CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

UNIVERSITY OF MICHIGAN

VOL. XII, No. 12, pp. 245–258 (3 pls.) DECEMBER 15, 1955

TERTIARY CONIFERS FROM THE PRINCETON COAL FIELD OF BRITISH COLUMBIA

BY

CHESTER A. ARNOLD

MUSEUM OF PALEONTOLOGY
UNIVERSITY OF MICHIGAN
ANN ARBOR

CONTRIBUTIONS FROM THE MUSEUM OF PALEONTOLOGY

Director: LEWIS B. KELLUM

The series of contributions from the Museum of Paleontology is a medium for the publication of papers based chiefly upon the collections in the Museum. When the number of pages issued is sufficient to make a volume, a title page and a table of contents will be sent to libraries on the mailing list, and to individuals upon request. A list of the separate papers may also be obtained. Correspondence should be directed to the Museum of Paleontology, University of Michigan, Ann Arbor, Michigan.

VOLS. II–XI. Parts of volumes may be obtained if available.

VOLUME XII

1. Four New Species of Rugose Corals of the Middle Devonian Genus *Eridophyllum,* from New York, Michigan, and Ohio, by Erwin C. Stumm. Pages 1–11, with 2 plates.
2. Ornamentation as a Character in Specific Differentiation of Ostracods, by Robert V. Kesling. Pages 13–21, with 2 plates.
3. Mississippian Megaspores from Michigan and Adjacent States, by William G. Chaloner. Pages 23–35, with 2 plates.
4. A Tertiary Azolla from British Columbia, by Chester A. Arnold. Pages 37–45, with 2 plates.
5. Pleistocene Vertebrates from the Upper Becerra (Becerra Superior) Formation, Valley of Tequixquiac, Mexico, with Notes on other Pleistocene Forms, by Claude W. Hibbard. Pages 47–96, with 9 plates.
6. Three New Species of the Cystid Genus *Lipsanocystis* from the Middle Devonian Traverse Group of Michigan, by Erwin C. Stumm. Pages 97–103, with 2 plates.
7. A New Occurrence of *Semitextularia thomasi* Miller and Carmer, 1933, by Murray J. Copeland and Robert V. Kesling. Pages 105–112, with 1 plate.
8. Lower Mississippian Cephalopods of Michigan. Part III, Ammonoids and Summary, by A. K. Miller and H. F. Garner. Pages 113–173, with 7 plates.
9. A New Occurrence of *Oncotechmonus chemotus* Kesling, A Middle Devonian Entomoconchid Ostracod, by Robert V. Kesling. Pages 175–178, with 1 plate.
10. The Jinglebob Interglacial (Sangamon?) Fauna from Kansas and Its Climatic Significance, by Claude W. Hibbard. Pages 179–228, with 2 plates.
11. A New Pliocene Species of *Ambystoma,* with Remarks on Other Fossil Ambystomids, by Joe A. Tihen. Pages 229–244, with 1 plate.
12. Tertiary Conifers from the Princeton Coal Field of British Columbia, by Chester A. Arnold. Pages 245–258, with 3 plates.
13. Notes on Two Ordovician Ostracods from Estonia, by Robert V. Kesling. Pages 259–272, with 1 plate.
14. Two New Species of Ostracods from the Centerfield Limestone of Western New York, by Robert V. Kesling. Pages 273–284, with 3 plates.

VOL. XII, No. 12, pp. 245–258 (3 pls.) DECEMBER 15, 1955

TERTIARY CONIFERS FROM THE PRINCETON COAL FIELD OF BRITISH COLUMBIA

BY
CHESTER A. ARNOLD

CONTENTS

Introduction 245
Fossil flora 245
Systematic descriptions 248
Literature cited 253
Plates ..... *(after)* 255

INTRODUCTION

THE town of Princeton in southern British Columbia is situated in an area where volcanic and sedimentary rocks of Tertiary age fill an isolated basin in older rocks. The basin, which covers about 75 square miles, includes the Princeton coal field. The rocks that fill the basin make up three formations, the Lower Volcanics, the Allenby formation, and the Upper Volcanics. The Allenby formation represents the sedimentary phase and contains the coal and the plant fossils. It is about 3500 feet thick and consists mainly of massive cross-bedded granule and pebble conglomerate, sandstone, massive and thin-bedded shale with intercalated coal seams, carbonaceous siltstone and shale, and bentonite (Shaw, 16). The sediments were evidently derived largely from weathered lava and ash.

