viburnum whymperi Heer and V. macrospernum 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 forms occur in Spitsbergen, was subsequently identified in specimens from Greenland 87 which had been originally described as the fruit of Diospyros.

It was recorded by Dawson 85 from the Mackenzie River region of Canada and by Newberry 86 from the Green River shales of Wyoming. It was heretofore known under the name Antholithes castaneoides Hollick, n. sp.

Genus PALAEANTHUS Newberry

Palaeanthus prindel Hollick, n. sp.

Plate 60, figure 2

Organism 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 ungerti 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 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 ungerti 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 prindel 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 sepal or petals that average about a centimeter in length.

This peculiar specimen presents very much the appearance of a flattened and partly dismembered compound 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 (Williamsia) problematica. Indeed, the resemblance of our specimen to certain of New-
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 superficial 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 profitable 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.²

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. GAP 350); collected by L. M. Prindle in 1903 (lot 3229).

**Genus PHYLLITES** Bronnarti

**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


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 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. 656); 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


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.

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 from the Tertiary of Spitsbergen, and of a similar object described and figured by the same author under the name *Chrysemelites 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.

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


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?


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
TERTIARY FLORAS OF ALASKA.

1a. Orontites clavichurus (Goesspert) (U.S.N.M. 28657; p. 40).
1b. Conquistanus cespitaez (Hartmann) (U.S.N.M. 28656; p. 74).
2, 3. Orontites sensibilis (Hartmann) (U.S.N.M. 28656; pp. 52-56).
4. Orontites sensibilis (Hartmann) (U.S.N.M. 28659; pp. 32-40).
5. Orontites thomsonii (Hartmann) (Hartmann) (U.S.N.M. 28651; p. 38).
TERTIARY FLORAS OF ALASKA.

1. Asplenium alaskense Holbeck, n. sp. (sterile frond) (U.S.N.M. 38662; p. 38).

la. Median part of a pinnule of figure 1 (p. 38).

lax. Part of figure la enlarged (p. 38).
2. *Osmunda dubia* Hollick, n. sp. (U.S.N.M. 38666; p. 40).
3. *Asplenium alaskense* Hollick, n. sp., fragments of a median-distal part of a sterile frond (U.S.N.M. 38666; p. 38).
TERTIARY FLORAS OF ALASKA.

1-5. *Ancephalophyllum hamiltonense* Hollis, n. sp. (U.S.G.S., 1884; 1899; p. 41).

3b. Fragment of a stem (U.S.G.S. M. 38672; p. 42).

4-7. Fragments of stems (U.S.G.S. M. 38673, 38674; p. 42).

**TERTIARY FLORAS OF ALASKA.**
2. Nodal diagram and fragments of stems (U.S.N.M. 36775, p. 42).
3. Fragment of a stem with sheaths (U.S.N.M. 36775, pp. 41, 42).
4-6. Fragment of a stem (U.S.N.M. 36775, p. 42).
8. Rhizome with rootlets (U.S.N.M. 36776, pp. 41, 42).
10. Rhizome with tubercles (U.S.N.M. 36776, pp. 41, 42).

TERTIARY FLOREAS OF ALASKA.
TERTIARY FLORAS OF ALASKA.

1b. Pinnate leaves of Betula sp.? (U.S.N.M. 38681; pp. 92, 94).
4a. Pinnulales Hottick (U.S.N.M. 38687; p. 42).
**TERTIARY FLORAS OF ALASKA.**

1b. *Joanna longispinata* Hollick, n. sp. (U.S.N.M. 28686, p. 70).
2a. *Dioica* eximia Heer (U.S.N.M. 28686, p. 8).
3a. *Joanna longispinata* Hollick, n. sp. (U.S.N.M. 28686, p. 70).
TERTIARY FLORAS OF ALASKA.

1b. Dicotyledonous leaf (gen. and sp. 7) (U.S.N.M. 36694: p. 170).
TERTIARY FLOREAS OF ALASKA.