Because the deposits in the basin rest unconformably on older rocks and have no continuity with formations of known age elsewhere, their age has been somewhat in question. They are generally assumed, however, to be Oligocene and that view is confirmed by the present study.

FOSSIL FLORA

In 1877 Sir William Dawson received a small collection of fossil plants from exposures along the Similkameen River, which flows through the Princeton coal field; these he published in 1879 as a preliminary list of 19 species (10). Later he obtained more material and in 1890 published a comprehensive account of all fossil plants then known from southern British Columbia (11). Dawson's descriptions are brief and his illustrations are merely line drawings with little detail. Nevertheless, one can be reasonably certain of the identity of several of the forms he figured, and his paper of 1890 is the most useful of all the early contributions. In 1908 Penhallow (15) prepared a compilation of the whole Tertiary flora of British Columbia. He redescribed the material treated by Dawson and described a few new species. Unfortunately, Penhallow's paper does not

contain many figures, which makes it necessary to rely in many instances on Dawson's works for illustrations.

The plants from the Princeton coal field described here were collected by the author and his sons, David and Bruce, in August, 1953. Special mention is made of Mr. James Fairley, of Princeton, for his interest in the project and for guidance to some of the better collecting places.

The best collecting was in the southern part of the coal field along the Hope-Princeton Highway, at mines near the highway, and along the Similkameen River near the place marked as Ashnola on the geological map of the basin (Shaw, 16). Some good material was obtained at the portal of the abandoned Pleasant Valley No. 2 coal mine, about one-half a mile west of Princeton. During the four days spent in the region, it became apparent that plants could be found at an undetermined number of places. Fragments were to be seen in almost any road cut, mine dump, or stream exposure in the area. Regardless of general prevalence, however, the fossils were seldom profuse. Considerable searching was usually necessary to find more than a few specimens; hence, the productivity of the Allenby formation is due to the number of accessible exposures rather than to a superabundance of material at any one place. An exception is the Pleasant Valley No. 2 mine, at which large quantities of rather badly fragmented leaves can be collected from the roof and from fallen rocks.

A larger collection than the one at hand would be necessary for a thorough analysis of the flora. Many of the species that are recognized are represented only by a single specimen of each and several of these are mere leaf fragments lacking apex or base. For this reason, no attempt is made to describe the whole flora. The following is a list of the determinations that have been made:

Azolla primaeva (Penhallow) Arnold
Ginkgo adiantoides (Unger) Heer
Metasequoia occidentalis (Newberry) Chaney
Sequoia affinis Lesquereux
Taxodium dubium (Sternberg) Heer
Pinus tulameenensis Penhallow
Pinus monticolensis Berry (seed)
Pinus latahensis Berry
Pinus trunculus Dawson
Abies sp. (cone scale)
Picea sp. (cone and twig)
Pseudolarix americana Brown
Chamaecyparis linguaefolia (Lesquereux) MacGinitie
Sassafras hesperia Berry
Laurophyllum? sp.
Cercidiphyllum arcticum (Heer) Brown
Diospyros? sp.
Prunus sp. (aff. *P. serotina* Ehr.)
Amelanchier sp.
Cercis? sp.
Nyssa hesperia Berry
Planera? sp.
Quercus sp.
Alnus corallina Lesquereux
Betula sp. (cf. *B. vera* Brown and *B. fairii* Knowlton)
Comptonia hesperia Berry (*Myrica cuspidata* Dawson, 1890, Fig. 9, *non* Lesquereux)
Acer negundifolium (Dawson) LaMotte
Aralia republicensis Brown

A noticeable feature of this collection is the relatively large number of gymnosperms. Nine genera are represented by leafy twigs, detached foliage, cones, cone scales, and seeds. Pollen is also present, but has not been studied.