1. Tilia grothi var. conformis (Hallick) var. (U.S.N.M. 38665; p. 44).
2. Sequoia leucodermatis (Borzi) (U.S.N.M. 38698; p. 6-18).
2. 3. Tarsopteris tenuis Heer (U.S.N.M. 38702, 38703; pp. 50-51).
4b. Tarsopteris dubia var. muralis Muenchberg (U.S.N.M. 38705; p. 49).
4c. Tarsopteris tenuis Heer (U.S.N.M. 38704; pp. 50-51).
5. 6. Tarsopteris tenuis Heer (U.S.N.M. 38704, 38705; pp. 50-51).

TERTIARY FLORAS OF ALASKA.
TERTIARY FLORAS OF ALASKA.

Sepesia lamarii (Hornemari) Heer (U.S.N.M. 3826: pp. 17, 18).
TERTIARY FLORAS OF ALASKA.

TERTIARY FLOREAS OF ALASKA.

1. *Paradion dentatum* var. *major* Massalongo (U.S.N.M. 38712; p. 49).
3. *Paradion occidentale* Newberry (U.S.N.M. 38717; p. 70).
8. *Paradion costatum* Hollick, n. sp. (U.S.N.M. 38720; p. 48).
TERTIARY FLORAS OF ALASKA.

*Glyptostrobus europaeus* (Brongniart) Unzer (U.S.N.M. 38721, 38722, 38723; pp. 51-52).
TERTIARY FLORAS OF ALASKA.


3b. Pytheoxylon moniliferum Heer (U. S. N. M. 8782: p. 56-57)
TERTIARY FLORAS OF ALASKA.

1. 2. *Glyptostrobaceae* (Bronn) Unger (U.S.N.M. 38727, pp. 51-52).

3-8. *Arundo pseudosupervarsit Berry* (U.S.N.M. 38728, pp. 54-55).
TERTIARY FLORAS OF ALASKA.


TERTIARY FLORAS OF ALASKA.

*Falcitriis horizontali* Lesueur in U.S.N.M. 36731; pp. 56-57.
5b. *Alnus betulifolia* (Bong.) Enger (U.S.N.M. 8728, p. 40).
TERTIARY FLORAS OF ALASKA.

1, 2. Populus arbores Heer (U.S.N.M. 38741, 38742; pp. 65-66).  
TERTIARY FLORAS OF ALASKA.

4, 5. *Populus zeudachi* Heer (U.S.N.M. 3648, 3649; p. 60).
TERTIARY FLORAS OF ALASKA.

2. 3. Populus grandiflora Fischer-Gleason (U.S.N.M. 38753; 38754; p. 67).

1a. Populus angustifolia Ward (U.S.N.M. 38766; p. 63).
5b. Populus angustifolia, Goeppert (U.S.N.M. 38766; p. 63).
TERTIARY FLORES OF ALASKA.

1-4. *Populus latifolia* A. Brann (U.S.N.M. 28728, 28729; pp. 64-65).

TERTIARY FLORA OF ALASKA.


5, 6. *Populus oblonga* Hollick, n. sp. (U.S.N.M. 38705; p. 68).
TERTIARY FLORAS OF ALASKA.

TERTIARY FLORAS OF ALASKA.


4-5. *Salix arguta* Ales. Braun (U.S.N.M. 3872; p. 76).
TERTIARY FLORAS OF ALASKA.

2. Salix alba L. Gessner (U.S.N.M. 3875: p. 73).
1. *Populus glandulifera* Heer (U.S.N.M. 38782; p. 65).
3a. *Tyzophaeus mcgili* (Lesquereux) Berry (U.S.N.M. 38784; p. 140).
3b. *Abietenia* sp. (U.S.N.M. 38785; p. 170).
5. *Salix ramina* Goepert (U.S.N.M. 38787; p. 71).
TERTIARY FLORAS OF ALASKA.

1a. Myrica spicata Unger (U.S.N.M. 3878; p. 27).
1b. Sequoia longipes Henningsen (U.S.N.M. 3879; p. 47, 84).
4. Myrica (Dypandra) igniaria (Unger) Sarratta (U.S.N.M. 3874; pp. 76-77).
3a. Populus graminifolia Heer (U.S.N.M. 3882; 5892; p. 60).
3b. Populus graminifolia Heer (U.S.N.M. 3882; 5892; p. 60).
TERTIARY FLORAS OF ALASKA.