The dominant species in the Allenby formation is *Metasequoia occidentalis,* leafy shoots of which were almost anywhere. *Metasequoia* shoots are easily distinguished from those of *Sequoia* and *Taxodium* by their opposite leaves. The presence of *Sequoia* in the flora is a matter of interest. Although there are many references to *Sequoia* in paleobotanical literature on western Canada, Chaney (9) concluded that the only known Canadian *Sequoia* is *Sequoia dakotensis* from the Cretaceous of Alberta, and that everything else identified as *Sequoia* from the Tertiary is either *Metasequoia* or *Taxodium.* In the present collection, however, there are well-preserved leafy *Sequoia* twigs.

Some of the leafy shoots collected in 1953 bear alternate leaves of which the decurrent bases extend straight down the stems as in *Taxodium* (Pl. II, Figs, 1, 2). These leaves are also more slender than typical *Sequoia* leaves and have larger midribs. Although the occurrence of *Metasequoia, Sequoia,* and *Taxodium* in one flora may be unusual, the three need not necessarily have existed contemporaneously in the Tertiary basin. They could represent a succession. *Taxodium* is the least prevalent.

The pines are also well represented. In addition to the four species listed, there are a number of isolated pinelike seeds that cannot be positively placed. Remains of *Pinus* rank next to *Metasequoia* in abundance in the Allenby formation.

Although never plentiful, fragments of *Ginkgo* leaves are common in the Princeton area. They show the same extent of variation usually displayed by *Ginkgo* leaves, but all are referable to the common Tertiary form *Ginkgo adiantoides.*

Material of Penhallow's *Azollophyllum primaevum* (in Dawson, 11, p. 77) was collected in 1953. It is a true *Azolla* (Arnold, 1) and similar to the living *A. filiculoides.* Penhallow's account of it is the first record of *Azolla* in the fossil condition.

Although the present collection is not considered large enough to make detailed comparisons with other flora, resemblances to the Oligocene flora at Republic, Washington, a flora studied by Brown (5, 6) is obvious. After allowing for a few name changes, the following species occur in both:

Ginkgo adiantoides
Metasequoia occidentalis
Taxodium dubium
Pseudolarix americana
Pinus latahensis
Pinus monticolensis
Comptonia hesperia
Alnus corallina
Sassafras hesperia
Aralia republicensis

In addition to those listed a few others are essentially similar. The fruits listed by Brown as *Acer negundoides* were probably borne on the trees whose foliage is *A. negundifolium*. The Republic species *Cercidiphyllum crenatum* can be distinguished from the *C. arcticum* of Princeton only if collections are large enough to display the complete range of variation among the leaves (Brown, 7). Of course, some of the species common to the two localities are wide ranging, but since about half of those at Republic occur at Princeton as well, agreement between the floras is evident.

SYSTEMATIC DESCRIPTIONS

Family Taxodiaceae

Genus *Metasequoia* Miki

Metasequoia occidentalis (Newberry) Chaney

(Pl. I, Figs. 1–7)

The most common remains of *Metasequoia occidentalis* in the Princeton vicinity are the detached leafy shoots. Typical specimens are 5–8 cm. long, with opposite leaves that have a spread of 12 mm. or more (Pl. I, Figs. 2, 6, 7). The individual leaves are about 8 mm. long. The better preserved specimens have retained the whorl of small bracts at the base of the shoot (Pl. I, Figs. 2, 5, 7). Occasional specimens are longer, with leaves as much as 20 mm. long and total leaf spread of about 35 mm. (Pl. I, Fig. 3). These are presumably long shoots that underwent indeterminate growth. Some specimens resemble the flat sprays on living trees of *Metasequoia glyptostroboides,* which consist of long shoots bearing a number of axillary short shoots (Pl. I, Fig. 4). The short shoots are smaller than the ordinary ones but show the same decussate phyllotaxy. Cones typical of *Metasequoia* also occur in the Allenby formation (Pl. I, Fig. 1.). They are characterized by decussately arranged cone scales and long naked peduncles.

Chaney (9) pointed out that *Metasequoia* is far more prevalent than either *Sequoia* or *Taxodium* in the Tertiary of western North America. The majority of the published records of *Sequoia* and *Taxodium* are erroneous. The branchlet that Dawson (11, p. 79) figured from the Similkameen Valley as *T. distichum Miocenum* is *M. occidentalis,* as is also the specimen figured by Penhallow (15, p. 89) as *S. heerii* from the Tulameen River.

Genus *Sequoia* Endlicher

Sequoia affinis Lesquereux

(Pl. III, Figs. 4, 9)

Sequoia is easily distinguished from *Metasequoia* by its alternate leaves. Less conspicuous differences are the wider angle of divergence of the leaves on the twigs and the sessile attachment. Differences between *Sequoia* and *Taxodium* are more subtile, but in well-preserved material the petiolate bases and the character of the decurrent portion on the stem are diagnostic features that can be employed with relative certainty and ease.

Sequoia affinis, like the living *S. sempervirens,* exhibits two foliage forms, and both have been collected from the Allenby formation. One consists of the rapidly growing twigs which bore small, scale-shaped, spirally arranged leaves that had some resemblance to the normal foliage of *Sequoiadendron giganteum* (Pl. III, Fig. 4). These twigs also bore the cones, and Chaney (9) says that the great inclination of collectors to save cone-bearing specimens has given a disproportionate idea of the prevalence of scaly foliage in the species. The focus of attention on material with scaly foliage has been responsible for the assumption that *S. affinis* is closer to *Sequoiadendron* than to *Sequoia,* which evidently is not true. *S. affinis* is assumed to be the Tertiary equivalent of the living redwood, its name replacing *Sequoia langsdorfii* in all instances in which North American Tertiary sequoias are concerned.

The other foliage form is a flat spray on which the spirally inserted leaves are turned so as to present a distichous pattern. One such specimen in the collection has a complete length of 12.5 cm. (Pl. III, Fig. 9). It consists of three branches and shows growth of four consecutive years. The persistent short shoots produced each season grew out from the apex of the growth of the preceeding year, and the point of juncture is distinctly marked by the small whorl of persistent bracts at the base of the growth of each year. Except for its slightly smaller dimensions, the specimen is virtually indistinguishable from a leafy branch system of *S. sempervirens.* The flat sprays have a spread of only about 12 mm., whereas an ordinary spray of living redwood may be about twice as wide. The maximum growth of any one season in the fossil did not seem to much exceed 3 cm., whereas in the living form the annual growth in length of a leafy shoot is often more than 10 cm. Whether this size difference amounts to a specific difference seems most doubtful, especially in the absence of cones and material to show the normal variation in size of leaves and leafy shoots. The differences are probably reflections of environmental differences.

Genus *Taxodium* Richard

Taxodium dubium (Sternberg) Heer

(Pl. II, Figs. 1, 2)

A few fragments of short deciduous shoots bearing alternate leaves are referable to *Taxodium dubium,* the common Tertiary equivalent of the living swamp cypresses. In contrast with *Sequoia affinis,* the leaves are longer, more slender, with more pronounced midribs, and the decurrent leaf base continues as a straight line down the stem almost to the next leaf below (Pl. II, Fig. 2). The alternate arrangement at once sets off this conifer from *Metasequoia.*

In his revision of the fossil species of *Sequoia* and *Taxodium* in North America, Chaney (9) retains only one of the previously reported occurrences of *Taxodium* in British Columbia. This happens to be an unfigured specimen that Penhallow called *Sequoia langsdorfii* (15, p. 89). However, Chaney does mention having seen several specimens from Princeton and other places in the province. There can be no question that the genus occurs in the Tertiary of western Canada, although it is obviously subordinate to *Metasequoia.*

Family Pinaceae

Genus *Pinus* Linnaeus

Pinus trunculus Dawson

(Pl. III, Fig. 5)

In 1890 Dawson (11, p. 78) gave the name *Pinus trunculus* to a cluster of three incomplete needles that were atttached to a dwarf shoot. If the drawing is even approximately correct, it is a true three-needle form, and not five, as Penhallow later claimed. Dawson's original interpretation is supported by well-preserved clusters, containing three needles each and attached to dwarf shoots, that were collected near Princeton. In the best specimens the needles are 8 cm. long and 1 mm. wide (Pl. III, Fig. 5). Dawson's figure of *Pinus trunculus* gives the impression of needles that are slightly wider, but this could be an error in drawing.