1b. *Populus mutabilis* Heer (U.S.N.M. 38763; p. 63).
2. *Populus tenuiollis* Hollick, n. sp. (U.S.N.M. 38701; p. 63).
4-6. *Cupressa cupidoe* Lesquereux (U.S.N.M. 38658; p. 74).
TERTIARY FLOREAS OF ALASKA.

1, 2. Pistillate aments of Botrya sp. (U.S.N.M. 3876, 3878; pp. 72-78).
3. Pistillate ament of Salix sp. (U.S.N.M. 3876; p. 74).
4. Salix libocedrus Lesquereux (U.S.N.M. 3877; p. 74).
5, 6a. Salix etowahensis (U.S.N.M. 3878; pp. 72-78).
6b. Salix libocedrus Lesquereux (U.S.N.M. 3877; p. 74).
7a, 7b. Salix praecox Alex. Braun (U.S.N.M. 3876; p. 78).
8-10. Salix lehmanii Alex. Braun (U.S.N.M. 3889, 3891; p. 72).
TERTIARY FLORAS OF ALASKA.

Ficoria magnifica Knowlton (U.S.N.M. 3872; pp. 134-141).
TERTIARY FLORAS OF ALASKA.

TERTIARY FLOREAS OF ALASKA.


TERTIARY FLORAS OF ALASKA.

1-4. 57. 67. *Juglans juglandis mis* (Stearnberg; Giebel (U.S.N.M. 38610, 38611; pp. 80-81).
TERTIARY FLORAS OF ALASKA.

1-4. *Juglans cretacea* Knowitz (U.S.N.M. 38812; p. 80).

5-7. *Picea yezoensis* Hollick, n. sp. (U.S.N.M. 38813; p. 84.)
TERTIARY FLORAS OF ALASKA.

1b. Quercus sp. (U.S.N.M. 88825: p. 88).
3. 4a. Quercus continens Hollick, n. sp. (U.S.N.M. 88824: fig. 2; 88818: fig. 48).
TE nary Floras of Alaska,

1. Quercus orthocarpa Ettenghauzen (U.S.N.M. 38812; p. 102).
2. Quercus juglandifolia Heer* (U.S.N.M. 38820; p. 101).
3-5. Juglans juglandifolia (Sertlbeg) Gmel (U.S.N.M. 38810; pp. 80-81).
7. Juglans pedunculosa Heer (U.S.N.M. 38828; p. 82).
TERTIARY FLOREAS OF ALASKA.

1-1a. Corylus kreisei Hollick, n. sp. (U.S.N.M. 38333, pp. 87-88).

2b. Corylus americana fasciata Newberry (U.S.N.M. 38332, p. 86).
TERTIARY FLORAS OF ALASKA.

1-5. Corylus kruzius Hollick, n. sp. (U.S.N.M. 38832; pp. 87-88).
6. Corylus subnuda Hollick, n. sp. (U.S.N.M. 38884; p. 86).
7b. 8. Alnus glabrata (Geespoort) Hollick, n. comb. (U.S.N.M. 38836, 38837; p. 90).

TERTIARY FLORES OF ALASKA.
TERTIARY FLOREAS OF ALASKA.

2. Ulmus diptera steenstrupi (U.S.G.S. 23862; p. 107).
3. Purea nitida Heer (U.S.G.S. 23840; p. 44).
4.
TERTIARY FLORAS OF ALASKA.

2. *Cupressus truncatus* Hollick, n. sp. (U.S.N.M. 38843; p. 85).

4. Staminate cones of *Cupressus* sp. (U.S.N.M. 38845; p. 94).
TERTIARY FLOREAS OF ALASKA.

2. *Alnus sp.* (U.S.N.M. 58848; p. 92).
3. *Betula piperi* Ehringhausen (U.S.N.M. 38890; p. 91).
5. *Quercus macrocarpa* Knowlton (U.S.N.M. 58851; p. 92).
7. *Betula sp.* (U.S.N.M. 58841; p. 92).
TERTIARY FLORAS OF ALASKA.