There are other fossil species of three-needle pines with which the Princeton material can be compared, but it seems best to refer it to Dawson's species. Among the others are *Pinus knowltoni,* a western species that ranges from the Oligocene to the Pliocene, and *P. florissanti,* from Florissant, Colorado. *Pinus florissanti* has needles that are conspicuously longer.

In his account of the Tertiary plants of British Columbia, Penhallow

(15, Figs. 24, 25) assigns to *Pinus trunculus* two five-needle forms that appear to differ markedly from each other as well as from Dawson's figure. His Figure 24 is of a specimen that is intermediate between *P. tulameenensis* and *P. latahensis* and his Figure 25 illustrates a large specimen with coarse needles 17 cm. long, which reminds one of *P. macrophylla* Berry from Republic, Washington. Berry says that *P. macrophylla* has clusters of three needles, but his figure (4, Pl. 49, Fig. 9) is not convincing on this point. It is believed that Penhallow was handling some other species than *P. trunculus*. Furthermore, there is no evidence that the seeds he assigns to *P. trunculus* actually belong to it, for his Figure 26 is of a seed that bears some resemblance to *P. monticolensis*. The seed that Dawson attributed to *P. trunculus* (11, Fig. 5b) resembles the seed of *Pseudolarix* fully as much as it does that of *Pinus*. The needle cluster that Berry (3, Pl. X, Fig. 5) identified as *Pinus trunculus* from the Chu Chua District of British Columbia probably is correctly determined.

Pinus latahensis Berry

(Pl. III, Figs. 7, 8)

Two clusters of *Pinus* leaves from the Princeton area closely resemble *Pinus latahensis* Berry from Republic, Washington. Each contains five needles which in the one still attached to the dwarf shoot are 7 cm. long. None of the leaves, however, appears to be complete. The needles in the specimens seem to be slightly narrower than those that Berry figures (4), but this may be due to less flattening during the fossilization process. It is possible that the seeds described below as *Pinus monticolensis* belong to *P. latahensis*.

Pinus monticolensis Berry

(Pl. II, Fig. 3)

A few isolated seeds resemble those described by Berry (4) from the Latah formation under the name *Pinus monticolensis*. The specimen figured here (Pl. II, Fig. 3) is 24 mm. long, and its slender wing is 5 mm. wide. The possible affinity between this seed and *P. latahensis* is based upon the resemblance they both bear to the living *P. monticola*. One of the seeds that Penhallow (15, Fig. 26) assigned to *Pinus trunculus* should probably be included in *P. monticolensis*.

Pinus tulameenensis Penhallow

(Pl. II, Fig. 6)

Pinus tulameenensis has heretofore been known only from the brief description of the species by Penhallow (15, p. 73), in which he figures a

single needle cluster from the Tulameen River. The only feature of distinction is the small size; the needles being only about 23 mm. long and very slender. Penhallow's specimen had four needles, but in the recently collected material some clusters have five.

One specimen from the Princeton coal field is a small portion of twig, 3.5 cm. long, that bears several needle clusters (Pl. II, Fig. 6). The small bristle-like leaves are from 10 to 25 mm. long and the dwarf shoots to which they are attached are very short and only about 0.5 mm. in diameter.

Regardless of the brevity of Penhallow's account of *Pinus tulameenensis* and the meager material upon which the species was based, it seems well founded and distinct from other fossil members of the white pine group. Its distinguishing feature is the small size of its needles and dwarf shoots. Its seeds and cones are unknown.

Picea sp.

(Pl. II, Fig. 4)

One specimen consisting of a defoliated twig and the basal half of an attached cone confirms the presence of spruces in the Princeton coal field. The cone, which is 13 mm. wide and which was originally about 6 cm. long, resembles in size and shape that of the living white spruce, *Picea glauca*. The small associated seeds probably belong to the same species.

Abies sp.