1, 2. Ulmus carpinioides Goeppert (U.S.N.M. 38380; pp. 185-186).
3, 4, 5b-7. Alnus ulnifolia (Goeppert) Hollick, n. comb. (U.S.N.M. 38806; p. 91).

8. Alnus sinuata Newberry (U.S.N.M. 38601; p. 34).
TERTIARY FLORAS OF ALASKA.

1, 2. *Fagus antarctica* Abich (U.S.N.M. 38871; pp. 95-96).
3. *Fagus decorticans* Unger (U.S.N.M. 38872; p. 97).
1. *Quercus knudsenii* Leister (U.S.N.M. 28675, p. 33).
2. *Quercus odontoptera* Leister (U.S.N.M. 28675, p. 33).
3. *Quercus glabra* Leister (U.S.N.M. 28675, p. 33).
4. *Quercus pseudocrenata* Leister (U.S.N.M. 28675, p. 33).
5. *Quercus viridiflora* Leister (U.S.N.M. 28675, p. 33).
7. *Quercus crispata* Leister (U.S.N.M. 28675, p. 33).

**TERTIARY FLOREAS OF ALASKA.**
TERTIARY FLORAS OF ALASKA.

Quercus taraikulani Heer (U.S.N.M. 38882 p. 98).
TERTIARY FLOWERS OF ALASKA.

1, 2. *Artocarpus ordinarius* Hollick, n. sp. (U.S.N.M. 38882: p. 108).
TERTIARY FLORAS OF ALASKA.

1, 2. Ulmus borealis Heer (U.S.N.M. 38848: pp. 166-167).
5. Quercus griseafoia Heer (U.S.N.M. 39022: p. 98).
TERTIARY FLORAS OF ALASKA.

1-3, Ulmus pseudoflava Hollick, n. sp. (U.S.N.M. 38885: p. 105).
6-12, Ulmus heueti Heer (U.S.N.M. 38800: p. 108).
TERTIARY FLOREAS OF ALASKA.

Astartopteris alaskana Hollick, n. sp. (U.S.N.M. 3889, 3890; pp. 108-109.)
TERTIARY FLORAS OF ALASKA.

Nelumbo antiquus Berry (U.S.N.M. 38667, pp. 118-119).
TERTIARY FLORAS OF ALASKA.

1, 2. Magnolia ovalis Lesueur (U.S. N. M. 38667; p. 114-115).
3. Magnolia vomitoria Heer (U.S. N. M. 38611; p. 113).
4, 5. Hydrangea aleutica Hollick (U.S. N. M. 38612; p. 122).
1. *Cinnamomum friderickii* Hollick, n. sp. (U.S.N.M. 30815; p. 120).
3. *Laurelia menitana* Hollick, n. sp. (U.S.N.M. 30616; p. 120).
4. *Laurelia cincta* Lesquereux (U.S.N.M. 3017; p. 120).
5. *Pastoria cupressoides* Hollick, n. sp. U.S.N.M. 30618; p. 120.
TERTIARY FLORAS OF ALASKA.


2-5. Baeckea antiqua Hollick (U.S.N.M. 38922; p. 119).

TERTIARY FLORAS OF ALASKA.

Maerophyllum saxifraga (Superta) Hollick, n. comb. (U.S.N.M. 38670, 38924, 38925, 38928, pp. 118-119).
TERTIARY FLORAS OF ALASKA.

1. Laurus princeps Heer (U.S.N.M. 38627, pp. 120-121).
2. Laurus antarcticus Knowlton and Cockerell (U.S.N.M. 38778, 38928, 38639c p. 121).
4. Laurus scoticus C. R. T. Southward (U.S.N.M. 38622 p. 120).
5. Impalhalnae brunei Heer (U.S.N.M. 38635; pp. 121-122).
TERTIARY FLORA OF ALASKA.

Platanus serrulata flavida Knowlton (U.S.N.M., 1884, p. 122).
TERTIARY FLORAS OF ALASKA.

1-2. *Praena birtum* n. gen. n. sp. (U.S.N.M. 38696: pp. 126-127)
1. 2. Prunus variabilis Newberry (U.S.N.M. 38992: p. 127
3. Crataegus cupressi Hollick, n. sp. (U.S.N.M. 38945: p. 128
4. Crataegus polyceratina Hollick, n. sp. (U.S.N.M. 38844: p. 126
5. Crataegus sinuatae Hollick, n. sp. (U.S.N.M. 38945: p. 125-126
6. Dolichos courchez Hollick, n. sp. (U.S.N.M. 38867: p. 133
7. Camarinus emerita Berry (U.S.N.M. 38946: p. 124-126
TERTIARY FLORAS OF ALASKA.

1. 2. 7. S. 9a. 10. 11a. 12, 13. Sophora multiformis Hollick. n. sp. U.S. N. M. 1897, p. 128.

3. 4. Chamaecyrus Berry (U.S. N. M. 1880, 1898, p. 128).


TERTIARY FLORAS OF ALASKA.

*Pax insignis* Heer (U.S.N.M. 36951; pp. 131-132).
TERTIARY FLORAS OF ALASKA.

4. *Neclecta* *disparabilis* Hallock, n. sp. (U.S.N.M. 8854: p. 134).
5. *Cupanae* *comparabilis* Hallock, n. sp. (U.S.N.M. 8855: p. 136).
TERTIARY FLOREAS OF ALASKA.

1. Fruit of Acer sp. (U.S.N.M. 28248, p. 196).
TERTIARY FLOREAS OF ALASKA.

1. *Acer arcticum* Heer (U.S.N.M. 38068, 38069; pl. 133-134).

2. *Acer tamariscifolium* Heer (U.S.N.M. 38068, 38069; p. 135).

TERTIARY FLORAS OF ALASKA.

1, 2. *Rhamnus marginata* Lesquer (U.S.N.M. 38615; p. 140).
TERTIARY FLOREAS OF ALASKA.

1. 2. Ribesum pseudobiogenum Hollick, n. sp. (U.S.N.M. 3878; pp. 136-140).
3. Ribesum heinitzii Alex. Braun (U.S.N.M. 3887; p. 136).
5. 6. Zizyphus hypophaea Heer? (U.S.N.M. 3880, 3881; p. 140).
TERTIARY FLORAS OF ALASKA.

5. 5. *Tilia sp.* Hollick (U.S.N.M. 38693; p. 145).
TERTIARY FLORAS OF ALASKA.

TERTIARY FLORAS OF ALASKA.

Grewia orbiculata Hollick, n. sp. (U.S.N.M. 38577; pp. 146-147).
TERTIARY FLOREAS OF ALASKA.

2. *Glosia zigzagodes* Hollick, n. sp. (U.S.N.M. 8706; p. 147).
3-5. *Glosia subevidens* Hollick, n. sp. (U.S.N.M. 3887-3888; pp. 146-147).
TERTIARY FLORAS OF ALASKA.

1-4. *Geocryptopis* sinuosa Hollick, n. sp. (U.S.N.M. 38007, 38001; p. 146.)

5, 6. *Geocryptopis* congerminalis Hollick, n. sp. (U.S.N.M. 38003, 38005; pp. 148-149.)
1. Pteraspermites ulavensis Heer (U.S.N.M. 30006, p. 151).
2. Pteraspermites spectabilis Heer (U.S.N.M. 30007, pp. 150-151).
1. 2. *Pterospermites parvula* Hollick, n. sp. (U.S.N.M. 3614; 3615; pp. 151-152).


5. *Lepidopyros montanus* Hollick, n. sp. (U.S.N.M. 3618; p. 155).


TERTIARY FLORAS OF ALASKA.

Dillewia elliptica Hollick, n. sp. (U.S.N.M. 38735, 38623, p. 154)
TERTIARY FLOREAS OF ALASKA.


TERTIARY FLORAS OF ALASKA.

1. *Dillenites ellipticus* Hollick, n. sp. (U.S.N.M. 38025; p. 151).
2, 3. *Dillenites ellipticus utahensis* Hollick, n. var. (U.S.N.M. 38026; p. 154).
TERTIARY FLOREAS OF ALASKA.

5-6. Acerita sp. Hollick (U.S.N.M. 3061); p. 157.
TERTIARY FLORAS OF ALASKA.