(Pl. III, Fig. 6)

A single cone scale without the subtending bract constitutes the only recognizable remains of firs in the flora of the region. Although it resembles such forms as *Abies alvordensis, A. chaneyi,* and *A. concoloroides,* specific assignment is impossible in absence of the bract. It is probably the same as the scales identified from Quilchina by Penhallow (15, p. 68) as *Pinus steenstrupiana,* a name proposed originally by Heer (12, p. 144, Pl. XXIV, Figs. 23, 24) for similar cone scales from Iceland. In both instances the assignment to *Pinus* was an error, and Heer's species should be *Abies steenstrupiana,* comb. nov. Whether the Quilchina material is the same as Heer's specimens from Iceland, there is at present no means of determining. Likewise, its relation to other fossil forms of *Abies* is in question.

Pseudolarix americana Brown

(Pl. III, Figs. 1–3)

A single shovel-shaped cone scale is evidence for the existence of *Pseudolarix* in the Princeton region (Pl. III, Fig. 2). Also, a dwarf shoot

bearing about 14 leaves (Pl. III, Fig. 1) and a few winged seeds (Pl. III, Fig. 3) probably belong to the same plant. This is the second instance in which unquestionable remains of *Pseudolarix* have been recovered from the North American Tertiary, the other one is of similar cone scales identified by Brown (8) from Republic, Washington. Beck (2) found wood in the Pliocene of Nevada, which he questionably assigned to *Pseudolarix*.

The leaves on the dwarf shoot are 2 mm. wide and about 40 mm. long, agreeing well with *Pseudolarix amabilis,* the living species, in which the leaves are from 25 to 50 mm. long. Only 14 leaves can be counted, but more were probably present originally. A single midvein is present in each leaf. No carbonaceous material has been retained: preservation is only in the form of an impression.

The seed here identified as belonging to *Pseudolarix* (Pl. III, Fig. 3) has a straight dorsal margin and a ventral margin that is curved so the wing is widest in the lower half. It then tapers to a point along its apical half in conformity with the shape of the cone scale.

Family Cupressaceae

Genus *Chamaecyparis*

Chamaecyparis linguaefolia (Lesquereux) MacGinitie

(Pl. II, Fig. 5)

Chamaecyparis is rare in the Tertiary and, previous to the discovery of *C. gilmoreae* in the Miocene of Nevada and California (LaMotte, 13), it was unknown in deposits older than Pleistocene. It was subsequently recognized in the Miocene at a few other places, and recently MacGinitie (14) recovered it at Florissant, Colorado, in beds interpreted as upper early Oligocene. Florissant and Princeton then are the oldest known occurrences of the genus. Only two small fragments were found at Princeton, one the terminal portion of a leafy twig. The material is given the oldest applicable name for any fossil species of *Chamaecyparis*.

LITERATURE CITED

1. Arnold, C. A. 1955. A Tertiary Azolla from British Columbia. Contrib. Mus. Paleontol. Univ. Mich., 12(4): 37–45.
2. Beck, G. F. 1945. Tertiary Coniferous Woods of Western North America. Northwest Science, 19: 67–69.
3. Berry, E. W. 1926. Tertiary Floras of British Columbia. Geol. Surv. Canada Bull., 42: 91–116.
4. ——— 1929. A Revision of the Flora of the Latah Formation. U. S. Geol. Surv., Prof. Paper, 154–H.