1. Coriaria irregulata Hollick, n. sp. (U.S.N.M. 3963; p. 158).
4. Rhododendron crassum Hollick, n. sp. (U.S.N.M. 3963; p. 169).
5. ?Arctostaphylos? sp. (U.S.N.M. 3965; p. 132).
TERTIARY FLORAS OF ALASKA.

1-4. *Praecox longifolium* sprouts (U.S.N.M. 36103, 36109; p. 163).


TERTIARY FLORAS OF ALASKA.

1-7. Fraxinus laurinae Heilick, n. sp. (U.S.N.M. 38815, pp. 162-161).

8-10. Fraxinus juneanae Suporta (U.S.N.M. 38779, 38812; p. 161).
TEERTIARY FLOWAS OF ALASKA.

Parnassia gyrogynanta Hollick, n. sp. (U.S. N. M. 2043, 2044, p. 364).
TERTIARY FLORAS OF ALASKA.

1. Juglea raidei Hollick, n. sp. (U.S.N.M. 30651; p. 92).
6. 7a. Fagianus pseudoklippeli Hollick, n. sp. (U.S.N.M. 30652, 30656; p. 104).

7b. Gyspoxylon europaeus (Brounart) Under (U.S.N.M. 30655; pp. 51-52).
8. 9. Decurcus pseudopedatus Hollick, n. sp. (U.S.N.M. 30658; p. 131).
1. *Hinogryphus brachyspermus* Alex. Bruun (U.S.N.M. 30009; p. 161).
4. *Fraxinus grisea* Hollick, n. sp. (U.S.N.M. 30001; p. 164).
5. 6. *Fraxinus lateralis* Hollick, n. sp. (U.S.N.M. 30021; 30063; p. 164).

TERTIARY FLORAS OF ALASKA.
TERTIARY FLORAS OF ALASKA.

1. *Uphorion conoicostum* Lesueur (U.S.N.M. 3896; p. 105-106).
TERTIARY FLORAS OF ALASKA.

1-3. Viburnum nordenskiodi Heer (U.S.N.M. 30005, 30008, 30009; p. 167).
4, 5, 6, 7. Viburnum algmieri Heer (U.S.N.M. 30050, 30072; pp. 167-168).
TERTIARY FLORAS OF ALASKA.


1-6. Dryopteris meyeri (Heer) Hollick, n. comb. (U.S.N.M. 39675-39678; p. 36).
7. Osmunda dorrokii n. sp. (U.S.N.M. 39626; p. 36).
9. Lauraeus californicus Lesquereux (U.S.N.M. 39605; p. 110).
10. Trichospernum occidentale Newberry (U.S.N.M. 39662, 39663; p. 30).
12. Pterocladus altissimus Heer (U.S.N.M. 39695; p. 35).
13. Myrica (Dryandra) ignita (Unr er) Sargent (U.S.N.M. 39686; pp. 31-33).
14-16. Myrica lambasiensis curtis Hollick, n. var. (U.S.N.M. 39687; pp. 73-76).
TERTIARY PLANTAS OF ALASKA.


TERTIARY FLORAS OF ALASKA.

Flabeelia alaskana Hollick, n. sp. (U.S.N.M. 39000; pp. 57-58).
TERTIARY FLORAS OF ALASKA.

Flebibiaria sitkana Hallier, n. sp. (U. S. N. M. 3006; pp. 57-58).
TERTIARY FLORAS OF ALASKA.

*Piper septata* Hollick, n. sp. (U.S. N.M. 39991, 39992; pp. 58-59.)
2. *Piper caesatocrotalis* Hollick, n. sp. (U.S.N.M. 3878, 3964, 3959).
1. *Piper concarum* Hollick, n. sp. (U.S.N.M. 30900, 30100; p. 30).
2. *Piper chepini* Hollick, n. sp. (U.S.N.M. 39101; p. 50).
TERTIARY FLORAS OF ALASKA.

1. 2. *Ginkgo adiantoides* (Unpr) Heer (U.S.N.M. 38142; pp. 43, 44).
6. *Populus bicornis* Hollick, n. sp. (U.S.N.M. 39122; p. 60.
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