5. BROWN, R. W. 1935. Miocene Leaves, Fruits, and Seeds from Idaho, Oregon, and Washington. Journ. Paleontol., 9: 572–87.
6. ——— 1937. Additions to some Fossil Floras of the Western Unitd States. U. S. Geol. Surv., Prof. Paper, 186–J.
7. ——— 1939. Fossil Leaves, Fruits, and Seeds of Cercidiphyllum. Journ. Paleontol., 13: 485–99.
8. ——— 1940. New Species and Changes of Name in Some American Fossil Floras. Journ. Wash. Acad. Sci., 30: 344–56.
9. CHANEY, R. W. 1951. A Revision of Fossil Sequoia and Taxodium in Western North America Based on the Recent Discovery of Metasequoia. Trans. Amer. Phil. Soc., N. S., 40(3): 172–239.
10. DAWSON, J. W. 1879. List of Tertiary Plants from Localities in the Southern Part of British Columbia, with the Description of a New Species of Equisetum. Geol. Surv. Canada, Rept. Prog., 1877–78. 186B–187B.
11. ——— 1890. On Fossil Plants from the Similkameen Valley and Other Places in the Southern Interior of British Columbia. Trans. Roy. Soc. Canada, Vol. 8, No. 4: 75–91.
12. HEER, O. 1868. Miocene Flora von Island. Flora Fossilis Arctica, 1: 139–55.
13. LAMOTTE, R. S. 1936. The Upper Cedarville Flora of Southwestern Nevada and Adjacent California. Carnegie Instit. Wash. Publ., 455: 57–142.
14. MACGINITIE, H. D. 1953. Fossil Plants of the Florissant Beds, Colorado. Carnegie Instit. Wash. Publ., 599.
15. PENHALLOW, D. P. 1908. A Report on Tertiary Plants of British Columbia, Collected by Lawrence M. Lambe in 1906 together with a Discussion of Previously Recorded Tertiary Floras. Canada Dept. Mines, Geol. Surv. Br., No. 1013. Ottawa.
16. SHAW, W. S. 1952. The Princeton Coalfield, British Columbia. Geol. Surv. Canada, Paper No. 52–12.

Received for publication May 10, 1955

PLATES

EXPLANATION OF PLATE I

(All figures natural size)

Metasequoia occidentalis (Newb.) Chaney

FIG. 1. Cone.

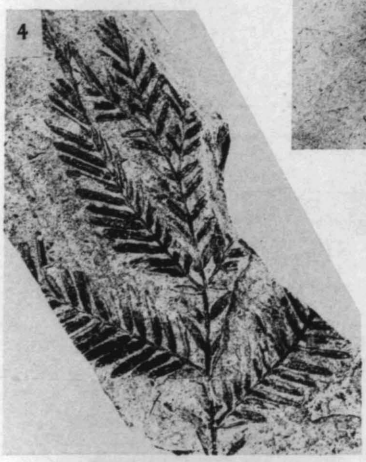
FIGS. 2, 6, 7. Typical leafy short shoots.

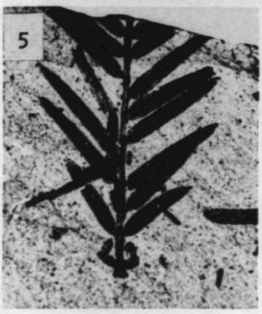
FIG. 3. Long shoot with large leaves.

FIG. 4. Branched shoot.

FIG. 5. Part of short shoot bearing basal bracts.

PLATE I





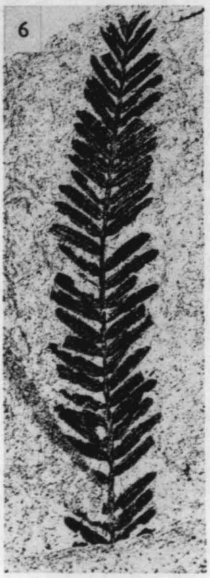
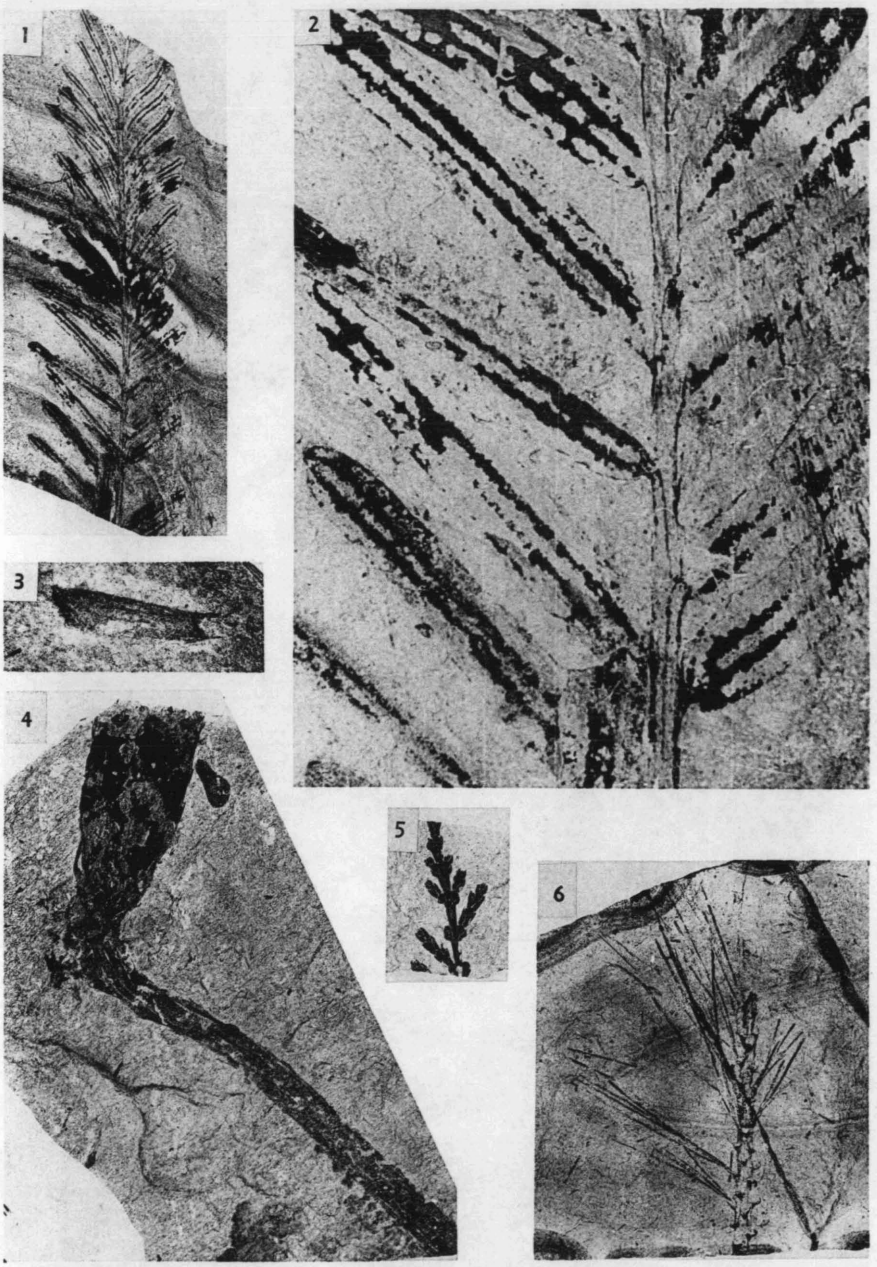


PLATE II



EXPLANATION OF PLATE II

(All figures natural size except as indicated)

FIG. 1. *Taxodium dubium* (Sternb.) Heer. Short shoot.

FIG. 2. Part of specimen in Figure 1, enlarged to show character of decurrent leaf base. × 4.

FIG. 3. *Pinus monticolensis* Berry. Seed.

FIG. 4. *Picea* sp. Defoliated branchlet bearing basal part of cone and winged seed that probably belongs to it.

FIG. 5. *Chamaecyparis linguaefolia* (Lesq.) MacG.

FIG. 6. *Pinus tulameenensis* Penh. Small twig bearing several needle clusters.

EXPLANATION OF PLATE III

(All figures natural size)

FIG. 1. *Pseudolarix americana* Brown. Dwarf shoot bearing cluster of leaves.

FIG. 2. *Pseudolarix americana* Brown. Cone scale.

FIG. 3. Winged seed probably belonging to *Pseudolarix americana* Brown.

FIG. 4. *Sequoia affinis* Lesquereux. Branched shoot with scalelike, spirally arranged leaves.

FIG. 5. *Pinus trunculus* Dawson.

FIG. 6. *Abies* sp. (Cf. *Abies steenstrupiana* (Heer), comb. nov.). Cone scale.

FIGS. 7, 8. *Pinus latahensis* Berry.

FIG. 9. *Sequoia affinis* Lesq. Flat spray with distichously arranged leaves and growth of four seasons.

PLATE III